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SECTION 1

SOCIO-ECOLOGICAL, ETHICAL AND PEDAGOGICAL PROBLEMS OF OUR TIME

SOCIAL STEREOTYPES AND PERSONALITY DISORDERS

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This article examines the influence of social stereotypes on the perception of people with personality disorders and their integration into society.

Keywords: social stereotypes, personality disorders, stigma, mental health.

Social stereotypes are simplified and generalized ideas about social groups that are formed based on cultural and historical characteristics. In the context of personality disorders, they often lead to bias and discrimination. Personality disorders are characterized by persistent patterns of thinking, perception, and behavior that significantly deviate from accepted cultural norms [1].

Among the most common stereotypes is the notion that people with personality disorders are dangerous to society, manipulative, or simply have a "bad character." These myths are untrue, as personality disorders are serious mental health conditions that require professional treatment and support. For example, people with borderline personality disorder often experience intense emotions and require understanding rather than judgment.

Stigma creates significant barriers to help and social integration. People with personality disorders often face social isolation, employment discrimination, and limited access to healthcare. Constant exposure to negative stereotypes can lead to low self-esteem, shame, and difficulties in social interactions.

Overcoming stereotypes requires comprehensive measures, including educational programs for the public, accurate coverage of mental health issues in the media, and the creation of a supportive social environment. Public initiatives aimed at disseminating reliable information about the nature of personality disorders and their treatment options play an important role [2].

Researching social stereotypes regarding personality disorders is essential for creating an inclusive society and improving the quality of life of patients. Understanding and overcoming stigma contributes to the formation of more equitable and supportive attitudes toward people with mental disorders [3].

Thus, established ideas about people with personality disorders are often distorted and lead to bias and discrimination. These conditions, being serious illnesses, require understanding and professional assistance, not judgment. Stigma prevents people from receiving the necessary treatment and fully participating in society. To combat this, education, responsible media coverage, and the creation of a supportive environment are necessary, which will ultimately help build a more equitable and inclusive society.

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PARADOX OF THE FREEDOM: PHILOSOPHY OF THE CHOICE AND PSYCHOLOGY OF THE RESPONSIBILITY

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The article examines the paradox of freedom in the context of philosophy and psychology.

Keywords: freedom, choice, responsibility, existentialism, self-regulation.

The problem of freedom is one of the central themes of philosophy and psychology of personality [4].

From a philosophical point of view, freedom is seen as a balance between individual desires and social responsibility. For existentialist thinkers, including J.-P. Sartre, it is not the absence of limitations but an awareness of being “in a situation.” A person is free to choose, yet every choice is made within circumstances and entails responsibility for one’s own existence. Only by accepting this responsibility does a person form authentic meaning and essence of life [2].

Modern psychology views responsibility as a form of internal self-regulation of behavior [1]. Studies in moral psychology emphasize that the experience of freedom is associated with cognitive autonomy, but it also requires mature impulse control and ethical awareness.

Furthermore, the phenomenon of freedom is closely linked to the concept of intrinsic motivation. When a person's actions are driven by conscious values, rather than external pressure, freedom acquires genuine psychological content. This state corresponds to the concept of autonomy in self-determination theory, where freedom is a prerequisite for personal growth and self-realization.

Research on retirement planning has shown that individuals presented with a wider range of investment options were more likely to make active decisions, develop a sense of agency, and experience greater satisfaction compared to those who had fewer alternatives.

The problem of choice in contemporary society reinforces the paradox of freedom: an excessive number of alternatives generates anxiety and cognitive overload. The classic study by S. Iyengar and M. Lepper (2000) demonstrated that when faced with too many options, people were less likely to make decisions and more likely to feel regret.

The paradox of choice also extends to creativity and innovation. A study by Iyengar et al. (2012) explored the relationship between choice and creativity, showing that the opportunity to choose promotes greater creativity and innovation. However, an overabundance of options leads to excessive focus on making the “right” choice, resulting in cognitive overload, stress, and reduced creative output [3].

Thus, freedom is not arbitrariness but the ability to make conscious decisions and take responsibility for their consequences. The paradox of freedom lies in the fact that it can be achieved only through self-limitation and the development of inner maturity. Without self-control and reflection, freedom turns into an illusion of willfulness, losing its existential meaning.

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PROBLEMS OF ACCESSIBILITY OF URBAN ENVIRONMENT FOR PEOPLE WITH DISABILITIES

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The paper discusses problems of accessibility of the urban environment for people with disabilities and analyzes society's attitude towards inclusion issues. A sociological survey among young people aged 18-30 was conducted, revealing main barriers – architectural, informational, and social. Causes of their persistence and shortcomings of existing solutions are analyzed. Special attention is paid to the concept of universal design as a way to create an environment comfortable and safe for all city residents regardless of their physical abilities.

Keywords: people with disabilities, urban environment, accessibility, universal design, inclusion, physical barriers, informational barriers, social attitude, sociological survey, equal opportunities.

People with disabilities include those with musculoskeletal, visual, auditory, or mental impairments. In urban areas, they face the following problems:

- Physical barriers: stairs, narrow passages, transportation that is difficult to use.
- Perception issues: lack of audible signals, tactile tiles.
- Information difficulties: inconvenient navigation, no formats for people with different needs (Braille, plain language).
- Social attitude: prejudice and misunderstanding [2].

The solution to these problems is universal design. It involves creating an environment, goods, and services that are initially convenient for use by everyone, regardless of age, body type, physical capabilities, or disability. It aims to ensure equal opportunities for all and is an important component of an accessible environment [3].

To assess society's readiness for changes towards inclusivity in the urban environment, we conducted a sociological survey among people aged 18-30.

The survey results showed the following:

Most respondents (58.8%) rated urban accessibility as average to poor (3 out of 5). The most inconvenient were leisure places (cafes, cinemas – one-third rated 2) and streets (stops, sidewalks). When asked about their knowledge of the problem and willingness to help, most (91.2%) said they were willing to help someone with mobility difficulties. However, many (38.2%) fear doing harm because they do not know how to act properly. Some (7.4%) encounter such situations frequently.

Few (17.6%) know about universal design, indicating that people see the problem but do not know how to solve it. Optimistically, the majority (86.7%) believe that an accessible urban environment benefits everyone – elderly, parents with strollers, people with disabilities or injuries.

Analysis of responses about obstacles revealed four main reasons:

1. Financial and systemic problems (~50%): lack of funds.

2. Poor organization (~30%): authorities are not interested, work for appearances, or are incompetent.

3. Societal and informational issues (~15%): people with disabilities are rarely seen in public spaces, so the problem is often forgotten.

4. Technical problems (~5%): low-quality implementation (crooked ramps, inconvenient buttons). The survey showed that people recognize the problem and empathize, but do not see it being solved. The main obstacle is not only the lack of funds but also the unwillingness of authorities to act and the silencing of the issue in public discourse.

Our recommendations for improving accessible urban environments:

- Inform: raise awareness about universal design as a solution beneficial for all.
- Educate: train officials and designers to create accessible environments genuinely, not superficially.
- Support those pursuing changes: assist organizations proposing comprehensive, not piecemeal, urban improvements.

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THE INFLUENCE OF NATURE ON STRESS REDUCE

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The article examines the role of being in nature in reducing stress levels and improving cognitive functions and the physiological mechanisms of the influence of nature on stress reduction.

Keywords: stress, health, cognitive functions, nature, physiological processes

In today's fast-paced world, characterized by a constant flow of information and increased productivity demands, stress and cognitive decline have become common problems. Urbanization, digitalization, and a lack of leisure time negatively impact physical and mental health, leading to decreased productivity, poor mood, and increased vulnerability to various diseases [1]. In this context, increasing attention is being paid to the potential of nature as a powerful tool for restoring the body's resources, reducing stress, and improving cognitive function.

The positive influence of nature is based on Wilson's biophilia hypothesis: humans are genetically predisposed to interact with nature because, through evolution, survival depended on it. Nature is associated with safety and resources, inducing peace and reducing stress [3].

Being in nature reduces stress in a comprehensive manner: it lowers cortisol levels and activates the parasympathetic system (relaxation), reduces blood pressure and heart rate (the calming effect of sounds), strengthens the immune system (activation of NK cells, phytoncides), and improves sleep (regulation of circadian rhythms).

In addition to reducing stress, nature improves cognitive function: it restores attention (gentle stimulation, improved concentration and memory), increases creativity (free exploration, new ideas), improves mood and reduces depression (endorphins), and potentially improves working memory. [2] Integrating nature into your life:

1. Regularly spend time in nature
2. Create "green" corners at home/work
3. Incorporate nature into your routine (walks, outdoor lunches)
4. Practice mindfulness in nature, participate in environmental activities.

Thus, nature effectively reduces stress and improves cognitive function through physiological, psychological, and behavioral factors. Integrating nature into our lives is becoming essential for maintaining well-being in the modern world, so we should strive for closer interaction with it.

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ARTIFICIAL INTELLIGENCE IN MEDICINE

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Keywords: artificial intelligence, medicine.

Artificial intelligence (AI) is a branch of computer science dedicated to creating systems that can perform tasks traditionally requiring human intelligence: self-learning, pattern recognition, decision-making, and solving complex problems. In recent years, AI technologies have rapidly developed and are being actively implemented in various fields, including healthcare.

The implementation of AI in the clinic opens up new opportunities to improve the quality of diagnostics, optimize the treatment and prevention of diseases, as well as to improve the efficiency of medical organizations and improve patient health outcomes.

One of the most notable applications is the automated analysis of medical images (X-rays, CT scans, MRI, ultrasound). Modern algorithms are able to quickly and accurately detect changes that sometimes go unnoticed during visual analysis. Successful applications include the diagnosis of lung cancer, breast tumors, strokes, and other pathologies. AI also allows for the integration and processing of large amounts of heterogeneous data about patients – genetic information, medical history, lifestyle data – to develop personalized treatment plans that take into account individual biological and clinical characteristics. In pharmaceutical research, AI accelerates the search and evaluation of potential drug compounds by analyzing large libraries of molecules and predicting their properties and interactions with biological targets. This reduces the time and costs of developing new drugs and makes clinical trials more targeted. At the level of healthcare management, AI is used to predict epidemiological trends, optimize logistics (inventory of medicines, distribution of equipment), plan workflows, and evaluate the effectiveness of medical programs. Clinical decision support systems provide doctors with quick access to a large amount of medical knowledge, help formulate differential diagnoses, select therapies, and predict outcomes, which enhances the quality of decision-making.

Despite all the advantages, there are also serious challenges: the need for large and high-quality datasets, the risk of bias and underrepresentation of certain patient groups, problems with the explainability of "black boxes," issues of medical data confidentiality, as well as the need for strict clinical validation and adequate regulation. Overall, AI has significant potential to transform medicine, but its widespread and safe implementation requires a comprehensive solution to technical, ethical, and regulatory challenges. Only under the condition of reliable data, transparent algorithms, and appropriate standards, can AI become a reliable tool for doctors and improve the quality of medical care.

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HUMAN HEALTH AS A SUBJECT OF PHYLOSOPHICAL AND MEDICAL KNOWLEDGE

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This paper examines the topic of health in philosophy and medicine. The influence of philosophical perspectives on human health and the relationship between philosophical and medical knowledge are analyzed. The influence of modern medicine and philosophy as a complex of two sciences in clearly understanding and appreciating the importance of health, namely its maintenance, treatment, and promotion, is demonstrated.

Keywords: health, harmonious body condition, ancient physician Hippocrates, purpose of a healthy life, universal human values.

Currently, there is no single, generally accepted definition of the term "health" that satisfies all aspects of modern society. It is well known that medicine guards public health. Therefore, logically, it is within the field of modern healthcare that a universal interpretation of the term "health" will be developed, applicable to all aspects of life. Health is a state of complete physical, social, and mental well-being [1; p.5]. Medicine studies the chemical and biological aspects of the body's functioning with the goal of identifying norms and anomalies, seeking ways to achieve high levels of public health. Medical knowledge specializes in the study of the biological and chemical processes that support the normal functioning of the body and maintain its harmonious state. Therefore, medical science faces the question: is health limited only to physical and psychological well-being? From a philosophical perspective, human health is the optimal flow of vital processes, allowing for the longest possible lifespan, free from disease. Therefore, health is a natural object of study for philosophical science, which analyzes not so much the medical aspects of public health as the eternal questions of the purpose of a healthy life, as well as the importance of health for humans [2].

The philosophy of health answers profound questions about the meaning of life and the role of vital forces in achieving harmony and happiness. While for some philosophers happiness is unattainable without physical health (Socrates, Hippocrates), for others it is merely a fleeting moment, not worth paying attention to (Marcus Aurelius).

Medicine as a science is a complex of methods for treating, maintaining, and restoring the body. The ancient physician Hippocrates asserted: "Anatomy in union with physiology is the queen of medicine"[3]. Without specific knowledge in anatomy, physiology, histology, embryology, and other medical and biological sciences, it would be impossible to master and understand the foundations of medicine [3]. At the same time, philosophy analyzes the general foundations of approaches to understanding the importance of physical health for humans.

Thus, having examined the role of philosophy and medicine in human health, we can conclude that these sciences are closely interconnected in analyzing the aforementioned aspects. However, these two branches of knowledge simultaneously view human health from two different perspectives: while for medicine, it is a subject of research for the treatment of pathologies, for philosophy it is an object of intellectual reflection in terms of universal human values. By complementing each other, these two sciences create a broader understanding of the human body and human attempts to understand health issues. Thus, it is clear that philosophical knowledge complements medical research, enriching people's understanding of general health issues. Therefore, the study of medicine from a philosophical perspective is an integral part of medical knowledge in the broad sense of the word.

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ETHICS OF CARING FOR FUTURE GENERATIONS AS A BASIS FOR SUSTAINABLE DEVELOPMENT

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This article examines the concept of ethics of caring for future generations as a fundamental element of the paradigm of sustainable development. An ethical approach focused on intergenerational responsibility asserts the need to conserve natural, social and cultural resources to ensure a decent life not only for current but also future generations. In the context of global environmental challenges such as climate change, loss of biodiversity, and depletion of natural resources, the ethics of caring is becoming a key principle in shaping a sustainable civilization.

Keywords: ethics of care, intergenerational responsibility, sustainable development, environmental ethics, moral philosophy, solidarity, ecology of the future.

The theoretical basis of the research is the work of Hans Jonas, Nancy Fraser, Carol Gilligan and other thinkers who developed the idea of responsibility as a central category of morality. Unlike traditional utilitarian and deontological approaches, the ethics of caring emphasizes the importance of attention, empathy, and solidarity as moral virtues applicable not only to human relationships, but also to human interaction with nature. This perspective allows us to rethink sustainable development as not just a balance of economic, social and environmental aspects, but as an expression of moral duty to future generations.

Modern global challenges – climate change, depletion of natural resources, social inequality – raise the issue of moral responsibility of the current generation to the future. The concept of sustainable development, enshrined in UN documents, implies not only an economic and environmental balance, but also an ethical dimension, expressed in caring for those who come after us.[3]

The ethics of caring, which was originally formed in feminist philosophy, has been actively interpreted in recent decades as a universal approach applicable to global ethics and sustainable development.[4] Its main idea is to recognize the interdependence of all forms of life and the need for moral sensitivity to the "other" – be it man, nature, or the future generation.

Traditional theories of justice focused on the relationship between contemporaries, leaving the issue of future generations in the shadows. The ethics of caring offers a different perspective – not a contractual one, but a relational one. It proceeds from the recognition of the moral bond between generations, which implies responsibility not out of calculation, but out of empathy and solidarity.[5]

Caring for the future should be considered as one of the cornerstones of the concept of a sustainable society. This is not an abstract concept, but a practical requirement that includes the development of environmental awareness, ethical education, and a rethinking of consumer values.

In the context of environmental ethics, concern for future generations is expressed in the desire to minimize environmental damage and preserve the biosphere as a common heritage. The idea of sustainability becomes not only an economic or political, but also a moral category.[1]The preservation of ecological balance is a manifestation of collective care, where a person ceases to be the center of the world, giving way to ecosystem thinking.

The transition to sustainable development is impossible without a change in the ethical paradigm. Modern society requires an individual to be able to think not only in terms of "here and now", but also taking into account the interests of the future. This implies abandoning the logic of short-term gain in favor of strategic thinking based on the principles of responsibility and care.[2]

Thus, the ethics of caring becomes the methodological basis for sustainable development.: It combines moral, environmental and social dimensions, forming a holistic approach to building a just and harmonious future.

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GAMIFICATION AS A MEANS OF SOLVING ETHICAL AND PEDAGOGICAL PROBLEMS

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The article explores the potential of gamification to address ethical and pedagogical problems related to adolescents' self-determination in the Republic of Belarus. It proposes a model of an online quest game for conscious career guidance featuring interactive tasks, a rating system, and virtual currency to enhance engagement and self-reflection among high school students.

Keywords: gamification, career guidance, self-determination, adolescents, ethical and pedagogical issues, conscious choice.

Gamification as a Means of Solving Ethical and Pedagogical Problems of Adolescents' Self-Determination

The process of professional self-determination during adolescence is associated with a number of ethical and pedagogical challenges. Traditional methods of career guidance often fail to immerse students in real professional contexts, leading to disappointment and frequent changes of specialization [1, 2]. This issue is exacerbated by demographic trends and the growing emphasis on making an informed career choice [1].

Modern universities face the challenge of maintaining a steady influx of talented applicants. The need to search for new forms of career guidance is recognized at the level of leading educational institutions [3]. Moreover, sociological surveys indicate a high level of professional dissatisfaction, highlighting the importance of proper initial orientation [4].

A promising solution to these problems lies in the use of gamification principles. The key mechanisms of such a system include:

- Tasks simulating real professional problems in various university faculties (e.g., journalism, applied mathematics, international relations).
- Personalized content delivery based on user activity and choices.
- Involvement of current university students to share experiences and mentor participants within the game environment.

The target audience for this approach includes school students aged 15-18, whose values are centered around self-development and success, but who also experience fear of making the wrong career choice. Gamification helps mitigate this fear by providing a safe space for experimentation and trial.

The implementation of this model requires a multi-stage promotion strategy, starting from the capital and expanding to regional areas. Monetization can be ensured through a subscription model, advertising, and sponsorship, which would guarantee the project's sustainability.

Thus, the integration of gamification into career guidance activities appears to be a viable path to addressing key ethical and pedagogical problems. It promotes a more conscious, informed, and responsible approach to adolescents' professional self-determination, aligning the interests of future students, parents, and educational institutions.

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EFFECTS OF CHRONIC STRESS ON PHYSICAL CONDITION A PERSON

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Abstract. This article discusses the features of the influence of chronic stress on a person's physical condition.

Keywords: stress, physical health, disorders, consequences

Chronic stress – is a prolonged activation of the body's adaptive reactions under the influence of unfavorable factors. It has a significant impact on both a person's mental and physical health. The main factor in a chronic stress reaction is considered to be prolonged psycho-emotional stress. There are many immediate causes, they are always individual – what is normal for one person will be a source of stress for another. The causes of chronic stress can be: disharmonious relationships, excessive loads, long-term illnesses material difficulties, insoluble problems.

Chronic stress activates the sympathetic nervous system, causing constant tension in the body. This is manifested by increased heart rate, increased blood pressure and increased levels of cortisol – stress hormone. Long-term exposure to these factors can lead to the development of cardiovascular diseases, including hypertension and coronary heart disease. Stress also suppresses the immune system, making the body more vulnerable to infections and diseases. Research shows that chronic stress reduces the activity of white blood cells, increasing the risk of developing colds, flu and even cancer. Constant nervous tension has a negative effect and to the work of the gastrointestinal tract. Stress-prone people often face problems such as gastritis, stomach ulcers, irritable bowel syndrome, and other digestive disorders. Elevated cortisol levels promote fat accumulation, especially in the abdominal area. This is due to impaired glucose metabolism and insulin resistance, which increases the risk of developing type 2 diabetes and obesity. Frequently satellites chronic stress sleep disorders are also. Insomnia, difficulty falling asleep and shallow sleep lead to fatigue, decreased concentration and even more deterioration of general well-being.

Although mental health goes beyond the physical state, it is important to note that chronic stress significantly affects mood, cognitive abilities, and overall quality of life. Depression, anxiety, decreased motivation and performance are becoming common among those who experience prolonged emotional pressure. To minimize the consequences of chronic stress, it is recommended to use a set of measures aimed at improving physical fitness, increasing the stability of the nervous system and maintaining a healthy lifestyle.

Thus, chronic stress poses a serious threat to human physical health, affecting many organs and systems of the body. Timely identification of signs of stress and the adoption of appropriate measures can prevent the development of serious diseases and maintain good health.

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RESPONSIBILITY AS A FACTOR OF ENVIRONMENTAL BEHAVIOR

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The article examines the role of personal responsibility in motivating environmental behavior, analyzes psychological factors, and proposes recommendations for forming environmental activity.

Keywords: motivation psychology, ecology, personal responsibility, environmental behavior.

Modern global challenges, including climate change and environmental pollution, highlight the need to study the behavioral aspects of their solution. The analysis of motivational mechanisms, especially the awareness of personal responsibility, takes a central place.

Personal responsibility is the awareness of one's role in ecology and the willingness to be accountable for the consequences. Theories of motivation (planned behavior, self-determination) and value theory explain the influence of attitudes, norms, control, and values on environmentally friendly behavior. The results of psychological research show that personal responsibility is an important factor in environmental behavior – from sorting waste and saving resources to participating in environmental campaigns. It is important to note that the awareness of personal responsibility can be hindered by the "diffusion of responsibility" effect, where an individual feels less responsible for a problem when they are part of a larger group. This is due to the influence on intentions, sense of control, morals, and environmental identity. At the same time, it should be taken into account that the influence of personal responsibility on environmental behavior is not direct and unconditional. It is mediated by a number of psychological factors such as environmental knowledge, environmental values, emotional involvement, social norms, self-efficacy [1]. Active highlighting of environmental issues, demonstrating the consequences of inaction, and simultaneously presenting positive examples of environmentally responsible behavior can significantly enhance awareness of individual roles in preserving the environment. To increase environmental motivation and responsibility, a comprehensive impact is important:

1. Increasing literacy: dissemination of information about environmental problems and solutions
2. Value formation: strengthening the connection with nature, ethics of interaction.
3. Emotional involvement: using visual materials, stories and experiences.
4. Support for social norms: consolidating rules of environmentally responsible behavior.
5. Strengthening self-confidence: creating opportunities for participation in environmental projects.
6. Practical activities: organizing campaigns, clean-up days, educational events.
7. Positive reinforcement: encouraging behavior through rewards, recognition.
8. Formation of ecological identity: development of eco-responsibility and values [2].

Thus, personal responsibility transforms environmental knowledge into action. It is important to consider and overcome the diffusion of responsibility effect. Its development requires support of internal motivation through values, self-efficacy and social norms. This turns environmental behavior into a sustainable life position.

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A PHILOSOPHICAL VIEW ON THE PROBLEMS OF INTERNET ADDICTION IN MODERN SOCIETY

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This work examines a pressing contemporary problem: internet addiction. Its types and causes are discussed. A philosophical perspective on internet abuse is offered, along with the importance of not losing oneself online.

Keywords: Internet, addiction, worldview, virtuality, social isolation.

In modern society, the internet is ubiquitous, and excessive use leads to internet addiction. Internet addiction is a disorder characterized by compulsive and excessive internet use, which leads to decreased self-control, the displacement of real life, and the development of behavioral problems. This addiction remains a pressing issue in the 21st century. In Belarus, according to a 2014 study, 20-25% of participants were internet addicted, while in 2019, the figure was 35% (16% of adolescents and 19% of young adults) [2].

Interesting fact! In China, internet addiction is called "electronic opium." There, it is officially recognized as a disease and included in national clinical guidelines for mental disorders [4].

Let's consider the main types of internet addiction. 1) Gaming addiction – an obsessive passion for online games, often accompanied by financial investments; 2) Addiction to virtual communication – the need to constantly communicate in chats, instant messaging apps, and social networks, replacing real-life contacts; 3) Compulsive shopping – the need to shop online (Wildberries, Ozon, etc.); 4) Addiction to video content – obsessive viewing of videos on video hosting sites and streaming services [3].

The main causes of this addiction are:

1) communication difficulties, low self-esteem, and self-doubt;

2) loneliness;

3) financial problems;

4) dissatisfaction with real life [3].

Abusive use of online resources blurs the boundaries between the "real" and "virtual" worlds, which has a detrimental effect on the development of a healthy worldview. In the virtual world, a person can create an ideal image for themselves that differs from their "true self," which can lead to a split personality and difficulties in developing a coherent identity. Despite virtual connectivity, internet addiction leads to profound loneliness and social isolation. Philosophically, this can be interpreted as a degradation of human communication, where online interactions replace the need for intimacy and emotional support, leading to a decline in registered marriages, an increase in divorce rates, and a decline in the demographics of countries [2].

Thus, from a philosophical perspective, internet addiction is not simply a behavioral disorder, but a social obstacle associated with the loss of individual agency, the blurring of the boundaries of reality, and the search for meaning in life in the information world [1].

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PSYCHOLOGICAL ASPECTS OF OVERCOMING ACADEMIC STRESS

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The relevance of this issue is due to the steady trend towards an increase in student complaints of psychoemotional disorders, which is confirmed by the statistics of the work of psychological services of universities. A conscious understanding of the impact of learning stress on the involvement of students in the educational process creates the prerequisites for adjusting pedagogical strategies.

Keywords: studying, academic stress, social support, students.

Promising areas for dealing with learning stress are justified by psychologists, considering anticipatory viability as a personal resource of students. In order for students to be aware of the difficulties of the learning process as a potential source of stress, it is important to understand the peculiarities of students' self-regulation in learning [1].

Academic stress is a persistent psycho – emotional stress that students experience in response to the demands of the educational environment, including high academic workload, the need to meet deadlines, pressure from teachers and peers, as well as fear of failure or non-compliance with expectations. In the context of modern higher education, characterized by an accelerated pace of learning, digitalization and increased demands on academic results, the stress level among students is showing steady growth. According to a number of studies, more than 60% of students report a chronic level of study-related stress, and one in five experiences symptoms of anxiety and depressive disorders.

Psychological science considers academic stress not as a pathology, but as a natural reaction to the imbalance between external demands and internal resources of the individual. In this regard, coping strategies are of particular importance, which determine the effectiveness of adaptation to stressful conditions. According to the theory of Lazarus and Folkman, coping is a cognitive and behavioral effort aimed at managing internal and external demands, assessed as exceeding the individual's resources. In the context of academic activity, there are two main types of strategies: problem-oriented (aimed at changing the situation) and emotion-oriented (aimed at regulating the emotional response).

The most effective cognitive aspects of coping with academic stress include cognitive reassessment and the formation of a growth mindset. Cognitive reassessment makes it possible to interpret stressful events not as a threat, but as a challenge or an opportunity for development, which reduces anxiety and increases motivation to achieve.

Emotional regulation plays a key role in maintaining psychological well-being. Research shows that students with advanced mindfulness, self-compassion, and emotional flexibility demonstrate lower stress levels and higher academic engagement.

At the behavioral level, the effectiveness of coping with stress is determined by such factors as time management skills, organization of the educational process, adherence to sleep and rest, physical activity and rejection of destructive strategies (for example, procrastination or abuse of psychostimulants). Empirical evidence suggests that students who adopt a structured approach to planning academic activities are less likely to experience a sense of overload and demonstrate higher academic results.

The social context is equally important. Having a supportive social network – including friends, family, mentors, and mental health professionals – acts as an important stress buffer. Social support not only reduces the subjective perception of stress, but also contributes to the formation of adaptive coping strategies.

Finally, personal resources such as self-efficacy and psychological resilience are predictors of successful coping with academic stress.

Thus, overcoming academic stress is a multicomponent process in which cognitive attitudes, emotional skills, behavioral strategies, social support, and personal characteristics interact. Understanding these aspects makes it possible to develop comprehensive psychological support programs for students aimed not only at reducing stress levels, but also at developing sustainable mechanisms for adapting to the challenges of the modern educational environment.

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TRENDS AND FACTORS AFFECTING THE NUMBER AND DISTRIBUTION OF SEAGULS IN THE CITY OF MINSK

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The ecological potential of urban landscapes is determined by the species composition, population structure, and adaptation of birds to new urban areas. In this regard, we analyze the rapidly increasing seagull population in Minsk, which is causing discontent among residents and even leading to complaints.

Keywords: gulls, gulls, numbers, biotic and anthropogenic factors.

In recent decades, the numbers of some gull species have increased significantly in Western European countries, as well as in the Republic of Belarus [2]. As a result, their status in nature and role in the national economy have changed.

The material for this work was based on our own research conducted in the floodplain zone of the Svisloch River (within the Moscow Ring Road) in Minsk. Field surveys of gull biodiversity and their spatial distribution across the capital's urban landscapes were studied in the capital in 2023-2025. The species composition of gulls was determined using standard external distinguishing features [4].

An analysis of literary data [1-3] and our own showed that 10 species of gulls have been recorded in the territory of Minsk: black-backed gull (***L. ridibundus*)**, common gull (*L. canus*), herring gull (L. argentatus), long-backed gull (L. marinus), gull (*L. cachinnas*), lesser black – backed gull (L. fascus), little-backed gull (*L. minutus*), Arctic gull (*L. glaucoides*), West Siberian gull (*L. heuglinis*) and spotted gull (*L. dominicanus*). The seagulls' distribution area covers the entire capital.

The capital's largest reservoirs–Drozdy, Chizhovskoye, Tsnyanskoye, and Loshitsa–are home to the greatest diversity of gull species. These reservoirs are home to key breeding grounds for black-headed gulls (82.4%) and herring gulls (17.4%). These aggregations play a significant role in maintaining the geographic populations of these species.

During the nesting season, the total gull population in the capital is 5,000-6,000 pairs. The most numerous gulls are the black-headed gull (up to 50% of the total), the common gull (25%), and the Caspian gull (10%). Gull population trends vary.

Several groups of gull species have been identified: those with dynamic population growth (black-headed gull); those with relatively stable populations (herring gull, gull); those with characteristic fluctuating populations (lesser black-backed gull, great black-backed gull); those with decreasing populations (little gull) and new species that periodically appear (West Siberian, Arctic and spotted gulls).

The timing of the reproductive cycle depends on the weather conditions of the particular season. The black-headed gull begins nesting earlier than others (april), while the herring gull is the last to breed (mid-may). Most gulls nest on sandy and pebble islands. Nesting is predominantly colonial, with colonies containing different species. Recently, in Minsk, about half of the entire black-headed gull population (more than 1,500 individuals), along with gulls and herring gulls, have been nesting on the roofs of industrial buildings (the Shabany industrial zone, the Chegladze public transport stop, BTU dormitories, etc.) and residential buildings (near the train station). For this reason, residents complain that the birds soil cars and sidewalks, and sometimes even snatch food from passersby.

Thus, over the past decades, the species composition and numbers of gulls in Minsk have undergone significant changes due to anthropogenic impacts. Gulls are most present in the capital's urban landscapes in the spring and fall, during their migrations. During the nesting season, the most common species are black-headed gulls, herring gulls, and

gulls, whose concentrations are confined not only to large reservoirs but also to the roofs of industrial buildings and residential buildings.

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THE ORIGIN OF THE BAROQUE ARCHITECTURE IN BELARUS

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This article analyzes the historical context and conditions of the development of Baroque architecture in Belarus, its characteristics and distinctive features, and presents the earliest and most striking monuments built in this architectural style in Belarus.

Keywords: history, architecture, history of architecture, Baroque, G. M. Bernardoni

Each era not only has its own economic and social content but also leaves an indelible mark on architecture. Architectural heritage is the most vivid trace of an era, captivating all subsequent generations, revealing all the characteristics of bygone days in stone.

The emergence of Baroque in Belarus was associated with the penetration of architectural innovations from Italy, a consequence of the activities of the Jesuits, who popularized this movement. It is known that the Jesuits appeared in Belarus after the Union of Lublin in 1569 [1]. One of the Jesuits' activities was education, which was provided through Jesuit colleges, whose instructors included not only local residents but also specialists from afar. One such figure was Giovanni Maria Bernardoni, who arrived in Belarus in 1586 as an architect. He was hired by Mikolaj Radziwill the Orphan as the Radziwill court architect. Serving in this position for 12 years, he distinguished himself not only as a secular architect but also as an architect of religious buildings, laying the foundation for the widespread adoption of Baroque in Belarus. Among the first Baroque architectural monuments are the Radziwill castle in Nesvizh, built from 1586 to 1600, and the Corpus Christi Church in Nesvizh (1587 to 1593). A characteristic feature is the transition to new architectural solutions, inherently Baroque: pretentious forms, extreme pomp, massiveness bordering on gigantism, the presence of small details, an abundance of decoration, stucco, gilding, and sculpture [2, p. 54].

One striking example of the establishment of the new style is the reconstruction of St. Sophia Cathedral in Polotsk, carried out by the architect J. Glaubitz in the mid-18th century [1]. It embodies all the characteristics of Baroque in Belarus: the plasticity of the facades, the use of original window openings and semicircular tiers. Other monuments include the Church of Sts. Peter and Paul in Berezvechye, the Trinity Church in Glubokoye, and later the church in Dyatlovo [3, p. 37].

Thus, Baroque emerged in Belarus in the late 16th and 17th centuries. Under the influence of Italian architectural traditions brought by the Jesuits, it became the mainstream in architecture for more than a century.

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THE SIGNIFICANCE OF THE 1557 "FELLING CHARTER" FOR THE INTENSIFICATION OF AGRICULTURAL PRDUCTION IN THE XVI CENTURY

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This article addresses the agrarian reform in the Grand Duchy of Lithuania in 1557 and analyzes its significance for the development of agriculture in the XVI century.

Keywords: history, economic history, agriculture, Felling Charter, felling Pomera.

Agriculture is a fundamental sector of the economy, its foundation, and the basis for social prosperity. This gives rise to a persistent desire to intensify agricultural production and find ways to achieve more efficient management in this sector. Efforts in this direction have been continuously pursued, including in Belarusian lands. However, historiography does not examine all aspects of one of the most important stages on this path: the Pomerania na Valoky (landfills) of 1557. In particular, the socioeconomic aspects of the changes brought about by this reform in the second half to the end of the 19th century are poorly analyzed.

Sigismund II Augustus, Grand Duke of the Grand Duchy of Lithuania (GDL), implemented this reform as early as 1551 on his princely lands [1; p. 693]. This innovation was part of the policy, already pursued by his mother, Bona Sforza, to strengthen the grand ducal power. The reform provided for the allocation of land plots to peasants equal to 30 morgas or 20 dessiatinas (21.36 hectares). These lands became the experimental site for the "Volochnaya Pomeraniya," which made it possible to increase the productivity of the Grand Duke's estates, paving the way for the reform's expansion throughout the Grand Duchy of Lithuania in 1557, including to the private lands of feudal lords. Legally, the Volochnaya Pomeraniya was established by the Statute of 49 Articles, which standardized the specific methods for implementing the reform locally. Tax rates (corvée and chinsha) were established, which peasant families who received the Volochnaya Pomeraniya plots had to pay. The increase in the number of plots cultivated centrally reduced strip farming, facilitating the transition to a three field system and a progressive system of falwarks (highly productive agricultural estates) for that time.

The reform created the preconditions for a powerful intensification of agricultural production and created equal conditions for peasant households, which slowed the differentiation of peasants [1; p. 694]. Uniform rules for farming were established throughout the Grand Duchy of Lithuania, lasting for over two hundred years. Overall, the significance of the "Valok Charter" of 1557 was enormous: it significantly increased food and fodder production, making the Belarusian lands one of the largest food exporters in the world, laying the foundations for a long-term stable inflow of funds from the export of these goods. Socially, it facilitated the emergence of special categories of peasants – "gardeners" – who became a new phenomenon in the villages of the Grand Duchy of Lithuania at that time. The remaining peasants were divided into those who were similar (free) and those who were not. The tax on one valok ranged from 66 to 106 groszy per year, depending on the productivity of the valok's soil [2; p. 2].

Thus, the 1557 Valok Charter marks a milestone not only in the development of agricultural production but also in the socioeconomic history of the Belarusian lands. Therefore, the changes it brought about radically altered the face of not only the agricultural sector but also greatly influenced the entire history of the XVI - XVII centuries.

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ECOLOGICAL QUEST AS A TOOL FOR RESEARCHING THE DEVELOPMENT OF ECOLOGICAL LITERACY IN OLDER PRESCHOOL CHILDREN

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The importance of environmental quests for the basic literacy of older preschool-aged children is demonstrated. It has been established that environmental quests are one of the most effective and sought-after tools for developing basic literacy in preschoolers.

Keywords: environmental literacy, environmental quest.

One of the goals of preschool education is to foster moral and aesthetic values, as well as environmental protection and nature management. The Republic of Belarus has established a legislative framework regulating environmental education for preschool-age children. This framework is reflected in the Law of the Republic of Belarus "On Environmental Protection" and the "National Action Plan for the Rational Use of Natural Resources and Environmental Protection." The documents provide for improved environmental management, stabilization of the ecological situation, and the preservation of biological and landscape diversity. In the preschool educational standard, one of the key components of the educational process is education aimed at developing in students a respectful attitude toward the environment and environmental management [1].

Environmental literacy is knowledge in areas related to maintaining a desirable environmental state and preventing undesirable phenomena. Students develop the fundamentals of environmental literacy and a caring attitude toward the natural environment through educational activities in preschools and in everyday life.

The effectiveness of developing environmental literacy depends on the age group of children and the methods used in organizing the educational process. We conducted a study on developing environmental literacy in children aged 5-6 at the state educational institution "Kindergarten No. 12 in Molodechno."

An ecological quest game, "Ecological Trail: Nature Experts," has been developed. A quest is a technology that implements educational objectives, with game elements, involving the search and discovery of places, objects, people, and information, using information resources to solve the problem. Quests are games in which players must search for various objects, find uses for them, solve puzzles, interact with various characters in the game, etc. [2].

The environmental quest for children aged 5-6 involved teamwork to complete tasks at designated sites. The participating children developed teamwork and collaborative problem-solving skills.

Based on the results of the quest game, it was found that among the pupils of the integrated education and upbringing group, 30% of children had a high level of environmental literacy, 60% had an average level, and 10% had a low level.

The results of a survey on the emotional perception of environmental game participants revealed that this form is effective for studying the level of development of environmental literacy in older preschool children.

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PRACTICAL STUDY OF BIORHYTHMOLOGICAL CHANGES IN PERFORMANCE OF STUDENTS

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The article presents the results of a practical study aimed at identifying biorhythmological changes in the physical and mental performance of students based on an analysis of their dependence on sleep and wakefulness patterns.

Keywords: chronotype, biological rhythms, students' performance.

The individual and genetically determined characteristics of the human body's circadian rhythms are called the chronotype. A person's chronotype determines the organization of the body's physiological functions and its adaptability and can be used as a universal criterion for the overall functional state of the body. It is possible to determine the following main chronobiological types, namely: morning (early, "larks"); intermediate (indifferent, "doves"); evening (late, "owls"). It should be noted that each type is characterized by its peculiar behavioral characteristics.

The aim of this work is to identify biorhythmological changes in the physical and mental performance of students based on the analysis of their dependence on the sleep and wakefulness regime.

To achieve this goal, the following objectives were set:

1. To analyze students' sleep and wake-up times, as well as their subjective levels of alertness.
2. To analyze their peak productivity and concentration times.

It should be pointed out that a questionnaire-based approach was used to analyze students' biorhythmological characteristics. A questionnaire was specifically developed and it included 11 questions to gather the proper and up-to-date information about sleep patterns, peak productivity times, concentration levels at different times of day, and overall well-being. Twenty-six 11th-grade students participated in the study. The questionnaire was administered during school hours.

Data analysis showed that the major part of students (64%) go to bed after 22.00, with 24% falling asleep after midnight. It is also important to stress that only 8% of students follow healthy sleep recommendations and go to bed before 21.00.

Most part of students being studied wake up between 6:00 and 7:30, 16% of participants of the study has to wake up before 6:00, which can have negative influence on their well-being. Sleep duration of most students accounts for 6-8 hours, but 20% of participants of the study sleep less than 6 hours, that indicates a significant sleep deficit.

Subjective feeling of alertness upon waking demonstrates that only 12% of students being studied feel alert or very alert, while 52% feel of students feel slack, and 36% of participants rate their well-being as average. This confirms that a significant proportion of students experience difficulty waking up in the morning, which may be related to a late bedtime.

The study also found that 40% of students occasionally needed a day nap (1-2 times a week), and 20% of students have a nap after school almost every day.

An analysis of the time peaks of physical and mental activity showed that 8% of students report the greatest increase in energy in the morning (before 10:00), 28% between 10:00 and 14:00, another 28% in the afternoon, and 36% feel a surge of energy only in the evening or late at night.

A similar picture is observed when assessing the time of greatest mental productivity: only 12% of students believe that they perform best on mental tasks in the morning, while 48% of students report that they reach their maximum productivity after 14.00. These data indicate that most part of students experience difficulty when having early lessons and could demonstrate better level of performance if their educational workload could happen later in the day.

When analyzing concentration of attention within different times of day, it has been revealed that in the morning (before 10:00), 36% of students reported low levels of concentration (1-2 points), while only 32% of students reported high levels of concentration (4-5 points). During the day (10:00 -14:00), scores are improving: only 12% of students experienced serious problems with having an appropriate level of concentration, while 64% of students demonstrated

high levels of focus. Thus, the major part of students experience their greatest mental performance during the day and afternoon.

An overall assessment of student well-being during the school week showed that 24% of students rated their well-being as good (4-5 points), but 60% of students had average or low levels of energy, and 16% of students rated their well-being as minimal. These obtained data confirm the presence of fatigue among a significant portion of students, which may be related to chronic sleep deprivation and a daily routine that is inconsistent with their biological rhythms.

It should be underlined that the results of the study showed that the sleep patterns of most students do not meet their physiological needs, thus resulting in decreased morning productivity and concentration. Of special importance is the fact that most students demonstrate the highest level of their productivity during the daytime and during the afternoon, while morning activities of the students are associated with low levels of alertness and concentration.

In conclusion it is considered of vital importance to stress that to improve students' level of productivity, it is recommended to consider their individual chronotypes. For example, it is best to schedule complex subjects and tests during the period of peak cognitive activity (10:00-14:00) rather than early morning. Physical education classes, on the other hand, can be shifted to the afternoon, when most students reach their peak physical activity. It is also important to conduct preventative work with students and their parents, explaining the importance of adequate sleep and the negative consequences of sleep deprivation.

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THE USE OF THE PROBLEM-BASED LEARNING METHOD IN TEACHING ENGLISH LANGUAGE FOR THE FORMATION OF PERSONAL COMPONENTS OF THE ENVIRONMENTAL CONSCIOUSNESS OF STUDENTS

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The potential of the Problem-Based Learning (PBL) method is considered in the context of teaching English as a foreign language. PBL is a highly effective pedagogical tool for the formation of not only foreign language communicative competence but also key personal components of ecological consciousness: cognitive, value-motivational, emotional-feeling, and practical-activity.

Keywords: Problem-Based Learning, environmental consciousness, personal components, sustainable development, critical thinking, ecological education.

Modern global ecological challenges require a transformation of human consciousness from an anthropocentric to an ecocentric paradigm. Higher school is called upon to prepare not only competent specialists but also responsible "ecological citizens," capable of critical comprehension of problems and active actions.

However, traditional methods aimed at the assimilation of thematic vocabulary and grammatical structures are insufficient for impacting deep personal structures. Pedagogical strategies are needed that model the complexity and ambiguity of real ecological dilemmas. Precisely such a strategy is Problem-Based Learning (PBL) – a method in which students encounter a complex, real problem before they receive ready knowledge for its solution, and the process of searching for a solution becomes a catalyst for learning. Its key principles ideally correspond to the nature of ecological problems, which often belong to the category of "wicked problems," not having an unambiguous or final solution.

Personal components of environmental consciousness, at which PBL is aimed: Cognitive component: deep, systemic understanding of interconnections in nature and consequences of human activity. PBL requires from students independent research, analysis of information from authentic English-language sources (scientific articles, UN reports, documentary films); value-motivational component: Formation of ecocentric values and internal motivation for action. Facing a real problem and the necessity of choice, students are forced to determine and defend their position; emotional-feeling component: Development of empathy towards nature and a feeling of co-participation); practical-activity component: An attitude towards active action and readiness for pro-ecological behavior.

Let us consider the implementation of the method using the example of the problem: «The city council is deciding whether to build a new shopping mall on a greenfield site or to renovate the abandoned industrial zone in the city center. Your task as an international advisory group is to analyze the environmental and social consequences and propose a sustainable solution». Stage 1: Encounter with the problem: the teacher presents the problem in the form of a brief case, video clip, or a set of statistical data in the English language (the cognitive and emotional components are activated – students begin to analyze the situation and form a primary attitude towards it). Stage 2: Identification of the known and unknown: students in small groups compose two lists in the English language: What do we KNOW? What do we NEED TO KNOW? (an assessment of the boundaries of their own knowledge occurs; the complexity and multifaceted nature of the problem is realized). Stage 3: Independent research: based on the "Need to Know" list, students distribute topics for research and independently search for information, using English-language resources (the cognitive component deepens due to work with authentic information; information literacy develops). Stage 4: Joint solution and synthesis: students return to groups to exchange the found information, discuss it in English language and work out an agreed-upon solution or recommendations (in the process of discussion, a crystallization of values occurs and readiness for collective action is formed). Stage 5: Presentation of the solution and reflection: groups present their solutions in English language, substantiating them with the results of the research (the practical-activity component is reinforced through the presentation; the emotional-feeling and value components are integrated into personal experience through reflection).

The Problem-Based Learning method goes far beyond purely linguistic tasks. It creates in the lesson a unique educational ecosystem where foreign language communication becomes a natural tool for comprehending and solving complex ecological problems. Going through all the stages of PBL, students not only perfect their English language skills in a real, life context but also live through a deep personal experience. This experience, combining intellectual search, emotional involvement, value choice, and practical action, is the most effective path for the formation of a holistic, ecocentric consciousness, necessary for building a sustainable future.

NARCISSISTIC PERSONALITY DISORDER

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This article examines narcissistic personality disorder, its signs, causes of formation, influence on interpersonal relationships, as well as methods of diagnosis and treatment, including approaches to interacting with people suffering from this disorder.

Keywords: narcissism, idealization, self-perception, relationships.

Narcissistic personality disorder is a mental condition in which a person is convinced of their own exclusivity and superiority, is constantly preoccupied with their own significance, and needs external validation. Personality disorders in general are persistent patterns of self-perception, behavior, and relationships that form in adolescence and persist throughout life; they interfere with adequate adaptation and often require intervention by a psychologist or psychiatrist.

Previously, it was believed that narcissism was exclusively a male trait, but recent studies have shown that it is equally common in both men and women. As a rule, narcissistic traits are formed under the influence of upbringing, social conditions and trauma, but biological and hereditary factors (including neurobiological features, such as ADHD)

can increase vulnerability. It is rarely expressed in childhood; the first signs usually appear in adolescence and intensify in youth and adulthood [1].

The diagnosis of narcissistic disorder relies on a consistent set of signs: an inflated sense of self-importance with the expectation of special recognition, a tendency to fantasize about exceptional success or power, and a belief in one's own "exclusivity" that requires communication only with equals in status; a constant need for admiration and the right to privileges; using others to achieve personal goals while being indifferent to their feelings; frequent envy of others and demonstration of arrogance. These traits are stable and significantly disrupt interpersonal relationships and adaptation.

Narcissism is not always noticeable: there are two types - grandiose, expressed in demonstrative self-confidence, the requirement of admiration and external assertiveness, and vulnerable, which looks withdrawn and insecure, but harbors internal fantasies of superiority and painfully perceives criticism. Both variants disrupt interpersonal relationships and interfere with adaptation.

Three key traumatic scenarios that shape the "false self" can be identified. The first is the trauma of neglect, which arises from emotionally cold or unavailable parents who ignore a child's basic needs, causing the child to stop feeling valued. The second is the trauma of adoration, where parents idealize the child, praising them for non-existent qualities while failing to see their real personality, thus making love conditional. The third is conditional love, where attention and warmth are given only for achievements, leading the child to learn that they are valued not for who they are, but only for their successes. In response to these traumas, the psyche creates a defense mechanism – the "false self." To receive love, the child hides their vulnerable, true self and forms an idealized version, which over time replaces the authentic personality.

The main method of treatment is long-term psychotherapy. The most effective are psychoanalytic therapy, dialectical behavior therapy, which develops emotional regulation skills, and schema therapy, which works with deep maladaptive beliefs. The goal is not "cure," but help in developing basic empathy, awareness of defense mechanisms, and building healthier relationships [2].

If you are dealing with a narcissist, the key strategy is to rely on their main fear of being insignificant, using the tactic of ignoring. Reinforce desired behavior with praise and deprive unwanted behavior of attention. Do not engage in excuses, firmly establish and defend your boundaries, and know how to say "no." Do not try to change a narcissist - it's useless. Maintain emotional distance, remaining calm and not getting involved in manipulation. Focus on yourself, not allowing them to consume all your time and energy. If the relationship is destroying your personality, consider a complete break.

Narcissistic personality disorder is not a sentence, but a heavy burden for both the person and their environment. Behind the mask of superiority hides someone who never learned that they can be loved not for achievements, but just as they are. Understanding NPD does not justify destructive behavior, but allows you to see the pain behind it - and stop taking it personally.

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BETWEEN WAKEFULNESS AND ANXIETY: HOW DO SLEEP, STRESS, AND COFFEE SHAPE OUR PERCEPTION OF REALITY?

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This paper explores the balance between the body's natural rhythms and artificial stimulants. It examines the impact of sleep patterns, stress levels, and caffeine consumption on physical and emotional health. Factors that influence the

human body are analyzed. Parallels are drawn between these themes, and their interactions with energy levels, mental health, and overall well-being are described.

Keywords: stress level, caffeine consumption, sleep patterns, health, emotional state, purpose of normal human functioning, striving for the ideal.

Sleep is the foundation of human health, essential for overall recovery. It strengthens the immune system, normalizes hormonal levels, and supports normal functioning. However, sleep quality can be disrupted. The cause of this is the thoughts and experiences caused by stress in everyday life. This relationship between sleep and emotional state is becoming a subject of study and analysis in the fields of medicine, sociology, and psychology. Understanding these interactions can help improve people's quality of life and health [1].

Caffeine, in turn, also affects human well-being. It is a central nervous system stimulant and provides an invigorating effect, reducing the risk of depression. However, excessive coffee consumption can cause anxiety, irritability, and cardiovascular disease [2; p. 2].

Based on the knowledge of the relationship between these three factors, a social survey was conducted on the impact of sleep, stress, and caffeine on well-being. One hundred and twenty volunteers participated in the survey, of whom more than 40% were minors aged 16-17 (schoolchildren and university students). The remainder of the population was primarily represented by the older working class (18-67 years old). The majority of respondents describe stress as a negative factor, negatively impacting their overall well-being and causing symptoms such as headaches, increased blood pressure, decreased appetite, and increased heart rate. To maintain their mental health, the majority (65.8%) prefer walking in the fresh air, spending time with loved ones, exercising, and meditating. Issues related to finances, health, family, work, and studies were identified as stress-causing factors. An analysis of the responses revealed that the majority of people (53.3%) do not perceive the impact of caffeine on their mood, overall well-being, or anxiety levels. However, quite often (about 54.2%) of respondents experience a deterioration in well-being without an apparent cause. Of the total number of people surveyed, 66 are completely healthy and have no health complaints. While the rest of the respondents most frequently suffer from heart disease, gastritis, and hypertension, attributing this to poor sleep and frequent stress in everyday life.

Thus, having examined the influence of sleep, stress levels, and caffeine consumption in both theoretical and practical **section**s, we can conclude that in this triad, a person balances between the biological and the social, between idea and body, and between peace and aspiration. A person is a system of compromises; a biological organism living in a sociocultural universe, where every star represents a choice between body and idea. Sleep, stress, and caffeine are not simply physiological phenomena. They are indicators of the era, reflecting the tension between the natural and the social.

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THE IMPACT OF INTIMATE LIFE ON MENTAL HEALTH

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The article examines the influence of the impact of intimate life on mental health and how various aspects of sexual life can affect a person's general condition, and also considers options for maintaining mental health in the context of sexuality.

Keywords: psychotherapy, sex, intimate relationships, mental health.

Sex and mental health are two interconnected areas that have a significant influence on each other. Understanding this connection can help people improve both their sexual life and general psychological well-being.

Sexual activity can have both positive and negative effects on mental health. According to research by many psychologists, regular sexual activity promotes the production of endorphins and other hormones that improve mood and reduce stress levels. Also, sex can strengthen the emotional bond between partners, which contributes to a sense of security and satisfaction in relationships. However, sex does not always bring positive emotions. Sexual dysfunction, such as erectile dysfunction or low libido, can cause feelings of shame, anxiety, and depression. These conditions can exacerbate relationship problems and reduce quality of life [1].

Mental health plays an important role in sexual function. Depression, anxiety disorders, and other mental illnesses can negatively affect sexual desire and the ability for intimate closeness. For example, people with depression often experience decreased libido, which can cause conflicts in relationships. On the other hand, satisfaction with sexual life can act as a protective factor for mental health. Research by sexologists shows that people who are satisfied with their sexual life have higher indicators of general well-being and suffer less frequently from depression and anxiety [2].

Psychotherapy can be an effective tool for solving problems related to sex and mental health. Sexologists can help patients understand their sexual preferences and problems related to intimacy. Psychotherapy can also help in overcoming sexual trauma and improving emotional connection with a partner [3].

The impact of intimate life on mental health is a multifaceted and complex aspect of human life. Having healthy and fulfilling intimate relationships can contribute to improved self-esteem, reduced stress levels, and overall emotional well-being. Conversely, a lack of intimacy or the presence of toxic relationships can lead to feelings of loneliness, anxiety, and depression.

It is also worth noting that intimate life can involve expressing feelings and providing emotional support, which can strengthen the bond between partners. However, it is important to consider individual differences and cultural factors that may influence the perception of intimacy. Ultimately, taking care of mental health requires recognizing the importance of harmonious relationships and working on their quality, which can be a key to emotional well-being [4].

Thus, sexual life not only makes us physically healthier, but also improves mood, reduces stress levels, and helps fight depression. By receiving a sense of satisfaction, we increase the level of our internal energy. It is important to seek help from specialists if problems arise in these areas.

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ENVIRONMENTAL INEQUALITY AND "ENVIRONMENTAL RACISM"

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The article presents the results of a practical study aimed at identifying awareness of environmental inequality and "environmental racism".

Keywords: environmental inequality, environmental racism.

Environmental inequality is the unequal distribution of environmental risks and pollution, as well as unequal access to natural resources among different social groups. "Environmental racism" is a form of environmental inequality where race or ethnicity becomes a key factor increasing the likelihood of facing unfit environmental living conditions.

The aim of this work is to analyze the manifestations of and attitudes towards environmental inequality and environmental racism in the world, to identify causes and consequences, and to find possible solutions.

To achieve this goal, the following task was set:

1.Conduct a survey aimed at understanding the population's perception and attitude towards environmental inequality and racism.

The questionnaire method was used for the analysis. A questionnaire was developed, containing 15 questions to gather information on attitudes and perceptions regarding problems such as environmental inequality and environmental racism. The study involved 52 people of different ages and from different professional fields.

Data analysis showed that the majority of respondents (44%) have no idea what environmental inequality and environmental racism mean, while 33% have heard of them but do not know the exact meaning. Only 23% of respondents know what they are.

A large portion of the respondents (40%) believe that industrial enterprises and landfills are most often located in areas where low-income people live, while 22% completely disagree with this.

It should also be noted that the majority of respondents were aged 36-50. This confirms that the older generation is more informed and interested in solving these problems.

The study also revealed that only 28% of respondents aged 18-25 are aware of environmental inequality issues.

About 6% have personally encountered situations that can be classified as environmental inequality; however, 44% have never heard of such situations, and 28% have heard about such situations from acquaintances. This indicates that situations attributable to environmental inequality and environmental racism are relatively few but still present.

Over 60% believe that the main cause of environmental inequality is the economic interests of large enterprises; 56% believe the causes are weak environmental legislation and the historically established location of industrial zones. However, 38% also believe that low civic engagement is a cause. These data indicate that the majority of respondents believe the main cause is economic interests.

When analyzing the consequences of environmental inequality and environmental racism, 48% believe it can lead to increased diseases in polluted areas, and 7% believe it can lead to mental health issues due to stress caused by discrimination; 44% believe it will lead to unequal opportunities in education, as prosperous areas have a sufficient number of educational institutions with highly qualified teachers.

According to the respondents, the most effective ways to solve these problems are increasing environmental literacy among the population (over 65%) and economic incentives for businesses for environmental responsibility (55%). Supporting environmental NGOs and civil activists was considered less effective by the respondents.

The results of the study showed that people are aware of the existence of such problems and are also interested in solving them to preserve all available resources for their own comfortable lives and for the comfortable lives of future generations.

In conclusion, it should be added that a sustainable future is only possible when the right to clean air, water, and land is guaranteed to every person, regardless of their origin, income, or skin color.

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THE ROLE OF MIND MAPS IN STUDENT LEARNING

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This article explores the potential applications of the mind map method, also known as mental mapping, in teaching higher education students, as well as assessing student awareness of this learning technique. The practical significance of the study lies in the possibility of using its results to develop methodological recommendations and practical materials, implement mind maps into the educational process, and enhance the efficiency of learning material acquisition.

The essence of a mind map lies in the graphical representation of information and thought processes in a radial format. Unlike traditional linear notes (lists, tables, continuous text), a mind map has a centered structure. The main topic, idea, or problem is located at the center. Main branches radiate from this central image or keyword, representing key subtopics or aspects of the central idea. Each main branch, in turn, can branch out into smaller branches of the second, third, and subsequent levels, detailing the information. This structure visually resembles a neural network or a tree crown, reflecting the associative nature of human thinking.

D. Morales distinguishes the following types of mind maps: spider map, bubble map, bridge map, brace map, multi-flow map, and dialogue map [1].

The "spider map" allows for structuring thoughts in a web-like format: the key concept is placed in the center, with related ideas or subtopics radiating outwards in all directions. By using color coding, clear organization, and visual imagery to break down complex issues, the "spider map" offers a simplified yet comprehensive overview of essential data.

"Bubble maps" are a type of mental map whose primary task is to describe a central concept or idea in detail. Their distinctive feature is the active use of adjectives for description. Therefore, it is critically important to carefully select these descriptive words. Working with a bubble map helps to expand vocabulary and understand its various forms.

The "bridge map" is used for the visual comparison of concepts and for identifying analogies between them, helping to eliminate confusion. It effectively identifies and compares two or more ideas, demonstrating the relationships and common ground between them, including shared data or characteristics. This tool is particularly useful when working with multiple datasets, as it allows for clear visualization of connections. The "bridge map" simplifies the process of analyzing a main topic by providing opportunities for its filtering, classification, and description through comparison. This is why it is in demand among researchers.

The "brace map" is excellent for structuring and analyzing extensive conceptual information. It allows for focusing on individual data elements, analyzing them without the need to grasp the entire picture at once. To draw the necessary conclusions, it is sufficient to isolate and examine a specific aspect.

The "multi-flow map" is used to visually display the causes and effects of an event or phenomenon. The event itself occupies the central position, with its causes listed to the left and its results (effects) to the right.

The primary goal of a "dialogue map" is to find a solution to a specific problem. It is a special style of mind map designed to develop critical thinking. The primary goal of many dialogue mapping sessions is to address wicked challenges. The discourse map begins with a set of related nodes. Each node serves as a main focus for a specific step or stage. They can be connected by lines depicting flows. Subsequently, all concepts and options are recorded [2].

Mind maps help structure and systematize information, which contributes to more effective planning of tasks and projects. Visual elements and information structuring not only aid in memorizing material more effectively but also in doing so more meaningfully. This is the fundamental difference between using mind maps and rote memorization of information. Mind maps serve as repositories of information and allow for its organization in a more systematic and understandable way. Complex topics are broken down into simpler and more comprehensible parts, making the material more accessible. They help highlight main aspects and their interrelationships, which facilitates the understanding of complex concepts.

According to a student survey, the majority (63.01%) indicated that they were not familiar with mind maps. After testing, the scores of students using the described method were statistically significantly higher (≈60%, $p<0.05$) compared to students who did not use mind maps in their learning process. This confirms that this method deserves attention and should be implemented in the educational process.

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THE ROLE OF METAPHORS AND ANALOGIES IN THE FORMATION OF SCIENTIFIC CONCEPTS

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The paper examines the definition of metaphors and analogies, the role of metaphors and analogies in the formation of scientific concepts, and the philosophical aspects of the use of metaphors and analogies.

Keywords: metaphor, analogy, scientific concepts.

Scientific knowledge is traditionally perceived as a rigorous, rational, and objective study of the world. However, in reality, the process of forming scientific concepts often relies on creative thinking tools, among which metaphors and analogies occupy a special place. They not only help scientists explain complex phenomena but also facilitate the development of new theories and models. This article examines the significance of metaphors and analogies in science, their role in the discovery and communication of scientific ideas, and the philosophical aspects of their use.

Metaphor is the transfer of meaning from one concept to another based on similarity or associative connection. Analogy is a more complex cognitive technique that involves identifying structural similarities between two different objects or systems. In a scientific context, these tools are used to simplify abstract and new concepts, making them more understandable and visual.

The role of metaphors and analogies in the formation of scientific concepts

1. Brainstorming and generating new ideas. New scientific theories are often born precisely by searching for analogies with familiar objects. When scientists encounter an incomprehensible phenomenon, they look for something to which it can be compared. For example, Newton's classical mechanics was based on an analogy with the motion of everyday objects; quantum physics, by contrast, is inspired by analogies with waves and statistics.

2. Simplification and visualization of complexity. Metaphors allow complex systems to be represented in sim pler, more familiar images. This simplification does not mean distortion, but rather serves to effectively assimilate and transmit knowledge. The method of analogy facilitates the explication of new concepts and promotes scientific learning.

3. Communicative function. Scientific ideas often remain abstract and difficult to understand. The use of metaphors and analogies makes these ideas accessible not only to specialists but also to a wider audience. This contributes to the popularization of science and its dissemination to society.

4. Forming a cognitive framework for research. Metaphors influence how scientists think about a problem, what questions they ask, and what methods they prefer. They can guide scientific inquiry and limit or expand a researcher's field of vision. An example is the "machine" metaphor in cognitive psychology, which has shaped approaches to the study of thinking.

Philosophical aspects of the use of metaphors and analogies

One of the fundamental questions in the philosophy of science is the reliability and adequacy of scientific concepts. Metaphors and analogies, being figurative by nature, do not always reflect absolute truth, but serve as models. This gives rise to debate about the extent to which models and concepts built on figurative transferences can be considered true.

Nevertheless, the history of science shows that metaphorical thinking stimulates science to develop and innovate. Even if a specific metaphor is ultimately rejected, it serves as a bridge between the unknown and the known.

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THE IMPACT OF ENVIRONMENTAL CONDITIONS ON MENTAL HEALTH

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The article examines the relationship between the ecological state of the environment and human mental health.

Keywords: environmental conditions, pollutants, noise, stress, environment.

One of the characteristic features of modern society can be confidently called rapid urbanization. Under these conditions, the problem of environmental impact on human health becomes especially acute and urgent. If the physiological consequences of environmental pollution are studied deeply enough, then the relationship between the environmental situation and the mental health of people remains an area of active research. Mental well-being is closely related to the physical, and a degrading environmental environment becomes a significant risk factor affecting mental processes, emotional state, and the development of various mental disorders.

One of the most important direct impacts of environmental factors is, first of all, air pollution. A variety of atmospheric pollutants such as carbon monoxide, volatile organic substances (VOCs), oxides of nitrogen, sulfur, particulate matter, and other pollutants can enter the bloodstream and then reach the brain, causing neuroinflammation, oxidative stress, and neuronal damage. These processes can impair the function of neurotransmitter systems such as dopamine and serotonergic, which play a critical role in mood, motivation and cognitive regulation. Exposure to pollutants can affect structural and functional changes in the amygdala and prefrontal cortex. Modern studies show a connection between long-term inhalation of polluted air and an increased risk of anxiety and depressive disorders [1,2], as well as an increased risk of neurodegenerative diseases with prolonged exposure to pollutants.

Chronic exposure to anthropogenic noise and sounds of high power (transport, industry, construction), which is not uncommon in modern large cities, acts as a physiological stressor. It leads to the activation of the sympathetic nervous system and the stress axis of the hypothalamus-pituitary-adrenal glands, which, accordingly, causes an increase in cortisol levels, sleep disturbance, arterial hypertension and even pain. These physiological changes are strongly associated with a worsening mental state, increased irritability, aggressiveness and anxiety. The effects of climate change, such as natural disasters (floods, hurricanes, wildfires), can cause acute psychological trauma. Those, in turn, lead to the development of post-traumatic stress disorder (PTSD), depression, anxiety disorders and exacerbated stress responses.

One of the most dangerous factors is rightfully the increased radiation background. Its effect, as a rule, causes atrophy of the cortex of the temporal and frontal lobes, subcortical structures, and conductive pathways. Radiation is a risk factor for chronic fatigue syndrome and also accelerated aging of the central nervous system.

The indirect impact of the environmental situation is no less important. In the modern urbanized environment, the availability of green spaces, parks and natural landscapes has significantly decreased, which seriously limits human capabilities for recovery and emotional relief [3]. This problem can also contribute to chronic fatigue, a decrease in concentration, a deterioration in mood and an increased risk of depressive states. The uneven distribution of environmental risks (for example, the concentration of industrial enterprises in areas of low-income groups or ethnic

minorities) creates additional stress loads and exacerbates existing mental health problems in the most vulnerable groups.

Thus, it can be concluded that the environmental situation has a significant impact on human mental health, acting both through direct physiological mechanisms and through indirect socio-economic and psychological pathways, therefore, both at the individual and state levels, it is necessary to minimize the negative consequences of environmental degradation of the environment.

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PSYCHOLOGY OF INDIVIDUAL DIFFERENCES FORMATION

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Character is an individual and stable structure of enduring, relatively constant mental properties that determine the specifics of an individual's relationships and behavior.

Keywords: character, personality formation, temperament, age.

By making each person individual, character is not a random set of traits. Heredity, upbringing, and life experience collectively determine the formation of a person's character, which is a complex process.

The formation of character is divided into several main stages:

1. Early childhood (from one to three years): the foundations of character are laid, the child becomes more independent and self-aware. The child learns about the world around them better through actions with objects, and the differentiation of the objective and social environment occurs.

2. Preschool and primary school age (from three to ten years): during primary school, children develop the foundations of achievement motivation, collectivism, and improve control over emotions and behavior.

3. Adolescence: adolescents actively search for their identity, asking questions "Who am I?", "Who do I want to be?". They begin to better understand their feelings, motives, and actions. The role of peers increases significantly.

4. Early adulthood and maturity: characterized by greater stability. The formation of close relationships requires the ability to build communication, show empathy, compromise, and take on commitments [1].

Various aspects also participate in the formation of character: Genetic predisposition, manifested in the features of the nervous system, determines the level of emotional reactivity.

Thanks to the Eysenck test, it was proven that the type of temperament and character are interconnected with the perception of gender differences. Upbringing also plays an important role in the formation of character [2].

Thus, character and temperament are the result of complex and multifaceted work, where genetic predisposition, life experience, and conscious self-development play interconnected roles.

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PLAN AND IMPLEMENTATION OF THE OPERATION “BAGRATION” – INTERACTIVE MAP

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The project is devoted to the creation of an interactive map of Operation “Bagration” using the Genially platform. Its aim is to visualize the course and importance of the operation through digital tools. The interactive map combines historical facts, schemes, and visuals, making learning more accessible and engaging. The project can be used for educational and patriotic purposes.

Keywords: Great Patriotic War, Operation “Bagration”, interactive map, visualization.

The development of IT technologies has opened up great opportunities for visualizing historical events. Modern digital tools make it possible not only to present complex processes clearly but also to understand historical facts more deeply. One of the most effective visualization tools is the creation of interactive maps.

This is especially relevant for studying the events of the Great Patriotic War, as the visual format helps young people better understand the scale and significance of what happened. For this project, a free version of the Genially online platform was used to create interactive content. The project represents a dynamic map of Operation “Bagration”, supported by theoretical and methodological justifications and visual clarity.

The interactive map is not just a modern digital tool but a significant step forward in the visualization of key historical events, particularly Operation “Bagration” and the liberation of Belarus. It can be used for educational purposes – in schools and universities, as well as in research – to study, analyze, and delve into historical events. In patriotic and educational projects – at lectures, excursions, and presentations – the map increases audience engagement.

The interactive map of Operation “Bagration” demonstrates how modern technologies can combine science, education, and patriotic upbringing. This approach helps not only to transmit knowledge but also to form an emotional connection with history, strengthening pride in the heroism of the Belarusian people.

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RESEARCH OF SOCIAL AND ECOLOGICAL CHALLENGES AND THE FORMATION OF ECOLOGICAL CULTURE

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The article presents the results of a study that reveals the essence and structural components of environmental culture in the context of modern social and environmental challenges, and also identifies the key pedagogical and institutional conditions for its formation.

Keywords: environmental culture, social and environmental challenges, sustainable development, environmental education, environmental awareness.

Modern society faces a complex of socio-environmental challenges, including climate change, depletion of natural resources, loss of biodiversity and environmental pollution. The answer to these challenges is the development of an environmental culture as the foundation for the transition to sustainable development. Environmental culture is a system of values, knowledge, and practices aimed at harmonizing human interaction with nature.

Ecological culture is understood as an organic part of general culture, including three interconnected components:

1. Environmental awareness is a system of knowledge, beliefs and ecological thinking oriented towards the co-evolution of man and nature.

2. Environmentall attitude are considered to be emotional and value perception of nature, responsibility for its preservation.

3. Environmental activities are practical actions aimed at preserving and restoring the environment.

The most important feature of ecological culture is the unity of social and natural principles, where nature is considered as the basis of life and social development.

The National Strategy for Sustainable Social and Economic Development of the Republic of Belarus till 2030 emphasizes the need of transition to a green economy. This requires a new way of thinking, which challenges the education system to foster an environmental culture. Among the key principles of environmental policy, the following can be highlighted:

- a combination of environmental, economic, and social interests;
- priority of preserving natural ecosystems;
- presumption of environmental hazards associated with economic activity.

Research shows that environmental education should be:

- systemic – integrated into curricula at all levels;
- consistent – ensuring the continuity of knowledge and skills;
- systematized - organized around key concepts such as sustainable development, environmental safety, quality of life.

Effective methods for developing environmental culture include: project activities, research work, practical participation in environmental campaigns, environmental games and holidays.

Social institutions play an important role in shaping environmental culture:

- educational institutions implementing environmental standards;
- government agencies developing legal and economic mechanisms for environmental protection and the rational use of natural resources;
- mass media promoting environmental education;
- social movements engaging citizens in solving environmental problems.

Developing an environmental culture is essential for overcoming socio-environmental challenges and transitioning to sustainable development. This requires a comprehensive approach, including updating educational content, developing environmental awareness, and actively engaging citizens in practical conservation efforts.

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BIOETHICAL ASPECTS OF TRANSPLANTATION

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Relevance: The transition from the 20th to the 21st century was marked by significant achievements in the field of transplantation, which turned scientific hypotheses into real medical procedures. However, this progress has raised several serious ethical issues.

Keywords: philosophy, transplantation, bioethics, organ donation, medicine, technology, achievements, social problems.

Ethical issues in resource allocation.

One of the key ethical aspects is the fairness of resource allocation in healthcare. High-cost organ transplantation surgeries help a limited number of patients, raising questions about the feasibility of large investments in this field of medicine. However, proponents argue that transplantation plays an important role in the development of innovative technologies and medical equipment [1].

The problems of organ donation.

Modern biotechnology leads to the commercialization of the human body, which is perceived as a collection of interchangeable components. This causes serious moral dilemmas, as the body becomes a subject of sale and purchase. The Church strongly opposes the sale of human organs, emphasizing the importance of voluntary donation as an act of altruism and compassion. International norms require adherence to the principle of autonomy and informed consent when using a living organism as a donor. It is important to ensure that the patient fully understands the potential risks and consequences of donation [3].

The use of deceased organs is also associated with a number of ethical issues. Historically, there have been three approaches to posthumous organ harvesting: routine harvesting, the presumption of consent, and the presumption of non-consent. Routine harvesting, characterized by a lack of control over the procedure and a violation of the right to personal autonomy, is no longer used. The presumption of consent assumes that every citizen automatically agrees to become an organ donor after death, unless they have expressed their disagreement in advance. This approach allows for an increase in the number of available organs for transplantation, as it does not require each individual to actively express their willingness to donate. In contrast, the presumption of refusal requires each potential donor to actively express their willingness to donate. This creates a barrier to increasing the number of donors, as many individuals may either forget to express their consent or choose to avoid making a decision [2].

Ethical issues in resuscitation Modern advances in resuscitation allow for the long-term support of patients with severe brain injuries. This has led to the emergence of the "extended process of dying." Medical technologies can sustain the functioning of individual organs even when the entire body is in a terminal state. This situation raises ethical concerns, as while medicine aims to prolong life, it raises questions about the quality of that life and the suffering experienced by the patient. The Russian Orthodox Church emphasizes the importance of providing patients with the opportunity to die with dignity, without the use of artificial life-support measures that may cause suffering. Instead, it suggests developing palliative care that focuses on alleviating pain and maintaining the quality of life for dying patients. Thus, the issue of organ transplantation and the understanding of death in the medical field [3].

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THE CURRENT STATE OF THE VIPER POPULATION COMMON (*VIPERA BERUS*) IN BELARUS AND MINSK REGION

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In the last decade, a number of very interesting microevolutionary studies on amphibians have been conducted in our country and abroad. The phenogeography of the common viper (*Vipera berus*) has been little studied. It is believed

that research on this species will not only allow us to elucidate the specific features of the microevolutionary process but also to obtain data on the role of this reptile species in the energetics of biogeocenoses [3].

Keywords: common viper, phenes, phalidosis, apical shields, suture shapes.

The common viper (*Vipera berus*) is a species of venomous snake in the genus Viperidae, commonly found in Europe and Asia. It prefers cooler temperatures and is found as far north as the Arctic Circle and even in the Arctic Circle, or in mountains up to 2,600 m above sea level [1].

The present study was based on population samples of the common viper (*Vipera berus*) collected from various landscape provinces of Belarus by the former Institute of Zoology of the National Academy of Sciences of Belarus between 1978 and 1998. During the field research, the reptiles were studied in 20 districts representing five regions of the republic, excluding the Grodno Region.

A total of 160 specimens were processed, and a total of 30 phenes were isolated. The isolation of integument phenes and their derivatives proceeded in two directions: the isolation of scale arrangement phenes (pholidosis) and the isolation of integument color and pattern phenes [2].

It has been established that the average number of apical scutes in the common viper in Belarus is 12.2. The number of abdominal scutes is 139.6. The number of subcaudal scutes is 37. The average number of fronto-supraorbital scutes is 7. The number of upper labial scutes is 16.5. The number of lower labial scutes is 18.5.

A certain pattern in the distribution of individuals by scute number is evident across all quantitative characteristics of scutes. The greatest number of individuals is concentrated in close proximity to or coincides with the arithmetic mean, while the number of individuals with higher and lower scute numbers gradually decreases, with only a few specimens exhibiting the extreme values.

An analysis of the shape of the suture between the zigzag stripe and the dark spot on the head revealed that the most common specimens have a suture in the form of a narrow, straight stripe (36%). Individuals without a suture account for 25%. Twenty-five percent of specimens have an acute-angled suture, while 10% have an obtuse-angled suture. A notch is present in 9%. The rarest pattern is the presence of a «notch».

To further study the viper's distribution in the Minsk region, the results of field studies conducted between 2012 and 2014 in the following administrative districts were used: Volozhin, Derzhinsky, Stolbtsy, Pukhovichi, Vileika, Minsk, and Logoisk. The collection material was collected by A.V. Khandogim and M.S. Medvedeva.

It was revealed that in the modern structure of the viper population inhabiting the Minsk region (a sample of 127 specimens), medium-sized individuals (60-70 cm in length) predominate. The ratio of immature males to females is 25%, 35.0%, and 40.0%. The sex balance in the population is shifted towards a slight dominance of females (1:1.1).

The following quantitative distribution of different color forms in the population was established: gray individuals – 32.8%, brown – 42.4% and black – 24.8%.

In the central part of the country, in the Minsk region, the dominant habitat group is made up of mixed coniferous-small-leaved forests, wet pine forests, and various types of swamps. The highest abundance rates are found in wet biogeocenoses – in swamps, along riverbanks, canals, and reservoirs, in mossy pine forests, and in mixed coniferous-small-leaved forests.

Thus, the common viper population in the Minsk region is unevenly distributed, due to landscape heterogeneity and anthropogenic transformation of the territory. It totals approximately 30,600 individuals. Thus, compared to other regions, Minsk has the poorest common viper population in Belarus. The most significant populations are found in the Dzerzhinsky, Vileika, Pukhovichi, and Stolbtsy districts. The population density in the Minsk region is very low, approximately 2-2.5 times lower than in other districts of the Minsk region, and ranges from 0.9-24.6 individuals/ha, with an average of 9.3±1.2 individuals/ha.

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ETHICAL CHALLENGES OF TECHNOLOGICAL PROGRESS AND SOCIETAL DIGITALIZATION

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The report analyzes the key ethical dilemmas associated with the rapid development of technology and the comprehensive digitalization of society. Special attention is paid to issues of privacy, data security, algorithmic bias, and the impact of technological unemployment on social justice. Proposals for developing ethical frameworks and regulatory mechanisms to mitigate negative consequences are considered.

Keywords: Digitalization, Ethics, Technological Progress, Privacy, Algorithmic Bias.

The main ethical issues of digitalization

The digitalization of society and rapid technological progress, including the development of artificial intelligence and big data, bring enormous benefits, but they constantly create pressing ethical challenges for humanity. The relevance of their discussion is determined by the need to form a socio-ecological and ethical-pedagogical environment capable of adapting to new realities.

The main ethical dilemmas relate to privacy and data security. The mass collection and processing of personal information creates risks of unauthorized access and abuse. Therefore, special attention should be paid to implementing the principle of the "right to be forgotten" in the digital space.

The problem with algorithmic bias is that decisions made by AI can reflect and reinforce existing societal biases (racial, gender, social). For example, recognition systems may demonstrate less accuracy for certain population groups, leading to social injustice. Addressing this issue requires the development of transparent and explainable algorithms.

The development of new ethical and pedagogical approaches should include training citizens in digital literacy and critical thinking to assess technological risks. The implementation of ethical codes for developers and regulators is becoming critical to ensuring sustainable technological development.

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ENVIRONMENTAL DIFFERENTIATION IN MAJOR CITIES: WHO PAYS FOR EXPANSION AND DEVELOPMENT

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This paper examines the phenomenon of environmental differentiation as a critical challenge of modern urbanization. It analyzes the systemic process of socio-spatial stratification where access to environmental benefits –

such as green spaces, clean air, and quality water – is distributed unevenly across different urban populations. Concurrently, environmental risks, including air and noise pollution and proximity to hazardous infrastructure, are disproportionately borne by vulnerable socio-economic groups. The study aims to uncover the mechanisms driving this inequality in the context of rapid urban growth and to identify the social strata that ultimately pay the highest price for metropolitan expansion and development.

Keywords: environmental differentiation, environmental justice, urban planning, transport poverty, green gap, gentrification, urban environment, spatial inequality, sustainability, social equity.

The research employs a comprehensive literature review and case study analysis of major cities in North America and Europe. It synthesizes findings from urban studies, environmental sociology, and spatial justice theories to construct a multifaceted understanding of the drivers and consequences of environmental differentiation.

The study reveals that environmental injustice manifests in several interconnected ways. Historically marginalized communities, including low-income and ethnic minority populations, are consistently concentrated in areas with high concentrations of environmental burdens, such as landfills, industrial zones, and major transport corridors, a practice identified as "environmental racism" [1]. A critical dimension of this is transport injustice, where proximity to highways exacerbates public health crises, increasing risks of asthma and other respiratory ailments by 20-40%, while simultaneously suffering from a lack of accessible and affordable public transport, creating a "transport poverty" trap [2, 3]. Furthermore, a significant "green gap" is documented; affluent neighborhoods possess substantially more parkland and tree canopy, which is directly correlated with better physical and mental health outcomes, while deprived areas remain devoid of these essential amenities [4].

A paradoxical outcome of urban sustainability initiatives is identified. Municipal investments in greening, public transit, and brownfield rehabilitation, while environmentally beneficial, often act as catalysts for gentrification [5]. This leads to the displacement of long-term, lower-income residents, who, after enduring poor environmental conditions, are priced out of their improved neighborhoods. This creates a double burden: first, health impacts from a neglected environment, and second, the loss of home and community due to subsequent redevelopment.

The relentless expansion of megacities exacts a heavy toll on their most vulnerable inhabitants, perpetuating cycles of social and health inequality. The inequitable distribution of environmental goods and bads deepens existing social fractures and undermines the goals of sustainable and inclusive urban development.

Addressing the chasm of environmental differentiation requires conscious and targeted policy interventions. Key recommendations include conducting rigorous equity-focused impact assessments for all urban planning decisions, establishing robust affordable housing funds in revitalizing areas, prioritizing "green" investments in environmentally deprived districts, and fostering genuine, meaningful participation of local communities in the planning processes [6]. Without such a foundational commitment to spatial and environmental justice, the future development of cities will continue to impose an unsustainable burden on those least able to bear it.

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BIOMEDICAL EDUCATION OF BELARUSIAN YOUTH AS AN ADAPTATION FACTOR DETERMINING THE WELL-BEING OF THE REPUBLIC

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A person, like any biological object, is under the influence and impact of numerous factors that come from living conditions and places of residence.

The processes occurring in the external environment equally affect all living organisms, and only the degree of their adaptation increases the chances of survival of some and dooms others to death. A person, as an intelligent creature, is by definition obliged to foresee all risks and be prepared for most of the unfavorable moments that arise throughout his life.

The very mechanism that will subsequently allow young people to avoid most problems of social and physiological orientation is obtaining the basics of medical and biological education, which will provide the opportunity to correctly navigate in a fairly aggressive environment. This knowledge, obtained by young people at the beginning of their lives, will allow them not only to avoid the risks of disruption of the physiological and psychological state, but also to help correctly navigate in choosing a healthy lifestyle for themselves and their immediate environment.

Keywords: medical and biological education, adaptation process, healthy lifestyle, young generation, infectious pathology, preventive measures.

Historically, people with a certain amount of biological knowledge are better adapted and feel more confident in the transition to independent life. There are many reports, both scientific and trivial stories from people's lives, indicating that young people who have had experience communicating in the biological spheres of human life adapt much more easily to society.

And, on the contrary, young people who have an insignificant level of biological awareness and a minimal amount of medical and biological knowledge have a much harder time adapting to independent life and have a harder time coping with even low levels of psychological challenges (problems).

In Belarus, a sufficient number of successfully functioning educational institutions have been created, which provide young people with the opportunity to obtain knowledge of various levels of complexity and focus. Biological, medical-biological and, specifically, medical education stand separately - which truly provide a high level of bio-focus in the adaptation processes of the period of entry of young people of the Republic of Belarus into independent life [1, 2].

All educational institutions of Belarus, without exception, in the programs for training specialists in the areas not mentioned above, have included, without fail, educational subjects that provide a certain minimum of medical and biological knowledge. This knowledge allows young people of Belarus to feel confident in any situation that they have to face not only at the beginning of their lives, but also in subsequent periods [3].

One of the key educational institutions that has included medical and biological subjects in its educational programs is the UO "International Ecological Institute named after A.D. Sakharov" of the Belarusian State University, where every year, along with specialist diplomas, a large number of young people receive a start in life, who become worthy members of Belarusian society.

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PSYCHOEMOTIONAL STRESS AND ITS EFFECT ON THE CHILD'S BODY

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The relevance of childhood stress as a global problem in the Republic of Belarus and around the world is considered.

Keywords: stress, psychoemotional stress, childhood stress.

Stress (from the English word "stress" meaning "pressure" or "tension") refers to a person's stressed state that occurs in response to extreme external factors.

Stress is one of the most pressing problems of our time. For a long time, stress has been considered a problem primarily faced by adults. But today, stress is spreading more and more to the children's world. Children, just like adults, suffer from excessive physiological and informational stress, as well as psychological pressure that they cannot cope with. [2].

Types of childhood stress:

1) Physical stress. It is manifested by the body's reactions to external factors.

2) Psychological (emotional, nervous) stress. It is manifested by behavioral and emotional reactions to stimuli.

Stress itself is very important for survival. Short-term stress in small doses helps to activate a person's reserve capabilities, promotes the development of new reactions, educates and ensures progress and evolution [2].

Prolonged exposure to stressful situations associated with constant negative experiences, on the contrary, "depletes" the body, causes impaired body functions, worsens the psycho-emotional state, and also gives rise to and progression of various diseases in adulthood: autoimmune diseases, allergies, bronchial asthma, chronic back pain, cardiovascular diseases, diabetes mellitus, migraines, obesity, depression, and personality disorders [1].

Regardless of the cause, childhood stress is a growing problem. The prevalence of psychosomatic disorders in children and adolescents ranges from 10 to 25%. In the Republic of Belarus, every third child constantly experiences psychoemotional stress [3].

Prevention and treatment of stress are based on increasing the adaptive (adaptive) capabilities of the child. To do this, it is necessary to actively identify children who cannot cope with situations in their lives [4].

Effective treatment of childhood stress is possible only with a comprehensive and long-term approach aimed at changing the lifestyle of both the child and his family members. Stress therapy is based on stress prevention measures (diaphragmatic breathing, regular exercises that develop flexibility, relaxation that replaces a child's active activity, an appropriate sense of humor and the ability to express their emotions), parental involvement and attention, regular physical activity, and adequate sleep [4].

Thus, understanding the early signs associated with the development of psychoemotional stress in children opens up opportunities for early prevention of stress and its complications.

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PSYCHOLOGICAL INFLUENCE OF CULTURE ON SEXUALITY

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This article describes the mechanisms by which the cultural environment influences the formation of human sexuality, as well as the impact of social norms in a cultural society on sexual behavior, development, and identity.

Keywords: sexuality, cultural influence, psychology

Human sexuality is not only a biological aspect, but also a social construct deeply rooted in cultural frameworks. It is social norms that determine the acceptability of certain sexual behaviors, identities, and their expressions.

Every culture has certain patterns of behavior, and deviating from them is subject to public condemnation. This is because people who grow up in a certain society unconsciously begin to imitate their surroundings. People who do not adopt the habits of their environment are perceived as antisocial. Thus, if in a cultural society where sex is taboo, someone begins to speak openly on this topic, many will feel discomfort, shame, and embarrassment [1].

In addition, cultural customs and social structures (patriarchal or matriarchal) influence what behavior (including sexual behavior) is characteristic of a particular gender, as well as awareness and willingness to discuss details of intimate health and sexual preferences. For example, in a strictly patriarchal society, female sexuality is expressed in gentleness and submissiveness, while male sexuality is expressed in confidence and dominance. Individuals who do not conform to the gender stereotypes characteristic of a given society are subject to social condemnation. For example, a timid and shy guy is likely to be called a loser, while an overly open and confident girl is likely to be called vulgar [2].

The formation of cultural norms regarding sexuality depends on a variety of social factors surrounding the individual. Among these factors are: the influence of family and environment, the media, peers, etc. The immediate environment creates an idea of what is “right” and “beautiful,” the media broadcasts generally accepted standards of sexuality and attractiveness, which are often practically unattainable, and the community establishes unspoken rules of behavior and expectations regarding sexual behavior. The availability of information, level of education, and historical context have an equally strong influence. The combination of these factors, as well as the degree of influence of each of them, combined with personal experience and individual perception, forms a unique perception of sexuality and attitude towards it in each person [3].

Thus, it is difficult to overestimate the psychological influence of culture on the formation of sexuality. However, despite the foundations of society, this topic should not be avoided, because open discussion will allow us to expand the boundaries of the norm.

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SYSTEMATIC PATTERN OF EXCLUSION: ENVIRONMENTAL AND HUMANITARIAN ETHICS IN THREE DECADES OF THE NICARAGUA CANAL

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The Nicaragua Interoceanic Canal project, systematically reactivated between 1998 and 2018 under three consecutive governments, represents a paradigmatic case of the subordination of indigenous rights and environmental

regulations. This article examines the pattern of exclusion of the Rama and Kriol communities, demonstrating how this project operates as a “state of exception” that suspends constitutional guarantees without complying with Free, Prior, and Informed Consent or conducting socio-environmental impact studies.

Keywords: Nicaragua Canal, ethics, exclusion, indigenous rights.

The Rama and Kriol peoples inhabit ancestral territories in Nicaragua's South Caribbean Coast Autonomous Region, where they have developed livelihoods based on fishing, agriculture, and sustainable use of forest resources. The interoceanic canal project would cross 52% of their titled territories, Lake Nicaragua, and the Indio Maíz Biological Reserve. The removal of millions of cubic meters of sediment poses irreversible risks, ecosystem disruption, and loss of biodiversity. For indigenous communities, forced displacement would likely mean cultural and linguistic extinction, making it imperative to examine the fundamental ethical implications of this case. [3]

Nicaragua has a formally progressive legal framework: the 1987 Constitution recognizes indigenous territorial rights; Law No. 28 establishes regional autonomy; Law No. 445 regulates communal property; ILO Convention 169 requires prior consultation; and Law No. 217 requires environmental impact assessments. However, the three canal initiatives reveal a structural contradiction between legislation and institutional practices that systematically suspend these guarantees. [1]

During the administration of Arnoldo Alemán, Presidential Order No. 68-98 of 1998 created the Multi-Sectoral Commission for the Dry Canal without prior consultation with indigenous communities, setting an institutional precedent of omission despite the fact that Nicaragua had ratified ILO Convention 169 eight years earlier. In 2002, under the government of Enrique Bolaños, Presidential Order No. 160-2002 established the Working Commission for the Interoceanic Grand Canal, maintaining the same structure of exclusion towards these communities. [3-1]

The most serious manifestation of this occurred in 2013 when the National Assembly approved Law No. 840 under the presidency of Daniel Ortega, granting Hong Kong Nicaragua Development (HKND) a 50-year concession with extraordinary faculties: accelerated expropriation, unrestricted use of natural resources, and explicit exemption from prior consultation. This continuity under governments of different political persuasions shows that the pattern transcends partisan politics and responds to institutional logic where economic development is seen as a state prerogative that doesn't need the consent of the affected populations and overrides the ordinary legal framework. [2]

Comparative analysis confirms the existence of institutional continuity in the exclusion of indigenous peoples, regardless of government ideology. The “national interest” has consistently functioned as a mechanism for legitimizing regulatory violations, creating a “state of exception” where constitutional guarantees are suspended indefinitely under economic justification. These facts expose an institutional weakness between the formal recognition of rights and the institutional capacity to enforce them in the face of economic interests.

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ETHICS OF ARTIFICIAL INTELLIGENCE IN SCIENTIFIC RESEARCH: THE BOUNDARIES OF THE SCIENTIST’S RESPONSIBILITY

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Artificial intelligence (AI) technologies are being increasingly integrated into scientific practice, transforming research methodologies, data analysis, and even the very process of knowledge generation. In the context of Belarus,

where the adoption of AI in science is still in its early stages, the question of the scientist's ethical responsibility becomes especially acute. Drawing on international surveys (including Nature, 2023), national statistical data, and philosophical frameworks developed by Hans Jonas, Karl Popper, and Michel Foucault, this article demonstrates that responsibility for scientific conclusions derived with the aid of AI cannot be delegated to algorithms.

AI-based technologies are reshaping established practices across all spheres of human activity, and science is no exception. According to a 2023 survey by the journal Nature, more than a quarter of scientists already using AI in their research expect this technology to become an indispensable part of their discipline within the next decade, while an additional 47% consider it "highly useful".

The integration of AI into the scientific sphere remains at an initial stage in Belarus. Data from the National Statistical Committee of the Republic of Belarus indicate that in 2023, only about 4% of research organizations and 7% of universities officially employed AI-based solutions in their activities. However, as in other countries, these figures reflect only institutional-level adoption and do not account for the individual use of AI tools by researchers themselves – for example, for literature review, processing experimental data, or preparing manuscripts.

This gap between official statistics and actual practice creates an ethical "grey zone": when a scientist uses AI outside the framework of approved institutional protocols, uncertainty arises regarding authorship, reliability, and accountability. Under these conditions, philosophical reflection on the moral foundations of scientific activity in the age of algorithmic reasoning becomes particularly crucial.

One of the central ethical challenges is the opacity – or "black box" nature – of many AI algorithms. As Mittelstadt note, complex machine learning models often do not allow users to trace the logical pathway from input data to output conclusion. This contradicts a core requirement of the scientific method: reproducibility and justification.

Karl Popper emphasized that a scientific hypothesis must be falsifiable. If a researcher cannot explain why an AI arrived at a particular conclusion, how can that conclusion be subjected to critical scrutiny? In the context of limited resources in Belarusian scientific laboratories, the temptation to rely on "off-the-shelf" AI solutions is strong – but it is precisely here that ethical risk emerges: the substitution of understanding with blind trust in technology.

Hans Jonas, in his work The Imperative of Responsibility, argued that in the age of advanced technologies, ethics must be oriented toward future consequences. In the Belarusian scientific context – where formal AI ethics committees have not yet been established – the personal responsibility of the researcher takes on particular significance.

AI lacks moral agency; it is incapable of reflection, remorse, or repentance. Therefore, even if an error stems from an algorithmic malfunction, the human researcher remains responsible for publishing unreliable results. Attempts to claim "the AI did it" constitute ethical evasion, which is unacceptable in the scientific community.

The issue of authorship is especially pressing amid the growing number of publications involving generative AI models. The Committee on Publication Ethics (COPE) explicitly states that AI cannot be listed as a co-author, although its use must be disclosed.

Currently, Belarusian universities and research institutes lack unified methodological guidelines for handling such cases. This creates a risk of violating principles of intellectual integrity. Michel Foucault reminded us that authorship is not merely a name beneath a text but an ethical stance tied to one's willingness to be accountable for what is said. Delegating this stance to a machine undermines the very foundations of scientific communication.

AI models are trained on datasets that often reflect dominant scientific paradigms. This may lead to the marginalization of local research traditions, including Belarusian ones–for instance, in the humanities or socio-economic sciences.A researcher who employs AI without critically assessing its cultural and linguistic assumptions risks reproducing epistemic inequality. From the perspective of John Rawls' theory of justice, the scientific community should strive to develop inclusive, critically reflective approaches to AI use.

The integration of artificial intelligence into science opens new opportunities but simultaneously poses complex ethical questions for researchers. The answers cannot be purely technical – they require philosophical reflection, the updating of normative frameworks, and, above all, the strengthening of a culture of personal responsibility. While official institutions are only beginning to consider the regulation of AI, it is ultimately individual researchers who determine whether this technology becomes a tool for progress or a source of new crises of trust. As Hans Jonas wrote, "Responsibility is a duty toward the future." In the age of AI, this duty rests upon every scientist.

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THE PHENOMENON OF CONFLICT

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This paper examines the main types of conflicts, their causes and dynamics, as well as the psychological mechanisms that determine the behavior of conflict participants. Special attention is paid to methods and methods of conflict resolution, including constructive approaches such as negotiation, mediation and arbitration. Various strategies of behavior in conflict situations are analyzed, such as cooperation, compromise, avoidance, and competition.

Keywords: conflict; methods of solution; strategy; personality behavior.

Conflicts are an integral part of human interaction and can occur in various forms. The main types of conflicts include personality conflicts that arise between individuals due to differences in personality characteristics, values, or opinions. Group conflicts occur between teams or organizations and can be caused by competition for resources or differences in goals. Social conflicts arise at the societal level and may be related to cultural, economic, or political factors. Conflicts of interest arise when two parties have opposing interests or goals.

The causes of conflicts can be diverse, including communication barriers that lead to misunderstandings and erroneous conclusions. Differences in values and beliefs can also become a source of disagreement, especially when the parties to the conflict have different views on important issues. Competition for limited resources such as time, money, or attention can cause conflicts between individuals or groups. In addition, high levels of stress and pressure can exacerbate conflicts and reduce participants' ability to engage in constructive dialogue.

The dynamics of a conflict describes its development and changes over time. There are usually several stages: the pre-conflict stage, when the prerequisites for conflict arise; the escalation of the conflict, when the parties begin to actively express their differences; the crisis stage, when the conflict reaches its peak; and conflict resolution, when the parties begin to look for ways out of the situation.

Psychological mechanisms play a key role in how participants respond to conflict. Cognitive distortions can make it difficult to objectively perceive a situation, and emotional reactions such as fear, anger, or resentment affect participants' behavior. Belonging to a certain group can increase the confrontation between the parties.

There are many conflict resolution methods, including negotiation, mediation, and arbitration. Negotiations are a process of discussing the interests of the parties in order to reach a mutually acceptable agreement. Mediation involves the involvement of a third party to help find a solution to a conflict, whereas arbitration involves a binding decision by a third party.

Constructive approaches to conflict resolution are aimed at turning conflict into an opportunity for growth and improvement of relations. These include cooperation, in which the parties work together to achieve a common goal; compromise, where each side makes concessions; avoiding conflict in situations that do not require immediate intervention; and competition, when one side tries to impose its opinion on the other.

The study of conflicts and their resolution methods is an important area of psychology and social sciences. Understanding the types of conflicts, their causes and dynamics allows us to develop effective strategies for their management. Constructive approaches not only help to resolve differences, but also contribute to improving mutual understanding and cooperation between participants.

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THEORETICAL BASIS OF NATURAL SCIENCE EDUCATION OF MODERN YOUTH IN BELARUS

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Natural science education is a term that arose as a result of the purposeful systemic unification of biological sciences. In essence, the process of forming such an educational enclave is dictated by the modern development of human society, which is interested in the well-being of its presence on Earth.

Evolutionary processes that have changed the intellectual needs of people accordingly could not but affect all areas of educational processes. This happened due to the successful development of natural sciences, as the most formed in the 19th century, and replaced "natural history" and "natural science". Natural science education is aimed at forming a holistic picture of the world, a scientific worldview, an idea of the unity and diversity of the properties of living and inanimate nature; environmental and technical knowledge. Studying the process of forming natural science education, its improvement and practical use is extremely relevant.

Keywords: natural science education, ecology, environmental education, environmental conservation, a set of academic disciplines.

According to the interpretation in the dictionary of education and pedagogy, natural science education as a term is presented as a purposeful process of upbringing and training in the interests of a person, society and the state, aimed at forming a scientific worldview, an idea of the unity and diversity of the properties of inanimate and animate nature. It is one of the components of general education, uniting a set of academic disciplines that set out the basics of scientific knowledge about nature.

The evolution of civilization with radical transformations of thinking and intellect gave birth to the evolution of natural science and natural science educational reality. The joint development of natural science and the natural science educational system gives new spheres and laws of development, gives rise to educational problems and new ways of solving them.

The last decades have attracted attention by the change in the natural and climatic balance. All biological objects suffer from these changes. Only people with deep knowledge and who have studied the processes occurring in the world are able to analyze the processes occurring in the natural and social environment of human society.

Natural sciences ("nature" or nature) are sciences that study nature (understood in a broad sense as the material world of the Universe) [1]. Many branches of natural sciences are united in a system called natural science. Even more

systems of sciences and scientific directions are united in the sphere of natural science education. It covers a set of academic disciplines that set out the foundations of scientific knowledge about nature, which provides for two main goals: a) the formation of a scientific picture of the world and an adequate understanding of the world; b) the preparation of a theoretical foundation for the successful study of specialized disciplines in the field of vocational education, preparing workers for industrial and agricultural production [2].

In the course of our research, we analyzed the process of teaching students natural sciences in the context of the modern information system of education at the UO "MGEI named after A.D. Sakharov" of BSU. For this, it was necessary to: 1) analyze the organization of the educational process and students' research work; 2) identify the level of students' natural science competence; 3) identify the main problems affecting the quality of education.

The methodology of the study was based on numerous reports from researchers, politicians, and teachers on the level of knowledge in the natural sciences. Theoretical analysis of psychological, pedagogical, and scientific and methodological literature; methodological analysis of curricula; academic performance documents; modeling method; pedagogical observation; expert assessment; methods of mathematical and statistical processing.

Our research has shown that students have a fairly high level of knowledge in biological and environmental subjects.

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ENVIRONMENTAL LITERACY OF SCHOOLCHILDREN IN ADDRESSING THE SUSTAINABLE DEVELOPMENT GOALS

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The paper assesses the environmental literacy of schoolchildren in the context of achieving the Sustainable Development Goals. The priority Sustainable Development Goals for schoolchildren in the Grodno region and Minsk have been identified.

Keywords: sustainable development goals, environmental education.

The development of students' environmental literacy is a vital component of the educational process. Environmental literacy is a key element of education for sustainable development, which encompasses the interaction between the environment and human activity to ensure the preservation of resources for future generations. Cultivating students' environmental knowledge, skills, and motivation to engage in solving ecological challenges is achieved through the formation of personal environmental culture, expressed in practical actions and awareness-raising efforts.

The goal of environmental literacy is to cultivate an educated and responsible citizen capable of making informed decisions and interacting with the environment in a sustainable and balanced manner [1].

The target groups included students from Ivye Secondary School (Ivye, Grodno Region) and School No. 165 in Minsk. The aim of the study was to explore students' perceptions of the Sustainable Development Goals (SDGs) and their willingness to contribute to their achievement. Following extracurricular activities, students completed assignments in which they identified the most relevant SDGs and wrote essays titled "I advocate for the achievement of the SDGs," proposing mechanisms for their implementation.

Students from School No. 165 in Minsk identified the following SDGs as priorities: Goal 1 – No Poverty (16%), Goal 16 – Peace, Justice and Strong Institutions, Goal 10 – Reduced Inequalities, Goal 3 – Good Health and Well-being (11%), Goal 2 – Zero Hunger, and Goal 4 – Quality Education (9%).

Students from the school in Ivye, Grodno Region, identified the following Sustainable Development Goals (SDGs) as priorities: Goal 3 – Good Health and Well-being (68%), Goal 4 – Quality Education (59%), and Goal 1 – No Poverty (50%).

In both groups, the priority Sustainable Development Goals (SDGs) were Goal 1 – No Poverty and Goal 4 – Quality Education. Students' selection of these goals reflects their perceived social relevance and importance for society.

In their essays, students demonstrated personal engagement with the challenges of achieving the Sustainable Development Goals (SDGs). The most frequently chosen goals were Goal 3 – Good Health and Well-being (14.1%–18%), Goal 4 – Quality Education, Goal 13 – Climate Action (12%), Goal 1 – No Poverty (10.7%), Goal 11 – Sustainable Cities and Communities (12.4%), and Goal 12 – Responsible Consumption and Production (9%).

It was found that the level of environmental literacy among students is relatively high, providing a solid foundation for the further effective development of students' environmental competencies in addressing the Sustainable Development Goals (SDGs).

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VULNERABILITY AS A PHENOMENON OF PSYCHOLOGICAL STRENGTH

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The article analyzes the concept of vulnerability as a phenomenon from the perspective of psychology and philosophy.

Keywords: vulnerability, psychology, philosophy.

Vulnerability is considered a fairly broad concept, and the term can be used in a variety of contexts. In its most general sense, vulnerability is a completely natural state of young children, baby animals, and other creatures who are unable to care for themselves. Typically, this type of vulnerability is easily overcome – it's a matter of time, growth, and development.

Vulnerability is a state of insecurity in which a person is especially susceptible to the influence of threats or harmful experiences, and the likelihood of a negative outcome increases significantly. Vulnerability can give rise to anxiety, worry, fear, apprehension, and foreboding associated with the possibility of experiencing harm or damage.

All people experience some vulnerability in the context of disasters and other types of traumatic events. Vulnerability can be described as a distressing feeling of being unable to avoid a threat, having difficulty coping with its impact, or being unable to recover from a traumatic incident. Some individuals recover from trauma quite quickly and effectively cope with its negative consequences, while others experience long-term effects, such as post-traumatic stress disorder and other mental health problems [2].

In the common consciousness, vulnerability is traditionally associated with weakness and an inability to self-control. However, modern philosophical and psychological concepts interpret it as a fundamental condition of human existence and an important resource for personal development.

Existential philosophy emphasizes the inevitability of human finitude and limited control over life's circumstances. Recognizing one's own limitations not only does not devalue the individual, but also fosters genuine freedom of choice: a person who accepts their vulnerability understands responsibility for the decisions they make. In this context, vulnerability is not a flaw, but an ontological given that enables one to attain existential authenticity.

From a psychological perspective, research by B. Brown and her followers shows that a willingness to acknowledge one's own weaknesses positively correlates with levels of trust in interpersonal relationships, a subjective sense of resilience to stress, and a reduction in manifestations of internal conflict. Accepting vulnerability narrows the gap between the idealized self-image and actual emotional experiences, which contributes to the development of psychological integrity.

Although the term "vulnerability" often carries negative connotations, psychology is seeing a growing appreciation for this concept in the context of human qualities – and many specialists recognize that vulnerability can be useful and beneficial. According to existentialist theory, vulnerability is an integral part of the human condition. While vulnerability indicates the likelihood of experiencing pain, it also implies a greater sensitivity to experiencing life in its fullness [1].

Thus, vulnerability can be viewed as a complex phenomenon, combining existential and psychodynamic aspects. Philosophically, it reveals the depth of human existence, and psychologically, it provides adaptive mechanisms for maintaining resilience and building trusting relationships.

Therefore, personal strength lies not in the denial of vulnerability, but in the ability to integrate it into one's experience. Consciously accepting vulnerability fosters not fragility, but inner resilience, making this phenomenon key both to the philosophical analysis of human existence and to psychological practice.

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DEVIANT BEHAVIOR

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The article discusses human deviant behavior, which refers to actions that contradict the generally accepted moral norms and rules of behavior in society. This behavior is influenced by a combination of biological, psychological, and social factors. Studying the factors that contribute to deviant behavior and the characteristics of deviant individuals is an important task in psychology, as it aims to understand and address this type of behavior.

Keywords: deviant behavior, moral norms, causes of deviant behavior, ways to prevent deviant behavior.

To prevent deviant behavior, it is important to understand the factors contributing to its development. There are many factors influencing deviant behavior, and most often they act in a complex. These factors are often divided into several groups, such as biological factors, psychological factors, and social factors.

The biological causes of deviant behavior cover a wide range of factors, including genetic predisposition, anatomical features, and the functioning of the nervous system. Thus, the Italian physician Cesare Lombroso argued in his works that "congenital criminals" can have specific physical signs, such as the shape of the skull and other anatomical features. Another important aspect is the state of the nervous system. Organic brain lesions, both congenital and acquired, and disorders in its functioning. One of the biological causes of deviant behavior can be seen in the work of hormones, or rather an imbalance (overabundance or lack) of hormones. The most striking example of this is an overabundance of the hormone testosterone, which can often lead to aggressive behavior towards others [1].

The psychological causes of deviant behavior are a complex set of factors that influence individual behavior and its deviations. One of the main characteristics influencing the manifestation of deviations from the norms of human behavior is temperament. It is noted that people with choleric traits may be more often affected by affective actions that are little or completely under the control of conscious regulation, since the formation of dominance occurs quite quickly. Melancholics are more likely than others to have communication problems, which become the foundation for problems

with socialization. We emphasize that there are no pure types of temperament among people as such, but even the predominance of one of the types does not mean a direct tendency to deviation. It is also necessary to take into account the subjective experience or so-called traumatic experiences, that is, events and related experiences that negatively affect a person's mental health. These can be the loss of a loved one, natural and man-made disasters, experienced acute or chronic effects of stressors. Such traumas can consolidate deviant patterns of behavior in a person's experience, and they can cause irreparable harm that prevents a person from responding adequately to the surrounding reality [2].

Social institutions carry certain patterns of behavior in specific situations, generate social statuses and roles according to which a person should behave, as well as learn and apply various kinds of social norms. In the life of every person there are role models from which he takes an example, such people become bearers of moral and ethical standards, legal norms. These can be both close people and idols. If social institutions fail to cope with their function of socialization, reference groups for a person and other people carry negative, deviant patterns of behavior, norms and values, or do not have clearly defined norms and rules at all (it often manifests itself if a person lives in a dysfunctional family or an area with a severe criminal situation), then a person with a large It is more likely to behave in a deviant manner [3].

Thus, it should be mentioned that most people may be subject to deviant behavior. To minimize the likelihood of this phenomenon, it is extremely important to understand the full range of causes and take into account everything from genetic to socio-cultural. The ways to prevent deviant behavior include a healthy lifestyle and sports, which will reduce the susceptibility to nervous diseases. Also an important component for the formation of prosocial behavior is a high level of intellectual development. It promotes the assimilation of social norms and principles, the correct construction of activities and behavior.

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THE INFLUENCE OF EMOTIONAL STATE ON AN ATTACK OF GASTRITIS

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This article describes the mechanisms by which psychoemotional state influences the development of gastritis.

Keywords: gastritis, stomach, gastrointestinal tract, stress, psychoemotional state.

Gastritis is an inflammation of the gastric mucosa, leading to tissue degeneration and dysfunction. This condition is caused by an imbalance of protective and damaging factors in the stomach, which occurs as a result of infectious agents, aggressive chemicals, and diseases of other organs of the digestive system. However, the most underestimated factor influencing the development of this condition is an unstable emotional state.

The physiological mechanism by which emotional states influence the digestive system is explained by the close relationship between the nervous and endocrine systems. In response to stress, the adrenal cortex produces large amounts of adrenaline. This stress hormone promotes increased conductivity of smooth muscle synapses [1]. Overstimulation of the stomach wall muscles leads to spasms and impaired motility, which increases the time food remains in the stomach and, consequently, increases the exposure of the mucosa to aggressive gastric juice. Muscle spasms in the blood vessel walls reduce tissue oxygenation, leading to a decreased ability to resist alteration.

At the same time, the release of cortisol causes untimely secretion of hydrochloric acid, which increases acidity. This results in increased secretion of pepsin, which is most active at low pH values. These two factors dramatically increase the aggressiveness of gastric juice on the mucosal wall [2].

During prolonged stress, cortisol levels are constantly elevated, which leads to the activation of adaptive mechanisms. Several outcomes can occur: first, the tissue may be replaced by mucous connective tissue, which is less sensitive to hydrochloric acid (metaplasia). Extensive metaplasia can lead to gastric sclerosis, as the connective tissue is unable to perform the functions of the mucous membrane [3]. Second, with persistently elevated cortisol, the gastric glands become less sensitive to its levels and stop synthesizing hydrochloric acid in a timely manner, which can lead to digestive problems.

If the adaptive mechanisms are not activated and the inner lining of the stomach continues to be exposed to aggressive acid, there is a risk of developing a stomach ulcer or rupture.

In addition to the physiological consequences of stress, it can also affect an individual's behavior. Many people, experiencing constant psychological discomfort, tend to develop unhealthy habits to cope (smoking, drinking alcohol, stress eating), which also contribute to the development of gastritis.

For the prevention and successful treatment of gastritis, it is important not only to eliminate infectious and chemical factors but also to correct the emotional state. A combination of preventive measures, including psychotherapy, relaxation, and normalizing work and rest patterns, helps stabilize the nervous system and restore balance to the gastrointestinal tract.

Thus, emotional state is one of the determining factors in the development of gastritis. Psychoemotional overload not only creates favorable conditions for inflammation of the gastric mucosa but can also cause its recurrence, even with diet and medication.

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SECTION 2
MEDICAL ECOLOGY

CYTOMORPHOLOGICAL CHARACTERISTICS OF BUCCAL EPITHELIAL CELLS IN SMOKERS AND NON-SMOKERS

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The article presents a study of changes in the state of buccal epithelium as a test criterion for the impact of various environmental pollutants. The appearance of non-epithelial inflammatory cells (neutrophils, lymphocytes, etc.) in groups of smokers was shown in comparison with non-smokers.

Keywords: buccal epithelial cells, cytological changes, smoking, inflammation, immune response.

Buccal epithelium (BE), as a structural component of the mucosal immune system, is a multi-layered flat non-keratinizing epithelium, whose cells (epitheliocytes) play an active role in a complex system of intercellular interactions that regulate the immune response and inflammatory processes. Epithelial cells express a diverse spectrum of signaling molecules, forming a dynamic network of interactions with elements of both innate and adaptive immunity.

The cheek epithelium, consisting of an upper layer of viable cells, is an easily accessible and convenient source of biological material for cytological studies. The cells of the cheek epithelium are characterized by large size, rounded or oval shape of the nucleus, low glycogen content (about 5%), thin lamellar structure (size 48-142 microns, area 2000-7500 microns) and smooth, non-curved edges of cells. The size of the nucleus is 8-15 microns (an area of 28-90 microns), and the cytoplasm is colored evenly and non-intensively [1].

The study involved 60 students aged 19-20 years who have lived in Minsk for at least one year. Cytological material was obtained by scraping the buccal epithelium. Participants were provided with questionnaires containing questions about the presence of chronic diseases, allergies, infectious / viral diseases at the time of material collection, diseases in the last 3 months, nasal injuries/ operations, as well as informed consent to participate in the study.

The research was conducted in the training laboratory of the Department of General Biology and Genetics of the Sakharov International State Ecological Institute of the Belarusian State University (MGEI). Sakharov BSU).

The study participants were divided into 2 groups of 30 people: a non-smoking group (control) and a group of smokers. According to the results of microscopy of cytological preparations of buccal epithelial cells, it was shown that binuclear cells were detected in a group of smokers. Their number was 1.77% (they normally lag behind). The nuclei had a rounded shape and were located close to each other, often symmetrically in the cytoplasm, and chromatin was evenly distributed. The cells did not have a division furrow, which indicated binucleation.

Eosinophils were detected on the drugs. Their appearance is characteristic of inflammation and allergies. More often seen in people with chronic inflammation, such as allergic diseases and smoking. Among the group of smokers, their number was 3.1%, while in the non-smoking group it was 1.13%.

Neutrophils were less common in smokers (2.03%). The number of non-smokers was 3.7%. The decrease in the number of neutrophils recorded during the study could be caused by the redistribution of these cells in response to inflammation, indicating their migration to the lesions [2].

Thus, the detected cytological changes in the oral epithelium can be interpreted as signs of inflammation and potential cytogenetic disorders. The decrease in the absolute number of neutrophils (2.03%) found in the study may reflect the redistribution of these cells in response to the inflammatory process, indicating directed migration to the lesions. The presence of an increased concentration of eosinophils (3.1%) in the group of smokers, which is not typical for a healthy oral mucosa (normally absent), confirms the development of an inflammatory reaction [3]. An increase in the number of monocytes (2.01%) and lymphocytes (3.4%) in individuals who have had acute respiratory viral infections in the last three months is associated with the activation of the immune response to the infectious agent.

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LOW-MOLECULAR INHIBITORS FACTOR XII / XIIA

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The article presents a comparative analysis of physico-chemical and pharmacokinetic properties of low-molecular factor XII/XIIa inhibitors obtained using SwissADME resource. The study revealed differences in lipophilicity, solubility, ability to penetrate through biological barriers.

Keywords: factor XIIa, inhibitors, thrombosis, SwissADME, pharmacokinetics, lipophilicity.

Factor XII (FXII) is a serine protease, which plays an important role in the initiation of the internal blood clotting pathway, calliccrein-kinin system and complement system. Unlike other clotting factors, FXII deficiency in humans does not cause bleeding, making it a highly selective and safe target for anticoagulation therapy. Pathological activation of FXII on foreign surfaces (catheters, artificial valves), as well as biological polyanions (extracellular traps of neutrophils, polyphosphates of platelets) contributes to the development of venous thrombosis, ischemic stroke and inflammatory processes. In this connection, the current task is to find and characterize effective FXII/FXIIa inhibitors [1]. Currently, the main classes of inhibitors being developed are antibodies, peptides and, to a lesser extent, low-molecular compounds with potential benefits in terms of oral bioavailability and low synthesis costs.

The object of the study was four low molecular weight inhibitors of FXIIa selected from the PubChem database based on screening data ($IC_{50}<$ μmol): 1-(4-bromoenzyl)-1H-1H-1,2,3-benzenitriazole (1), 1-(4-chlorobenzyl)-1H-benzenitriazole (2), 5-amino-3-(pyridin-3-yl)-1H-1,2,4-triazol-1-ylanone (3) and 1-(4-chlorobenzoyl)-3-pyridine-3-yl 1H-1,2,4-triazole-5-amine (4). The SwissADME web resource was used for a comprehensive characterization, allowing to predict key physico-chemical descriptors (molecular mass, TPSA, Log P, number of rotational bonds, hydrogen bond donors/acceptors) and pharmacokinetic profiles (HIA permeability, CYP inhibition, P-gp substrate, synthetic availability).

Analysis of physico-chemical properties revealed significant differences between the compounds. Compound 1 had the highest molecular weight (302.13 g/mol) and the highest TPSA value (139.55 $Å^2$), indicating its high polarity and potentially low permeability through cell membranes. In contrast, compound 2 was characterized by the lowest molecular weight (257.67 g/mol) and the lowest TPSA (47.78 $Å^2$), which correlates with its predicted high capacity for passive diffusion. All compounds conform to Lipinsky's «Rule five» and have identical FABS (0.55) bioavailability assessment, assuming moderate oral bioavailability.

The evaluation of lipophilicity by consensus Log P showed that compound 2 is the most lipophilic (2.94), while compound 1 is the least (0.92). The high lipophilicity of compound 2 predicts its good absorption in digestive tract. An important pharmacokinetic difference was the ability of only compound 2 to pass through the blood-brain barrier, which may open prospects for treatment of thrombotic complications in the cerebrovascular system.

All compounds, except compound 1, are not P-gp substrates, which is a favorable sign as it prevents the active removal of the drug from the cells and helps maintain therapeutic concentration. In the context of drug interactions,

compounds 2, 3 and 4 have shown potential to inhibit CYP1A2 and/or CYP2C19 isoenzymes, which requires special attention in combination therapy [2].

The study carried out allowed a comparative characterization of four promising low-molecular inhibitors of FHIIa. Based on a comprehensive analysis of the physico-chemical and pharmacokinetic parameters, 1-(4-chlorobenzoyl)-1H-benzetriazole (compound 2) has been identified as the most optimal candidate for further pre-clinical studies. It combines a favorable lipophilicity profile, ability to penetrate through HIA and absence of substrate for P-gp. The data obtained serve as a theoretical basis for a targeted synthesis and subsequent experimental study of the efficacy and safety of these compounds as new antitumorous agents.

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QUANTUM-CHEMICAL MODELING OF (R)-2-AMINO-5-OXO-4-(5-PHENYLISOXAOL-3-YL)-4,5,6,7-TETRAHYDROCYCLOPENTA[B]PYRAN-3-CARBONITRILE

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Tetrahydrocyclopentapyrans are heterocyclic compounds with interesting structural features and exhibit a wide range of biological activities, including antiviral, antitumor, and antimicrobial activity[1,2,3]. Therefore, the study of tetrahydrocyclopentapyran derivatives is a relevant area of research in medicinal chemistry.

In this study, we aim to conduct quantum chemical modeling of tetrahydrocyclopentapyran to assess its interactions with biological life. We studied the electrical and geometric parameters of the compounds and also considered the possibility of their action on biological targets in real time.

Keywords: biological activity, FMO.

To determine the physicochemical properties and activity of the molecule, the ionization potential (1), electron affinity (2), global hardness (3), electronegativity (4), chemical softness (5), electrochemical potential (6), electrophilicity (7), and electron donor capacity (8) were calculated, electron acceptor capacity (9), total charge transfer (10)[4].

$\mathrm{IP} = -E_{HOMO}$, *(eV) (1),* $\mathrm{EA} = -E_{LUMO}$, *(eV) (2),* $\eta = \frac{IP-EA}{2}$, *(eV) (3),* $\chi = \frac{IP+EA}{2}$, *(eV) (4),* $\mathrm{S} = \frac{1}{\eta}$, *(eV) (5),* $\mu = -\frac{IP+EA}{2}$, *(eV) (6),* $\omega = \frac{\mu^2}{2\eta}$, *(eV) (7),* $\omega^- = \frac{(3*IP+EA)^2}{16*(IP-EA)}$, *(eV) (8),* $\omega^+ = \frac{(IP+3*EA)^2}{16*(IP-EA)}$, *(eV) (9),* $\Delta N_{max} = -\frac{\mu}{\eta}$, *(eV) (10)*

The results of the analysis of physico-chemical properties are shown in Table.

Table – Results of the FMO compound analysis

E_{HOMO} (eV)	E_{LUMO} (eV)	IP (eV)	EA (eV)	Eg (eV)	χ (eV)	η (eV)	S $(eV)^{-1}$	μ (eV)	ω (eV)	ω+ (eV)	ω- (eV)	ΔNmax
6.72	1.64	5.09	4.18	2.54	0.197	-4.18	3.44	1.67	5.85	1.65	6.73	1.64

DOS analysis shows that the band gap of the joint is 2.54 eV, and the total hardness (η) is -4.18 eV (table). Based on the data obtained, it can be concluded that the molecule has a very high biological activity.

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DYNAMICS OF MORBIDITY AND MORTALITY OF PATIENTS DIAGNOSED WITH BREAST CANCER IN THE REPUBLIC OF BELARUS

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There is a steady trend of increasing breast cancer incidence in Belarus from 2012 to 2021. Significant regional disparities have been noted, with higher rates in cities and certain regions. Meanwhile, the stability of the mortality rate indicates an improvement in diagnostics and treatment effectiveness.

Keywords: breast cancer, mutations, incidence dynamics.

Breast cancer is a malignant tumor of glandular tissue that develops as a result of a mutation, causing abnormally rapid cell division. These cell's form a tumor capable of invading neighboring tissues and creating secondary foci – metastases.

The purpose of this work was to analyze the morbidity and mortality of the population of the Republic of Belarus from breast cancer in 2012-2021.

There is a steady trend of increasing breast cancer incidence in Belarus. Analysis of data from 2012 to 2021 shows that the standardized incidence rate per 100,000 female population increased from 45.7 in 2012 to 52.7 in 2021.

There is a significant difference in the incidence rate between urban and rural populations, as well as between different regions of the country. The incidence rate is significantly higher in urban areas (80.7 per 100,000 female population in 2012 compared to 63.5 in rural areas), and this gap has persisted in subsequent years. Among the regions, the highest rates are observed in Gomel and Grodno regions, as well as in Minsk, while Brest and Minsk regions have relatively lower rates. This significant regional variation requires further investigation and identification of the underlying causes. This indicates the need to develop and implement specific preventive programs that are tailored to the specific needs of each region, taking into account the risk factors that are unique to each area.

Minor fluctuations in mortality rates with increasing incidence indicate improvements in diagnosis and treatment. Despite a significant increase in breast cancer incidence, the mortality rate remains relatively stable, with a slight increase from 23.7 in 2012 to 25.0 in 2021. This may indicate improvements in diagnosis, early detection, and treatment effectiveness, leading to a decrease in mortality rates.

The need for further research to identify risk factors and develop effective prevention and treatment strategies. The findings highlight the complexity of the breast cancer problem in Belarus. To develop effective prevention strategies and improve the cancer care system, further research is needed to identify risk factors, analyze the impact of socio-economic factors on disease incidence in different regions, and evaluate the effectiveness of existing prevention and treatment programs. Special attention should be given to understanding the causes of regional differences in disease incidence and developing targeted programs for areas with higher rates.

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RETROSPECTIVE ANALYSIS OF THE INCIDENCE OF DIABETES MELLITUS IN THE REPUBLIC OF BELARUS

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Abstract: A retrospective analysis of the incidence of diabetes mellitus among the population the Republic of Belarus for 2018-2023 was carried out. Throughout the entire period of the study, the average value of the proportion of diabetes mellitus in the structure of the incidence of endocrine pathology among the population of the Republic of Belarus was 77.5%. Dynamics were analyzed, growth rates were calculated and the main trends in population morbidity were identified based on available statistical data.

Keywords: diabetes mellitus, incidence, growth rates, dynamics, structure.

Diabetes mellitus is one of the global problems of our time. It ranks ninth in the ranking of the most common causes of death after cardiovascular and oncological diseases and consistently holds the first place among the causes of blindness and kidney failure [1, 2]. In the Republic of Belarus, the number of people with diabetes has increased in 3 times over the past 20 years.

Throughout the entire study period, the average proportion of diabetes mellitus in the incidence of endocrine pathology was 77.5%.

When analyzing the long-term dynamics (2017-2023) of general and primary morbidity of the population of the Republic of Belarus with diabetes mellitus in general and its individual forms a steady trend towards an increase in morbidity was noted. The only exception was the general and primary morbidity of the child population with type 2 diabetes mellitus (unclear dynamics).

The growth rates of diabetes mellitus were considered. In 2018, the growth rates in the prevalence of the disease per 100 thousand child population was 2.28%, and in 2023 – 5.30%. For the adult population, these parameters in 2018 and 2023 were 10.73% and 4.99%, respectively. The growth rate of primary morbidity per 100 thousand population was 8.53% in 2018 and -2.50% in 2023 for the child population. In the case of the adult population, this parameter was 12.47% in 2018 and 11.89% in 2023.

The average annual overall incidence rate for adults and children was 4998.43 and 164.88, respectively, per 100 thousand people. The annual trend indicator – 164.04 and 11.64 per 100 thousand adults and children, respectively. It is noted that the overall incidence of diabetes mellitus in the adult population exceeds the incidence in children by more than 30 times.

Polyneuropathies, angiopathies and preproliferative retinopathy accounted for the largest share in the structure of complications resulting from diabetes mellitus in the adult population.

In 2017 and 2023, the largest share in the structure of adult treatment methods was taken only by hypoglycemic oral medications (68.73 and 77.26 %, respectively); for the child population, combination therapy (54.6%) in 2017 and insulin therapy (97.69%) in 2023.

Among people with diabetes, group 2 people with disabilities account for the largest proportion (on average, 56.6% during the study period), group 3 people with disabilities account for an average of 33.81% and group 3 – 9.59%. More than 95% of all people with disabilities due to diabetes mellitus are adults in the republic.

Diabetes mellitus differs from all other endocrine diseases in the frequency of development and severity of complications. High damage to public health and significant economic costs for expensive treatment of complications, rehabilitation of patients and the disabled determine diabetes mellitus in many countries, including Belarus, as national priorities among the most important health problems. In the Republic of Belarus, for the treatment and prevention of

diabetes mellitus, the state program "People's Health and Demographic Security" for 2021-2025 is currently being implemented, which will further reduce the number of cases.

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EFFECT OF TURMERIC EXTRACT FROM DIFFERENT MANUFACTURERS ON THE GROWTH OF COMMON BACTERIA

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As numerous studies have shown, the antibacterial activity of turmeric extracts and curcuminoids has a wide range of biological and pharmacological properties against various pathogenic and opportunistic microbes

Keywords: turmeric, curcuminoids, disco-diffusion analysis, Staphylococcus aureus, Escherichia coli.

Curcumin ((1E,6E)-1,7-bis-(4-hydroxy-3-methoxyphenyl)-hepta-1,6-diene-3,5-dione) is one of the main active ingredients of turmeric extract. Curcumin is a mixture consisting mainly of three hydrophobic curcuminoids, namely demethoxycurcumin (DMC), bisdemethoxycurcumin (BDMC), and curcumin in a ratio of 17:3:77 [1].

Curcumin's beneficial properties are significantly hampered by its color, poor water solubility, and low bioavailability. By its nature, the polyphenol is poorly absorbed when taken orally and has low bioavailability, partly due to its slow intestinal absorption rate and partly due to rapid metabolism (glucuronidation), which limits its clinical use.

Increasing bioavailability can lead to a reduction in the therapeutic dose of the main drug, decreased toxicity and side effects, as well as increased efficacy, decreased resistance, and reduced raw material requirements for drug production. Piperine is used as a well-known adjuvant to enhance the bioavailability of curcumin. Piperine enhances and supports the analgesic and anti-inflammatory effects of curcumin [2].

The test substances were aqueous and alcoholic extracts of pure Austrian, Uzbek, and Indian turmeric, as well as extracts of the previously mentioned turmeric mixed with black pepper in a 1:1 ratio.

The following antibiotics were used as control disks for the disk diffusion assay: ampicillin for E. coli and oxacillin for St. aureus. Ampicillin and oxacillin were selected based on literature data on the susceptibility of microorganisms to these antibiotics. Antibiotic activity was assessed based on the phenomenon of growth inhibition around the disk. The diameter of the growth inhibition zones around the disks was determined using a ruler, including the diameter of the disk itself.

Unlike aqueous extracts, ethanol extracts of turmeric demonstrated antibacterial activity against Staphylococcus aureus and E. coli in the overwhelming majority of cases, demonstrating the effective use of ethanol as a solvent.

The highest antibacterial activity was demonstrated by ethanol extracts of turmeric and a turmeric-pepper mixture produced in India. For Staphylococcus aureus, the inhibition zones averaged 20 and 23 mm in diameter, respectively. For E. coli, the zones were 18 and 30 mm.

Alcohol extracts of Uzbek turmeric demonstrated greater antibacterial activity against E. coli than against Staphylococcus aureus. The inhibition zones for E. coli were 17 and 14 mm in diameter, respectively. The inhibition zones for Staphylococcus aureus were 10 and 11 mm in diameter, respectively. Austrian turmeric demonstrated moderate activity against E. coli (inhibition zones of 10 and 15 mm). Staphylococcus aureus was relatively resistant to the Austrian powder (inhibition zones of 10 and 7 mm in diameter).

The use of piperine to enhance the antibacterial activity of turmeric extracts is currently inadvisable. The obtained results do not prove that the extracts increase their effectiveness against bacteria.

The study, the results of which are presented in this paper, is aimed at studying the antibacterial properties of alcoholic extracts of turmeric from various manufacturers, which in the future can be used as antibacterial substances in medicine and various industries, such as food and chemical.

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APPLICATION OF CHITOSAN-BASED BIOPOLYMERS IN MEDICAL ECOLOGY

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In modern medical ecology, special attention is given to studying the effects of biomaterials and nanostructures on human health and the state of the environment. One of the most promising areas is the use of naturally derived biopolymers. Chitosan exhibits high biocompatibility, non-toxicity, and pronounced sorption and antimicrobial properties. Thanks to these characteristics, chitosan is widely considered as a basis for the development of new medical and environmentally safe materials.

Keywords: chitosan, biopolymers, medical ecology, biosorption, nanomaterials, biosafety, biocompatibility, bioremediation.

Chitosan is obtained by partial deacetylation of chitin, a structural polysaccharide of the exoskeleton of crustaceans, arthropods, and fungal cell walls. Due to its cationic nature and ability to bind negatively charged molecules, it is actively used in medical ecology for the biosorption of toxicants, purification of biological fluids, neutralization of radionuclides, and creation of biocompatible nanomaterials.

At the molecular level, the amino groups of chitosan can undergo protonation at physiological pH values, enabling interactions with cell membranes, microbial walls, and heavy metal ions. These properties allow chitosan to be applied as a biosorbent in purification systems for biological media (blood, plasma) as well as in filtering systems for removing radionuclides and toxic compounds.

In medical practice, chitosan is used for biodegradable coatings of implants that accelerate tissue regeneration, antimicrobial dressings, hydrogels for wounds, and drug delivery carriers. At the cellular level, chitosan molecules can form thin biofilms that exhibit antiseptic and healing properties, accelerating tissue regeneration and preventing secondary infections. Thanks to its biocompatibility and degradability by lysozyme, chitosan materials do not elicit an immune response and provide accelerated tissue regeneration.

A promising direction is the development of chitosan nanocomposites with incorporated silver, copper, and zinc oxide nanoparticles, which exhibit prolonged antiseptic effects and provide localized therapeutic activity without systemic toxicity. Furthermore, chitosan is actively studied in tissue engineering, bioindication, and biomonitoring, where it serves as a carrier for biosensor systems that detect changes in internal organism parameters.

From an ecological perspective, chitosan is a safe alternative to synthetic polymers: it is biodegradable, does not form toxic metabolites, and is produced from seafood waste, making the process environmentally rational and economically advantageous. Current research focuses on optimizing chitosan’s molecular weight, degree of deacetylation, and nanostructuring, as well as chemical modification with functional molecules to expand its applications in medicine and ecology.

Thus, chitosan-based biopolymers form a scientific and technological platform for medical ecology, combining the properties of a sorbent, biomaterial, and ecological detoxifier. High chemical adaptability, antimicrobial activity, non-toxicity, and modifiability make chitosan a key component in the development of biocompatible and environmentally safe nanomaterials for medicine and sanitary biotechnology.

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PROPAEDEUTIC ASSESSMENT OF THE EFFECTS OF HOUSEHOLD TOXICANTS AND THEIR RELATIONSHIP TO THE GENERAL STATE OF HUMAN HEALTH

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The modern urbanized environment is saturated with household sources of toxic compounds that have a chronic effect on the human body. A propaedeutic assessment of their effects makes it possible to identify early functional disorders and prevent the development of intoxication.

Keywords: household toxicants, propaedeutic assessment, chronic intoxication, biomonitoring, free radical processes, endocrine disruptors, preventive medicine, chemical safety.

The modern urbanized environment is characterized by a high chemical load due to household sources of toxic compounds. The most common are organic solvents, aromatic hydrocarbons, aldehydes, phenols, phthalates, bisphenol A, synthetic surfactants, and heavy metals. They are part of paint and cleaning products, cosmetics, polymers, furniture and building materials, and are present in the air, dust, and water of residential environments [1].

Chronic exposure to toxicants causes cumulative effects, manifested by impaired metabolic, neurohumoral, and immunobiological processes. The routes of entry of toxicants into the human body include inhalation, percutaneous and oral, which contributes to their bioaccumulation. The pathogenetic mechanism of toxic effects is associated with the activation of free radical processes and an imbalance between the pro-oxidant and antioxidant systems, which causes lipid peroxidation, membrane damage and destabilization of mitochondria. The activity of xenobiotic biotransformation enzymes is inhibited and the functioning of liver cytochrome systems is disrupted. Endocrine-disrupting compounds interact with hormonal receptors, causing dysregulation of reproductive and metabolic functions, and heavy metals have a neurotoxic effect, disrupting hematopoiesis, as well as calcium and enzyme metabolism [2,3].

Epidemiological studies in recent years have indicated a significant correlation between prolonged exposure to low doses of household toxins and an increased prevalence of allergic, autoimmune, metabolic, and endocrine disorders [1].

Propaedeutic assessment of the effects of household toxicants is a system of early diagnosis of functional disorders that precede the clinical development of intoxication. It is based on the integration of laboratory, biochemical and instrumental research methods. The preventive direction of propaedeutic medicine involves minimizing contact with potential toxicants and developing a safe strategy for their use in everyday life. Effective measures are the replacement of chemically active agents with environmentally friendly analogues [3].

Thus, propaedeutic assessment of the effects of household toxicants is a key element of the preventive medicine system aimed at preventing chronic intoxication and related metabolic and neurohumoral disorders. The complex application of biomonitoring and functional diagnostic methods allows timely identification of risks and corrective measures before the formation of clinically pronounced diseases [1-3].

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EFFECT OF AIR POLLUTION ON DEVELOPMENT OF BRONCHIAL ASTHMA

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During the analysis of literature data, the influence of atmospheric air pollution on the state of human respiratory system and development of bronchial asthma was considered. The main mechanisms of influence of harmful substances on bronchi and their role in formation of inflammatory processes are disclosed. There is a need to improve the environmental situation as an important area for the prevention of respiratory diseases.

Keywords: bronchial asthma, air pollution, respiratory system, prevention.

Bronchial asthma is a chronic disease of the respiratory system, in which there is inflammation and narrowing of bronchi. The main manifestations of the disease are cough, wheezing and difficulty breathing. Among the factors contributing to the development of asthma, air pollution occupies a special place - one of the most serious environmental problems of our time [1,2].

Polluted air has an adverse effect on the respiratory organs. Harmful substances accumulate in the urban atmosphere: sulphur dioxide, nitrogen oxides, carbon monoxide, ozone, suspended particles of dust and soot. These compounds are formed during the combustion of fuel in transport and factories, as well as during operation of heating systems [1,3].

When breathing in polluted air, the smallest particles enter the respiratory tract and settle on the mucosa of the bronchi. As a result, irritation and inflammation develop, the work of the returned epithelium is disrupted, which cleans the respiratory tract from dust and microorganisms. The constant exposure of pollutants leads to an increased sensitivity of bronchi - they begin to respond with spasm even to minor irritants [4].

In addition to direct toxic action, polluted air amplifies allergic reactions. Dust particles and exhaust gases can bind to allergens, making them more active. This is especially dangerous for children and people with low immunity. Prolonged stay in a polluted environment contributes not only to the development of asthma, but also to the exacerbation of already existing forms of disease.

The problem is exacerbated in large cities, where concentrations of harmful substances in the air are well above safe levels. Residents of mega-cities more often complain of chronic cough, increased fatigue, feeling of lack of air. All this points to a direct link between the state of the environment and human health.

For prevention, it is important to reduce the amount of emissions into the atmosphere, develop environmentally friendly technologies, increase the number of green areas. It is also recommended to use personal protective equipment, monitor the quality of the air and limit outdoor exposure during periods of heavy pollution [1,2].

Thus, air pollution has a significant impact on the development of bronchial asthma. It causes inflammatory changes in the airways, exacerbates allergic reactions and increases the frequency of seizures. Improvement of the environmental situation, control of emissions and increase of ecological literacy of the population are important conditions for health preservation and prevention of bronchial diseases.

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PHYSIOLOGICAL ROLE OF HORMONES IN THE REGULATION OF METABOLISM AND PROTEIN SYNTHESIS

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Hormones serve as key regulators, integrating metabolic pathways and protein biosynthesis processes to maintain systemic homeostasis. This article reviews current understanding of the mechanisms of hormonal control over energy and protein metabolism. Particular attention is paid to the roles of insulin, glucagon, growth hormone, and thyroid hormones. Furthermore, it addresses the question of how environmental factors, such as endocrine disruptors, can disrupt these delicate mechanisms, posing new challenges for human health and ecosystems.

Keywords: hormonal regulation, metabolism, protein synthesis, insulin, glucagon, endocrine disruptors, environmental physiology.

The complex network of endocrine regulation serves as the foundation for maintaining metabolic equilibrium in the body. Hormones act as systemic coordinators, enabling adaptation to changes in nutrition, physical activity, and stress. In recent decades, it has become evident that external environmental factors can interfere with these processes, disrupting the delicate hormonal balance [1].

Current research confirms that the maintenance of energy homeostasis is achieved through the coordinated action of antagonistic hormones. Insulin, secreted by the β-cells of the pancreas, not only stimulates glucose utilization but also acts as a central regulator of anabolic processes, suppressing lipolysis and gluconeogenesis [2]. Its main antagonist, glucagon, activates the mobilization of energy substrates through cAMP-dependent signaling pathways in the liver.

Thyroid hormones (T3 and T4) regulate basal metabolic rate by affecting mitochondrial biogenesis and oxidative phosphorylation. Studies show that they activate nuclear receptors (TRα and TRβ), which act as transcription factors, modulating the expression of genes involved in metabolism [3]. Cortisol, in turn, facilitates adaptation to long-term stress by reprogramming metabolism towards catabolism and gluconeogenesis.

The anabolic effects of somatotropin (growth hormone) are mediated by insulin-like growth factors (IGF-1), whose synthesis is stimulated in the liver. The GH/IGF-1 complex activates the PI3K/Akt/mTOR signaling cascade, which is a central regulator of translation and protein synthesis in skeletal muscle and other tissues [4].

Insulin potentiates this process by enhancing amino acid uptake and initiating translation. Sex hormones contribute in a tissue-specific manner: testosterone enhances muscle protein synthesis through androgen receptors, while estrogens modulate gene expression in reproductive tissues.

In the modern environment, the classical view of hormonal regulation is now complemented by an understanding of the influence of anthropogenic factors. Chemicals known as endocrine disruptors (EDs), such as bisphenol A (BPA), phthalates, and certain pesticides, can mimic or block the action of natural hormones.

For instance, it has been shown that BPA can interact with estrogen receptors, disrupting lipid metabolism regulation and contributing to the development of insulin resistance [5]. Exposure to perfluoroalkyl substances (PFAS) is associated with impaired thyroid function, which can lead to shifts in basal metabolism and thermogenesis [1]. These environmental interferences create a constant background burden that disrupts the delicate mechanisms of hormonal regulation, potentially having long-term consequences for population health.

Thus, hormones form an integrated system that precisely calibrates metabolism and protein synthesis according to the body's needs. However, in the modern world, this system faces new challenges in the form of environmental chemical pollutants. Further research at the intersection of endocrinology and environmental medicine is necessary to develop strategies for protecting human health and the integrity of ecosystems from the consequences of hormonally-mediated disruptions induced by environmental factors.

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EFFECT OF SUGAR CONSUMPTION ON HUMAN HEALTH

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This article examines the effects of sugar on the human body, the risks associated with excess consumption, and suggests ways to reduce its intake in the diet.

Keywords: sugar, health, glucose, fructose, sucrose, metabolism

Sugar is an essential part of many people's diets. It adds flavor and pleasure to our lives, but excessive consumption can have serious health consequences.

Sugar is a general term for sweet, soluble carbohydrates, primarily simple sugars: glucose (the primary source of energy for cells), fructose (fruit, honey, corn syrup), sucrose (table sugar, glucose + fructose), and lactose (milk). It is found in both obvious sources (candy, cakes, soda, juices, sugary cereals) and hidden sources (bread, sauces, yogurts, processed foods).

Sugar has a number of negative health effects: it disrupts metabolism (glucose spikes, insulin resistance, fat accumulation, increased triglycerides/LDL), causes type 2 diabetes (insulin resistance, pancreatic dysfunction), increases the risk of cardiovascular disease (vascular inflammation, atherosclerosis, high blood pressure), leads to obesity (high calorie content, lack of satiety), causes dental problems (caries), worsens skin condition (glycation, collagen/elastin damage, acne), affects mental health (mood swings, depression, anxiety), and increases the risk of certain cancers.

To reduce sugar intake:

1. Read labels (pay attention to the sugar content of foods and drinks. Look for low-sugar or no-added-sugar alternatives)
2. Limit sugary drinks (replace with water/tea)
3. Cook at home (control ingredients)
4. Choose whole foods (fruits, vegetables, grains)
5. Use natural sweeteners (stevia, erythritol)
6. Be aware of hidden sources (sauces)
7. Increase fiber intake (slows sugar absorption)
8. Develop taste preferences (get used to less sweet things).

In conclusion, moderate sugar consumption is acceptable, but excess sugar leads to serious problems (diabetes, heart disease, obesity, tooth decay). Reducing sugar intake and switching to healthy alternatives improves health.

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ANTIBACTERIAL ACTIVITY OF BAZIRON AGAINST CUTIBACTERIUM ACNES (PROPIONIBACTERIUM ACNES) AND STAPHYLOCOCCUS EPIDERMIDIS

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The thesis presents the results of a study of literature data on the antibacterial activity of the drug for the treatment of acne Baziron AC, manufactured by Galderma laboratories, France, against Cutibacterium acnes (Propionibacterium acnes) and Staphylococcus epidermidis.The main component of baziron is benzoyl peroxide, which exhibits diverse biological activity, including bactericidal and bacteriostatic properties. The drug's antimicrobial activity, superior to that of topical antibiotics, and the absence of resistance make Baziron AC a recommended first-line treatment for papulopustular acne.

Keywords: Baziron, benzoyl peroxide, acne.

Acne (Acne vulgaris) is one of the most common chronic inflammatory skin diseases, affecting up to 90% of adolescents and young adults and a significant proportion of the adult population, primarily women. The disease negatively impacts patients' quality of life, causing psychoemotional disorders, social maladjustment, and the development of persistent cosmetic defects.[1]

Let's take a closer look at the antibacterial and anti-inflammatory properties of benzoyl peroxide.

1. Bactericidal efficacy (kills bacteria): Benzoyl peroxide is a powerful oxidizing agent. Upon contact with the skin, it breaks down, forming oxygen free radicals that literally "explode" the cell walls and membranes of Cutibacterium acnes (Propionibacterium acnes). This action leads to the rapid and immediate death of bacteria. Benzoyl peroxide acts as a non-specific antiseptic, meaning it can also kill other bacteria on the skin's surface.[2]

2. Bacteriostatic activity (inhibition of bacterial growth): The direct bacteriostatic activity of BPO is not its primary function, but its continued use creates an environment on the skin that is hostile to the growth of C. acnes. By destroying the bulk of bacteria, BPO prevents the remaining individual bacteria from actively multiplying and reaching numbers sufficient to cause inflammation. A key aspect associated with growth suppression is the lack of resistance. Unlike antibiotics, bacteria do not develop resistance to BPO, making it an exceptionally valuable agent for long-term therapy and relapse prevention.[2]

3. Keratolytic and comedolytic action: Benzoyl peroxide promotes exfoliation of dead skin cells and opens pores, preventing the formation of new comedones (blackheads and whiteheads).[3]

4. Anti-inflammatory action: Benzoyl peroxide is capable of moderately suppressing inflammatory reactions.[3]

Baziron also has side effects. All adverse reactions identified during clinical trials are associated with disorders of the skin and subcutaneous tissues. Dry skin, erythema, scaling (desquamation), and a burning sensation are very common; itching, pain, tingling, and contact dermatitis are common; Uncommon: allergic contact dermatitis. All adverse reactions are reversible with reduced frequency of use or discontinuation of treatment.

Baziron AC is a highly effective foundation drug for the treatment of moderate acne. Its antimicrobial activity, superior to that of topical antibiotics, and the absence of resistance development make it suitable for use as a primary treatment for grades II and III acne. The ACAP-glycerin system absorbs excess sebum, while the gradually released glycerin helps soften and moisturize dry and sensitive skin.

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INFLUENCE OF HEAVY METALS ON THE DEVELOPMENT OF ENDOMETRIOSIS

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The article focuses on studying the impact of heavy metals and dioxins on the development of endometriosis – a chronic condition affecting women of reproductive age. It examines ecological factors that can disrupt hormonal balance and immune function, potentially contributing to the progression of this pathology.

Keywords: endometriosis, heavy metals, dioxins, ecology, female fertility, hormonal disorders, cadmium, mercury, lead, arsenic.

Relevance of the topic: Endometriosis is one of the leading causes of female infertility, and its connection to environmental pollution requires special attention. The rise of industrialization and the accumulation of toxic substances in the body make this issue particularly significant for modern medicine and ecology.

Endometriosis is a condition in which cells from the inner lining of the uterus grow beyond its boundaries. These clusters of cells are referred to as lesions. During menstruation, endometriosis lesions become inflamed and increase in size, causing severe pain and discomfort. It is most commonly seen in women of reproductive age between 25 and 44 years. Without treatment, it can lead to infertility and the development of cancer.

Endometriosis arises from complex pathological processes occurring within the body. The disease disrupts the body's systems (endocrine, immune, etc.). The exact cause of endometriosis is unknown; however, there are several factors that may trigger this condition, one of which is environmental [2].

Heavy metals are naturally occurring and necessary for life, but they can become toxic as they accumulate in organisms [1]. The most common heavy metals include arsenic, cadmium, chromium, copper, nickel, lead, and mercury. UNEP considers mercury, lead, and cadmium to be the most dangerous heavy metals due to their ability to travel long distances through the air.

Based on known negative effects of heavy metals on female fertility, a Chinese study published in the journal Environmental Science in 2023 found that women with the highest levels of cadmium and lead in their blood were three times more likely to suffer from endometriosis compared to those with the lowest levels [3]. Similarly, endometriosis was five times more prevalent among women with the highest levels of arsenic and 13 times more common among those with the highest levels of mercury. Lead, arsenic, cadmium, and mercury are known endocrine disruptors. They have widespread effects on the reproductive system, including menstrual cycle irregularities, adverse pregnancy outcomes, DNA damage and mitochondrial dysfunction, and an increased risk of breast and endometrial cancer.

It is possible that heavy metals interact with estrogen receptors in the body, stimulating the growth of endometriosis-like cells outside the uterus and generally worsening endometriosis symptoms.

The effects of the dioxin 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) have also been studied. Experiments on primates showed that TCDD affects the reproductive system, increasing the prevalence and severity of endometriosis. Further animal studies indicated that dioxins and dioxin-like compounds could induce this disease. Research on rodents supports the likelihood that environmental pollutants may play a role in the pathophysiology of endometriosis. Dioxins can accumulate in the body over long periods and affect the immune system, hormonal balance, and other biological processes [4]. Some studies have shown that women exposed to dioxins have an increased risk of developing endometriosis.

Thus, exposure to heavy metals and dioxins may play a significant role in the pathogenesis of endometriosis. These substances disrupt hormonal balance, immune mechanisms, and reproductive function, contributing to the development and progression of the disease. Given the increasing environmental burden, it is important to consider the impact of toxicants when diagnosing and preventing endometriosis.

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COMPARATIVE ANALYSIS OF DISEASE-FREE SURVIVAL IN PATIENTS WITH DIFFERENT MOLECULAR-BIOLOGICAL SUBTYPES OF BREAST CANCER

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In this study, clinical data from 124 patients with a confirmed molecular-biological subtype of breast cancer, as well as the stage and degree of tumor differentiation, were analyzed. A comparative assessment of disease-free survival among patients with different molecular-biological subtypes of breast cancer was carried out, and it was found that no statistically significant differences were observed for this parameter.

Keywords: breast cancer, disease-free survival, immunohistochemical method, luminal A, luminal B (Her-2−), luminal B (Her-2+), Her-2 positive, triple-negative, molecular-biological subtype.

Breast cancer (BC) is a heterogeneous disease and one of the major challenges of clinical oncology [1]. According to the Belarusian Cancer Registry, the annual increase in BC incidence is 1.2–1.5%, making it the most common oncological pathology among women. In modern oncology, five molecular-biological subtypes are used for diagnosis and treatment planning: luminal A is characterized by high expression of estrogen (ER) and progesterone (PR) receptors, lack of Her2/neu expression, and low Ki-67 expression (<20%); luminal B (Her-2−) is defined by the absence of Her-2/neu expression combined with either lack of PR expression or elevated Ki-67 (>20%); luminal B (Her-2+) is characterized by decreased expression of ER and PR (<20%) and overexpression of HER2 receptors; Her-2 positive (non-luminal) subtype demonstrates negative ER and PR expression, positive Her-2/neu expression, and any level of Ki-67; triple-negative subtype is defined by lack of ER, PR, and Her-2/neu expression and overexpression (>50–90%) of Ki-67 [2].

The study material consisted of clinical data and tumor tissue from 124 female patients with BC aged 27–85 years who received treatment at the N.N. Alexandrov National Cancer Centre of Belarus.

According to the results of previously conducted immunohistochemical studies, patients with breast cancer were divided into five molecular-biological subtypes. For each group, tumor stage and disease-free survival were analyzed.

In patients with the luminal A subtype (33.9% of cases), the stage distribution was as follows: stage I – 23.8%, stage II – 35.7%, stage III – 33.3%, stage IV – 7.1%. Disease-free survival for this subtype was 73.5 [51; 88]. The luminal B (Her-2−) subtype was identified in 29% of patients: stage I – 19%, stage II – 38%, stage III – 29%, with a median survival of 71 [38.5; 84.5]. The luminal B (Her-2+) subtype was detected in 9.7% of cases: stage I – 17%, stage II – 5%, stage III – 5%. Disease-free survival was 79 [76; 84]. The Her-2 positive subtype was identified in 7.3% of patients: stage I – 2%, stage II – 14%, stage III – 5%, with a median survival of 79 [70; 82]. The triple-negative breast cancer subtype accounted for 20.2% of all molecular subtypes: stage I – 7%, stage II – 33%, stage III – 19%. Disease-free survival was 70 [44; 85]. Comparative analysis revealed that disease-free survival in luminal A patients was 1.03 and 1.05 times higher than in patients with luminal B (Her-2−) and triple-negative subtypes, respectively. The median survival was 1.07 times higher in luminal B (Her-2+) and Her-2 positive subtypes compared to luminal A. Disease-free survival in luminal B (Her-2−) was 1.11 times higher than in Her-2 positive and luminal B (Her-2+) subtypes. The triple-negative subtype demonstrated 1.014 times lower disease-free survival compared to luminal B (Her-2−).

No significant differences were observed between Her-2 positive and luminal B (Her-2+) subtypes, whereas disease-free survival in these groups was 1.13 times higher than in the triple-negative subtype. Statistical analysis revealed no

significant correlations (p (Mann–Whitney) > 0.05) between disease-free survival and molecular-biological subtypes of breast cancer.

Thus, the obtained data indicate that the molecular-biological subtype of the tumor does not have a statistically significant effect on disease-free survival in breast cancer patients, but may serve as an additional marker of tumor aggressiveness to be considered when choosing a treatment strategy.

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RETROSPECTIVE ANALYSIS OF THE INCIDENCE OF CIRCULATORY DISEASES IN THE GORETSKY DISTRICT

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Abstract: The work is devoted to a retrospective analysis of the incidence of cardiovascular diseases in the population of the Goretsky district for the period 2016 - 2023: extensive and intensive coefficients, growth rates of primary and general morbidity were calculated, a comparative analysis of the incidence of the working-age population of the district and the population older than working age was carried out.

Keywords: cardiovascular diseases, risk factors, morbidity.

Cardiovascular diseases remain a major health problem in most countries worldwide. In particular, 4 million people die from cardiovascular diseases in Europe each year. A key indicator of all-cause mortality is the proportion of deaths from cardiovascular diseases, which in the Republic of Belarus amounted to 55.9%, compared to 47% in Europe.

Among people of working age, who bear the brunt of the gross domestic product (GDP), the wealth of which determines the nation's well-being, circulatory diseases account for more than one-third of all deaths. Moreover, the mortality rate for men is 4.7 times higher than for women overall, from coronary heart disease (CHD) by 7.2 times, from myocardial infarction by 9.1 times, and from cerebrovascular diseases by 3.4 times. Despite the fact that mortality rates have declined in developed countries, and in recent years in Belarus as well, the situation in our country remains extremely serious, as highlighted in numerous domestic and international publications.

When analyzing the structure of morbidity of the population of the Gorki district with cardiovascular diseases, it was noted that in 2016, in the structure of the general morbidity of the population of the district with diseases of the cardiovascular system, 60.08% accounted for arterial hypertension (first place), in second place was ischemic heart disease - 22.81%, cerebrovascular diseases accounted for 9.75%, cerebral infarction - 1.17% and myocardial infarction - 0.6%.

In 2023, in the structure of the general incidence of cardiovascular diseases in the district, arterial hypertension also occupied the first place (67.56%), ischemic heart disease was in second place - 20.03%, cerebrovascular diseases accounted for 2.91%, myocardial infarction - 0.41% and cerebral infarction - 0.32%.

Thus, in the Gorki District, circulatory diseases are one of the main causes of permanent disability and mortality. The main causes are diseases characterized by high blood pressure, coronary heart disease, and cerebrovascular diseases.

Over the study period, a steady increase in the overall incidence of coronary heart disease and a moderate increase in the incidence of arterial hypertension, as well as a moderate decrease in the overall incidence of cerebrovascular diseases, were identified in the Gorki District population.

Statistically significant differences in the incidence rates of cardiovascular diseases between the working-age population of the district and the population of post-working age for the period from 2016 to 2023 with a probability of $p < 0.001$ were found for the overall incidence of circulatory diseases, arterial hypertension, coronary heart disease, and

cerebrovascular diseases, as well as for the primary incidence of cerebrovascular disease, myocardial infarction, and cerebral infarction, and with a probability of $p < 0.05$ for the primary incidence of coronary heart disease.

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IMMUNOHISTOCHEMICAL DETERMINATION OF THE EXPRESSION OF INDIVIDUAL TISSUE ANTIGENS IN GASTROINTESTINAL STROMAL TUMORS

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Every year, 15 cases of GIST are diagnosed in the world per million population, of which up to 30% are malignant with the presence of metastases mainly within the abdominal cavity and liver, which is 0.1–3% of all gastrointestinal malignancies [2]. Currently, there are no reliable epidemiological data on the incidence of GIST in the Republic of Belarus, which is due to the limited level of awareness and diagnostic alertness of clinical morphologists and oncologists.

Keywords: Gastrointestinal stromal tumors, immunohistochemical study, CD117, CD34, markers, gastrointestinal tract.

Gastrointestinal stromal tumors (GIST) are mesenchymal neoplasms of the gastrointestinal tract that arise from interstitial Cajal cells or their precursors, which have a pronounced activity of the KIT protein (CD117) or mutations in the KIT or PDGFRA (CD140a) genes, which leads to uncontrolled proliferation of these cells [1]. To make a morphological diagnosis of GIST, it is mandatory to perform an immunohistochemical study. The main IHC markers used to differentiate HISO from other non-epithelial gastrointestinal tumors are KIT (CD117), DOG-1, and protein kinase C-theta (PKC-theta). GISO treatment is complex and includes a surgical approach and drug therapy [3].

The study material was tumor tissue of 25 patients suffering from mesenchymal neoplasms of the gastrointestinal tract, abdominal cavity, retroperitoneal space and small pelvis, who received special treatment in the oncogynecological department of the State Institution "Republican Scientific and Practical Center of Oncology and Medical Radiology named after N. N. Alexandrov". The study methods were immunohistochemical determination of the expression of stem cell markers (CD117) and endothelial cells (CD34). The immunohistochemical study was performed on sections of tumor tissues fixed in paraffin blocks and intended for routine morphological examination. Sample preparation included dewaxing and rehydration of sections in accordance with the standard protocol. The degree of expression intensity of the immunohistochemical marker was evaluated semi-quantitatively on a four-point scale, depending on the intensity of staining.

As a result of preliminary data obtained from an immunohistochemical study of patients suffering from GISO, we found that CD117 overexpression was detected in 48% of cases, moderate-in 32%, hypo expression-in 16%, and lack of expression was detected in 4 % of cases. Immunohistochemical determination of CD34 expression showed that hyperexpression was detected in 56% of cases, moderate-in 12%, hypo expression-in 4%, and lack of expression was detected in 28% of patients.

Thus, in the studied 96% of gastrointestinal stromal tumors, a focal or diffuse positive reaction to CD117 was detected. A positive response to the CD34 marker was observed in 72% of gastrointestinal stromal tumors. The study continues.

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EFFECTS OF THE HEAVY METAL LEAD ON THE HUMAN BODY

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Abstract: Ecological pollution with lead has a serious impact on the human nervous system, causing: a decrease in intelligence, a decrease in physical activity, hearing impairment, and disruption of the cardiovascular system. This is especially reflected in the state of health of children, who are most susceptible to lead poisoning. Therefore, the development of aspects of environmental protection requires the strengthening of fundamental research aimed at studying the mechanisms of the relationship of living organisms with lead.

Keywords: lead, organism, environment.

Lead is a toxic metal that is widely distributed in the earth's crust. Its widespread use in industry has led to widespread environmental pollution, lead exposure to the human body, and serious public health problems in many regions of the world.

The lion's share of lead consumed worldwide comes from the production of lead-acid batteries for motor vehicles. However, lead is also used in many other products (pigments, paints, solder, stained glass, stained glass, stained glass, lead crystal utensils, ammunition, ceramic glaze, jewelry, toys), as well as in some folk cosmetics or some traditional medicine in India, Mexico, Vietnam and a number of other countries. Lead can enter drinking water coming through lead pipelines or pipes welded with lead solder. Lead causes long-term damage in adults, including an increased risk of high blood pressure, cardiovascular disease, and kidney damage. Once in the body, lead is concentrated in various organs: in the brain, kidneys, liver and bone tissue. Over time, lead accumulates in the teeth and bones. High concentrations of lead in pregnant women can cause miscarriages, stillbirths, preterm birth and low birth weight. Young children are especially vulnerable to lead poisoning, since compared to adults, their body absorbs 4 to 5 times more lead that enters the gastrointestinal tract from one source or another. In high concentrations, lead leads to serious damage to the brain and central nervous system, which can be accompanied by coma, convulsions and even death. Children who have suffered severe lead poisoning may experience irreversible mental retardation and behavioral disorders. Increased lead content in the body can lead to toxicity and contribute to the development of kidney failure, neuropathy, osteoporosis, atherosclerosis, nephropathy, and dysfunctions of the gastrointestinal tract. Also, a strong excess of the element in the body causes such a dangerous disease as encephalopathy. At lower concentrations that do not cause any obvious symptoms, lead affects a number of body systems. Lead exposure causes anaemia, hypertension, kidney failure, immune toxicosis and reproductive toxicity. The neurological and behavioural effects of lead exposure are considered irreversible. Malnourished children are more exposed to lead because, due to a lack of other micronutrients, such as calcium or iron, their body absorbs more lead. There is no safe concentration of lead in the blood; Even as low blood lead as 3.5 μg/dL can cause mental decline, behavioral disorders, and learning difficulties in children [1].

Studies show that lead does not perform any biological function in the human body and affects almost all organs and systems.

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PROSPECTS FOR THE USE OF SQUALENE IN TYPE 2 DIABETES

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Abstract: The pharmacological activity of squalene as a drug for the treatment of type 2 diabetes has been analyzed. It has been proved that squalene, due to its antioxidant and membrane-stabilizing properties, is able to protect the islets of Langerhans, demonstrate antihyperglycemic and anti-inflammatory effects, improve the function of pancreatic β cells, and can be considered as a promising compound for the treatment of T2DM.

Keywords: squalene, insulin, diabetes mellitus.

Squalene, derived from shark liver, has become known as an anti-cancer drug as a drug. Further studies have also shown the presence of cardioprotective, antibacterial, antifungal, detoxifying, antioxidant and, very importantly, antidiabetic properties for this drug. Type 2 diabetes, characterized by elevated blood glucose, insulin resistance, and relative insulin dysfunction, is now showing signs of a pandemic. The antidiabetic properties of squalene were studied in comparison with metformin, which also has significant side effects. Importantly, in clinical and preclinical trials, intravenous administration of squalene emulsion has been shown to be safe and well tolerated. The effect of squalene and metformin on the state of pancreatic cells in diabetic rats caused by the administration of low doses of STD (30 mg/kg body weight) was investigated. Histopathological examination of the pancreas revealed that control rats without diabetes lacked degenerated alpha and beta cells. In contrast, diabetic rats showed a significant decrease in the volume and number of islets. In rats treated with squalene, islet cells acquired a normal appearance and size. Similar differences in histopathological sections of pancreatic tissues were found in the groups of healthy people and patients with diabetes. Administration of squalene to diabetic patients resulted in a significant improvement in β cell size.

Dipeptidyl peptidase-4 (DPPIV) is an important enzyme that regulates insulin production by deactivating GLP-1, an incretin capable of regulating insulin secretion after meals. DPPIV enzyme inhibitors are used to treat diabetic conditions. In the experiment, it was found that in a group of rats with developed insulin resistance due to HFD ((high-fat diet) feeding, the activity of the DPPIV enzyme decreased as a result of taking squalene. In patients with diabetes, a similar effect of squalene inhibiting the activity of the DPPIV enzyme was revealed. In diabetes , the administration of squalene resulted in lower levels of glucose, leptin, cholesterol and triglycerides, as well as less weight gain. This is consistent with the action of metformin and is indicative of modulation of leptin and insulin signaling. The antioxidant effect of squalene was manifested through an increase in superoxide dismutase (SOD) activity and a decrease in lipid peroxidation (MDA β). reducing the production of ROS and pro-inflammatory cytokines (IL-6, IL-1β, TNF-α, NF-κB) and increasing the levels of anti-inflammatory IL-10, IL-13, IL-14 [1]. Patients taking squalene also showed significant changes in other health-related parameters, including systolic and diastolic blood pressure, blood urea nitrogen (BUN), albumin, transforming growth factor beta 1 (TGFbeta1), and creatinine levels [2]. Discovered antiatherosclerotic effect of squalene was realized due to its ability to increase HDL cholesterol levels, regulate lipid metabolism in the liver.

Thus, squalene, due to its antioxidant and membrane-stabilizing properties, is able to protect the islets of Langerhans, demonstrate antihyperglycemic and anti-inflammatory effects, improve the function of pancreatic β cells, and can be considered as a promising compound for the treatment of T2DM.

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CHARACTERISTIC OF POLLUTANTS IN THE ATMOSPHERIC AIR OF BELARUS

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This article reviews the pollutants present in the regional cities of the Republic of Belarus based on data from the National Statistical Committee and the Ministry of Natural Resources and Environmental Protection. Indicators such as the annual mean concentration of PM10, SO_2, CO and NO_2 characterize the state of the environment in terms of air quality and the negative impact of elevated concentrations of pollutants on public health.

Keywords: pollutants, air, Belarus, sulfur dioxide, carbon monoxide, nitrogen dioxide

The health of the urban ecosystem is the foundation of a country's sustainable development. The main environmental problems facing cities include air, water, and soil pollution from industrial emissions, transport, and waste. In addition, problems include noise and heat pollution, as well as soil and biodiversity degradation due to dense development and unsustainable land use. Characteristics of air pollutants in large regional cities is crucial for assessing the impact of anthropogenic emissions on the urban ecosystem and human health.

The aim of the work was to conduct a comparative analysis of the state of atmospheric air in regional cities of the Republic of Belarus according to data from the National Statistical Committee and the Ministry of Natural Resources and Environmental Protection for 2023 and 2024. The main pollutants considered were annual mean concentrations of microscopic particles with a diameter of less than 10 micrometers (PM10), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2).

The main sources of air pollution in Belarus are transport, thermal power plants, industrial enterprises, farming, and housing and communal services. The largest contributions come from mobile sources such as vehicle exhaust gases and stationary sources associated with fuel combustion in thermal power plants and industrial plants. The total volume of pollutant emissions in Belarus in 2023 amounted to 897.9 t or 4,325 kg/km^2.

Table

Annual mean concentrations of air pollutants in Belarusian cities in 2023-2024, μg/m^3

Cities	PM10		Sulfur dioxide (SO_2)		Carbon monoxide (CO)		Nitrogen dioxide (NO_2)	
	2023	2024	2023	2024	2023	2024	2023	2024
Minsk	25	25	14	19	379	468	33	29
Brest	29	30	33	21	596	399	20	29
Vitebsk	17	15	3	4	370	439	24	21
Gomel	44	44	26	22	617	640	28	20
Mogilev	25	20	24	9	428	227	55	50
Grodno	7	-	11	17	412	455	28	27

The lowest PM10 level was recorded in Grodno, and the highest in Brest and Gomel. The similar trend was observed in both 2023 and 2024. The highest annual mean concentration of sulfur dioxide in 2023 was recorded in Brest, but in 2024 the data rate in this area decreased by 36,4%. The lowest levels of sulfur dioxide were recorded in Vitebsk. In Minsk, a slight increase in SO_2 concentration was established in 2024 (19 μg/m^3) compared to 2023 (14 μg/m^3) data. Changes in the annual mean concentration of carbon monoxide in regional cities of Belarus are quite heterogeneous. In Gomel the concentration of this air pollutant was the highest (617 μg/m^3 in 2023 and 640 μg/m^3 in 2024). In Minsk, Vitebsk and Grodno, an increase in nitrogen oxide concentrations was observed in 2024 compared to 2023 data (by 19,0%, 15,7% and 9,5%, respectively). Whereas in Mogilev and Brest a significant decrease in this indicator was noted by 46,9 and 33,1%, respectively. The most pronounced increase in annual mean concentrations of nitrogen dioxide in the period from 2023 to 2024 was characteristic of the city of Brest (31,0%). In Mogilev, a 9,1% decrease in nitrogen dioxide concentrations was recorded: from 55 μg/m^3 in 2023 to 50 μg/m^3 in 2024.

Thus, atmospheric air quality in the largest cities of Belarus for the period 2023-2024 can be assessed as very good and good. During the study period, the highest annual mean concentrations of PM10 and carbon monoxide were observed in Gomel, and nitrogen dioxide in Mogilev.

THE ROLE OF AIR POLLUTION IN THE DEVELOPMENT AND EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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A literature review examined environmental factors that significantly influence the development and progression of chronic obstructive pulmonary disease. Understanding these factors is critical for developing effective strategies for primary and secondary prevention, as well as for optimizing treatment and comprehensive disease management, particularly by minimizing exposure to harmful pollutants.

Keywords: chronic obstructive pulmonary disease, environmental factors, respiratory infections, air, tobacco smoke, nutrition

Studying the influence of environmental factors on COPD is crucial for understanding its development and progression, as well as for effective prevention and treatment. Research into the impact of air pollution, occupational hazards, climate, and other environmental factors helps identify risks, develop preventive measures, and optimize patient management strategies [1].

Chronic obstructive pulmonary disease is a chronic, progressive lung disease characterized by irreversible airflow limitation and chronic airway inflammation caused by exposure to harmful particles or gases [2]. The main symptoms are shortness of breath, chronic cough with sputum, and chest tightness, which worsen over time.

Environmental factors play a significant role in the etiology and pathogenesis of the disease. Key environmental factors influencing the development and exacerbation of chronic obstructive pulmonary disease include:

1. Indoor air pollution and occupational hazards.

Exposure to biomass combustion products (wood, coal, straw) during cooking and heating in poorly ventilated spaces is a significant risk factor. Similarly, prolonged exposure to occupational dust (e.g., coal dust, cotton dust), chemical fumes, irritating gases, and fumes in the workplace also leads to the development of the disease.

2. Respiratory infections.

Viral and bacterial infections are a common cause of disease exacerbations, leading to worsening symptoms, hospitalizations, and increased mortality by increasing inflammation and bronchospasm.

3. Air pollution.

Inhaled pollutants such as fine particulate matter, nitrogen dioxide, ozone, sulfur dioxide, and industrial emissions are among the leading risk factors for the development of chronic obstructive pulmonary disease in nonsmokers and a powerful trigger for exacerbations in patients already diagnosed. They cause chronic inflammation, oxidative stress, and structural changes in the lungs.

4. Tobacco smoke.

Active tobacco smoking is the primary and most significant risk factor for the development of the disease, responsible for the vast majority of cases. Exposure to passive smoking (secondhand smoke) also significantly increases the risk of developing chronic disease and contributes to its progression, especially in individuals exposed from an early age. Reducing the risk of developing and progressing chronic obstructive pulmonary disease requires a multifaceted approach. A key step is stopping smoking and avoiding secondhand smoke. Minimizing exposure to outdoor and indoor air pollution, as well as occupational hazards, is also crucial.

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FEATURES OF HAND GRIP STRENGTH IN ROWERS

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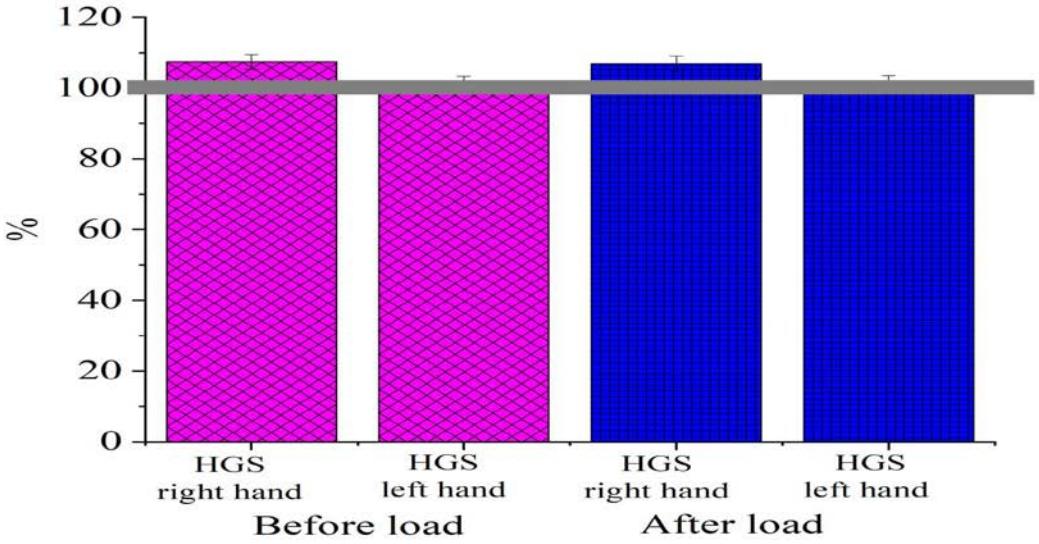
In Uzbekistan, great attention is paid to the development of sports and physical culture. This is reflected in the wide promotion of a healthy lifestyle and in practical measures aimed at raising a well-rounded younger generation. Such an approach contributes not only to the development of physical culture and sports but also to the improvement of public health, motivation, and the professional training of athletes. The state’s focus on creating favorable conditions for the growth of young sports talents allows the republic to maintain competitiveness in various international sports arenas.

Keywords: rowing, grip strength, muscle fatigue, forearm muscles, athletes, training, endurance, physical performance, dynamometer, adaptation.

Purpose of the study – to compare the hand muscle strength of elite rowers and non-athletes and to evaluate the degree of fatigue that occurs after physical exertion.

Materials and methods. The study involved athletes from the national rowing team of Uzbekistan and students from the National University of Uzbekistan who did not engage in professional sports. Hand grip strength was measured before and after training sessions of approximately the same intensity. The values were determined using a hand dynamometer (Megeon-34090). All participants were male and of similar age, which minimized the influence of age-related physiological differences. The obtained data were analyzed statistically to assess the magnitude of grip strength and its reduction after exertion.

Results and discussion. Absolute Hand Strength (kg) Values of Elite Rowers Depending on Somatotype (M±m).



It was found that the right-hand grip strength of rowers averaged 68.6 ± 12.1 kg, while among non-athletes it was 52.5 ± 7.5 kg. The left-hand grip strength of rowers reached 64.7 ± 10.4 kg, whereas that of non-athletes was 55.4 ± 7.5 kg. After physical load, the right-hand strength of rowers decreased by 6.1 kg, and the left-hand strength by 6.2 kg. In non-athletes, the reduction was greater – 9.2 kg for the right hand and 9.3 kg for the left.

These results indicate that although both groups experienced a decline in hand grip strength after exertion, the decrease was significantly smaller in trained athletes. This demonstrates that regular rowing training enhances the endurance of forearm and hand muscles and reduces the impact of fatigue. Despite the dominance of the right hand in both groups, the proportional decline in strength was similar for both hands, suggesting balanced muscular work during rowing training.

In conclusion, systematic training contributes to the development of greater initial muscle strength and a higher resistance to fatigue. The results obtained may be useful for coaches and sports physiologists when planning training loads, monitoring athletes’ adaptation to stress, and optimizing recovery. Further research could include

electromyographic analysis of hand muscles during rowing to better understand neuromuscular coordination and endurance mechanisms.

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THE EFFECT OF POLYPHENOL EXTRACT *HELMAR 1* ON THE PASSIVE PERMEABILITY OF LIVER MITOCHONDRIAL MEMBRANES IN RATS WITH TOXIC HEPATITIS

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In this study, the effect of the polyphenol extract helmar 1, isolated from the plant Helichrysum maracandicum, on the passive ion permeability of liver mitochondrial membranes was investigated in vivo. The experimental results revealed that the polyphenol extract increased the passive permeability of mitochondrial membranes to certain cations – particularly K^+, Na^+, and H^+ ions – in a dose-dependent manner. Consequently, a dose-dependent biphasic effect (stabilizing and inducing) of helmar 1 was identified, highlighting their importance as natural bioactive compounds capable of modulating mitochondrial membrane function.

Keywords: Helmar 1, mitochondria, passive ion permeability.

Mitochondria are the primary energy-producing organelles within the cell, responsible not only for oxidative phosphorylation (OXPHOS) but also for regulating cellular ion homeostasis [1,2]. Under conditions of hepatitis induced by CCl_4, the formation of free radicals, lipid peroxidation, and protein modification are enhanced, leading to the loss of ion selectivity of the mitochondrial membrane [3]. According to the studies by Ahmedova S. and co-authors, polyphenols from Helichrysum maracandicum restore oxidative phosphorylation processes in liver mitochondria, reduce lipid peroxidation, and enhance the activity of antioxidant enzymes (SOD, catalase, GPx) [4,5,6].

According to the obtained results, an increase in the permeability of liver mitochondria to KNO_3, $NaNO_3$, and NH_4NO_3 salts was observed in the group II rats with CCl_4-induced toxic hepatitis compared to the control group (group I) under isoosmotic conditions. Under the influence of CCl_4 induced toxic hepatitis, passive ion permeability increased by 67.6% for K^+, 72.7% for Na^+, and 32.1% for H^+ ions compared to the control. These findings indicate that in the experimental model of toxic hepatitis, the passive permeability of liver mitochondria to K^+, Na^+, and H^+ ions was significantly elevated. After 10 days of pharmacotherapy with helmar 1 (20 mg/kg injection) and silymarin (20 mg/kg injection) in animals of groups III and IV, respectively, a partial restoration of passive permeability was observed. In these groups, the passive permeability of liver mitochondria decreased compared to the CCl_4 induced group (group II): for KNO_3 by 15.8% with helmar 1 and by 26.4% with silymarin; for $NaNO_3$ by 18.1% and 36.9%; and for NH_4NO_3 by 10.8% and 21.6%, respectively.

Based on the obtained results, it can be concluded that in the model of toxic hepatitis, the increase in CCl_4 concentration in the blood of animals leads to damage of liver cells, including mitochondrial membrane systems, and enhances the passive transport of ions in mitochondria. Moreover, the contribution of glycolysis to ATP synthesis increases under these conditions. The corrective (hepatoprotective) effect of the polyphenol extract, which reduces the degree of such damage in toxic hepatitis, can be explained by its ability to restore oxidative phosphorylation processes and the antioxidant defense system in mitochondria. In the future, identifying such hepatoprotective compounds and studying their mechanisms of action may provide opportunities for the development of effective therapeutic agents for the treatment of toxic hepatitis.

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EFFECT OF IMMUNOSTIMULATORS ON THE IMMUNE SYSTEM IN EXPERIMENTAL HEPATITIS

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Keywords: tissue solutions, immunostimulants, anemia, immune response, antibody-forming cells, and antigen.

Toxic substances can cause liver damage with prolonged exposure. This condition is mainly characterized by intermittent liver pain, diarrhea, fatigue, low body temperature, a bitter taste in the mouth, flatulence, loss of appetite, hepatomegaly, splenomegaly, and skin itching. These symptoms appear periodically and may resolve spontaneously after some time. The symptoms and clinical presentation of toxic hepatitis vary slightly. In acute hepatitis, the first signs appear 2–4 days after the administration of a toxic substance, but this period may shorten to 12–24 hours. Patients may experience pain in the right hypochondrium, fever, weakness, decreased appetite, headache, nausea, vomiting, and associated pain. The toxic effects on blood vessel walls can lead to hemorrhages, increased bleeding, and jaundice.

The aim of this work is to evaluate the effectiveness of immunostimulants derived from tissue compounds in experimental hepatitis.

Materials and methods.

Experiments were performed on non-inbred white mice. Hepatitis was induced by intraperitoneal injection of an oil solution of carbon tetrachloride (CCl_4) at a dose of 0.2 mg/kg for three consecutive days. To detect deep infection in animals with secondary immunodeficiency, assess the effect on antibody-forming cells in the spleen, and evaluate the hematopoietic system, five groups of ten animals each were formed. The animals were immunized with sheep erythrocytes at a dose of 2×10^8. After seven days, the spleens were removed for analysis. To correct the immunodeficiency state, mice were injected intraperitoneally with tissue-derived immunostimulants at concentrations of 0.1%, 0.3%, and 0.5%.

Conclusions: Experiments were conducted to determine the effects of tissue-based immunostimulating solutions. Toxic hepatitis was successfully induced in experimental animals. In mice with induced hepatitis, the number of antibody-producing cells in the spleen decreased by approximately 3.3 times. Similar results were obtained when assessing the number of antibody-producing cells per 1 million splenocytes. The immunodeficiency state was manifested by a decrease in antibody-forming cells, while treatment with tissue-based immunostimulating solutions demonstrated a pronounced immunostimulatory effect.

BIOELEMENT STATUS OF YOUNG PEOPLE IN TURKMENISTAN

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Data on the elemental composition (Ca, Cu, Fe, Pb, Zn) of the hair of young people in Turkmenistan were obtained. The mean and median concentrations of Ca, Fe, Zn, and Cu were within reference limits. There were some cases of elevated Pb levels.

Keywords: bioelement status, chemical elements, heavy metals, microelementoses, hair, youth, environmental pollution.

Microelements are required by all organisms only in optimal quantities. Two zones of microelement action have been established: biotic action and toxicopharmacological action. The zone of biotic action is revealed when microelements are used in concentrations close to those in which they are found in the body under normal environmental conditions. In this case, microelements, without stimulating the body's physiological barriers and without encountering resistance from them, exhibit biological activity. The zone of toxicopharmacological action is revealed when microelements are used in quantities significantly exceeding biotic concentrations. In this case, microelements overcome the resistance of physiological barriers by their "functional breakdown" and, penetrating in large quantities, cause not a biotic, but a toxic effect [1]. Long-term deficiency or, conversely, excess of any element leads to metabolic disorders and disease, therefore, a balanced diet in terms of mineral composition is of particular importance.

The aim of our work was to assess the levels of accumulation of chemical elements in the hair of young people of Turkmenistan. In this regard, the following tasks were solved: 1. To collect samples of biomaterial (hair). 2. To determine the concentrations of chemical elements in the hair of young people. 3. To evaluate the compliance of the content of chemical elements in hair with reference values. The object of the study was the hair of young people (11 young men) aged 22 years. Dashoguz city and Dashoguz region (Turkmenistan). The subject of the study is the concentration of Cu (copper), Zn (zinc), Ca (calcium), Fe (iron), Pb (lead). Research methods: review and analytical, statistical, X-ray fluorescence analysis [2]. Hair sampling, sample preparation and measurements were carried out according to established methods based on the laboratory of environmental monitoring and management of International Sakharov Environmental Institute of Belarusian State University. Table 1 presents data on the concentrations of chemical elements in the hair of young people living in the city of Dashoguz and the Dashoguz region, in comparison with reference values.

Table 1

Content of chemical elements in young men's hair (n=11; p=0.05), mg/kg

Element	Mean ± error (p=0,05)	Minimum	Maximum	Median	P=25%	P=75%	Reference values	
							Minimum	Maximum
Ca	348 ± 131	130	719	311	212	402	300	1000
Cu	9 ± 1	7	12	10	8	10	9	30
Fe	18 ± 3	13	28	15	14	22	13	35
Pb	4 ± 2	1	7	3	2	6	0	5
Zn	185 ± 8	165	203	187	177	196	114	320

Pb concentrations were outside the reference range (>5 mg/kg) in 36% of cases, although the median was within the reference range. The mean and median values of Ca, Fe, Zn, and Cu concentrations were within the reference range.

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EFFECTIVENESS OF ZOLEDRONIC ACID IN IMPROVING BONE MINERAL DENSITY IN PROSTATE CANCER PATIENTS RECEIVING ANDROGEN DEPRIVATION THERAPY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Prostate cancer is one of the most prevalent malignancies affecting men worldwide, with notable geographical differences in incidence. In China, it ranks sixth among male cancers, whereas in the United States, it is the most commonly diagnosed malignancy in men[1]. In advanced stages, prostate cancer is highly prone to bone metastases, with up to 80% of patients developing skeletal involvement[2]. Androgen deprivation therapy (ADT) is widely used as first-line or adjuvant treatment for prostate cancer; however, it leads to significant bone mineral loss and an increased risk of osteoporosis and skeletal-related events (SREs)[3-4].

Osteoporosis and related complications such as fractures and spinal cord compression can drastically impact patients' quality of life and prognosis. Therefore, effective strategies to prevent or mitigate ADT-induced bone loss are urgently needed in clinical practice.

Zoledronic acid, a third-generation nitrogen-containing bisphosphonate, exhibits strong antiresorptive properties by inhibiting osteoclast activity. It has been widely used in managing cancer-associated bone loss[5]. Although several studies have suggested its efficacy, comprehensive evaluation of zoledronic acid in the specific context of ADT for prostate cancer is still limited. This meta-analysis aims to consolidate current evidence and assess the efficacy and safety of zoledronic acid in improving bone mineral density (BMD) among prostate cancer patients undergoing ADT.

Study Objective: To evaluate the clinical efficacy of zoledronic acid in improving bone mineral density among prostate cancer patients receiving androgen deprivation therapy.

Databases Searched: PubMed, Embase, Web of Science, CNKI, and Wanfang up to July 11, 2025.

Inclusion Criteria: Randomized or non-randomized controlled trials involving prostate cancer patients aged ≥18 receiving ADT; intervention group treated with zoledronic acid; outcome measures included lumbar spine, femoral neck, and total hip BMD.

Data Extraction & Quality Assessment: Two reviewers independently extracted data and assessed study quality using the RoB 2.0 tool for RCTs and MINORS scale for non-RCTs.

Statistical Analysis: Meta-analysis conducted using Stata 15.0. Fixed or random-effects models were applied based on heterogeneity (I^2), along with subgroup, sensitivity, and publication bias analyses (Egger's and Begg's tests).

Results：A total of 10 studies (n=678 patients) were included.

Lumbar Spine BMD: Zoledronic acid significantly increased BMD compared to control (WMD=0.07; 95% CI: 0.04–0.10), with low heterogeneity (I^2=30.8%).

Femoral Neck and Total Hip BMD: No statistically significant difference was observed (WMD=-0.002 and -0.003, respectively; P>0.05).

Sensitivity and funnel plot analyses indicated robust results with no significant publication bias.

Conclusion

Current evidence suggests that zoledronic acid significantly improves lumbar spine bone mineral density in prostate cancer patients undergoing ADT, though its effect on femoral neck and total hip BMD is not statistically significant. Zoledronic acid appears to be a safe and potentially long-term effective adjunct in managing ADT-related bone loss. However, further high-quality studies are needed to confirm these findings.

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INTERACTION OF THE INTESTINAL MICROBIOTA AND THE CNS THROUGH THE "GUT-BRAIN" AXIS: MECHANISMS AND THERAPEUTIC PERSPECTIVES

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This review examines the gut-brain axis through key interaction mechanisms and the microbiota's role in producing neuroactive substances, its epigenetic influence during early development, and therapeutic potential for CNS disorders.

Keywords: "gut-brain" axis, intestinal microbiota, neurotransmitters, dysbiosis, probiotics.

The intestinal microbiota is a complex community of microorganisms that plays a key role in the physiology of the host. Of particular importance is the bidirectional communication axis "gut-brain", linking the intestinal microbiota with the central nervous system (CNS). From the gut side, this interaction is carried out, in particular, through the microbiota's production of neurotransmitters (GABA, glutamate) and the neurotrophic factor BDNF, which affect cognitive functions and neuroplasticity. The reverse influence of the CNS on the microbiota is mediated mainly by stress-induced changes, such as the activation of the hypothalamic-pituitary-adrenal axis and the autonomic nervous system.

The study of the intestinal microbiota, initiated by the discoveries of A. van Leeuwenhoek about 300 years ago, received a qualitative leap with the development of molecular genetic methods, initiated in part by the "Human Microbiome Project" (2007). The scale of this community underscores its potential influence on host physiology: the number of microorganisms inhabiting the intestine is orders of magnitude greater than the size of the human population. In this regard, a key task of modern science is not only to determine the composition of the microbiome but also to decipher its specific role in maintaining homeostasis and the pathogenesis of diseases [1].

One of the key mechanisms of the intestinal microbiota's influence on the CNS is the synthesis of neuroactive metabolites. These include the brain-derived neurotrophic factor (BDNF), which is critical for neurogenesis, synaptic plasticity, and neuroprotection, as well as neurotransmitters – GABA (inhibitory) and glutamate (excitatory). A decrease in BDNF levels is associated with an increased risk of developing dementia, Alzheimer's disease, and depression. Intestinal microbiota dysbiosis, especially against the background of increased intestinal permeability, disrupts the production of these compounds, which contributes to systemic inflammation and is involved in the pathogenesis of neurological and psychiatric disorders [2].

The reverse influence of the CNS on the composition and function of the intestinal microbiota is realized mainly during stress. The resulting dysbiosis, often against the background of increased intestinal barrier permeability, maintains chronic inflammation and dysfunction of the "gut-brain" axis, which is associated with the pathogenesis of autism spectrum disorders and other neurological diseases. Of particular importance is the epigenetic programming of CNS functions during critical periods of development (the first 1000 days of life), when interventions such as cesarean section or antibiotic use can lead to persistent disturbances in the formation of the intestinal microbiota and increase the risk of neurodevelopmental pathology [3].

Thus, gut microbiota dysbiosis is a significant risk factor for neurological disorders. Correcting the balance using probiotics (Lactobacillus, Bifidobacterium) is a promising approach for the prevention and therapy of CNS disorders. Personalized microbiota modulation strategies require further research.

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MODERN APPROACHES TO SUSTAINABLE PHYSIOLOGICAL NUTRITION IN ENSURING FOOD SECURITY

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Sustainable physiological nutrition is a multidimensional approach that integrates human nutritional needs, food security, environmental sustainability, and socio-economic factors. This article analyzes the principles of sustainable nutrition using locusts (Orthoptera) as an example and highlights their significance as a promising protein source for global food security. The nutritional value, physiological compatibility, safety aspects, ecological advantages, and socio-cultural acceptance of locusts are discussed.

Keywords: sustainable nutrition, food security, locusts, edible insects, physiology, protein

In the 21st century, ensuring sustainable food security and healthy nutrition is among humanity's greatest challenges. Population growth, climate change, and the depletion of natural resources demand the exploration of new protein sources. Edible insects, including locusts (*Locusta migratoria*, *Schistocerca gregaria*, *Dociostaurus maroccanus*), are considered a promising alternative due to their high nutritional value and low environmental impact.

Dried locusts contain about 55–65% protein and 8–15% fat. Their amino acid profile partially meets the requirements recommended by the World Health Organization (WHO/FAO). Locusts are rich in iron, zinc, magnesium, and B-group vitamins. The high bioavailability of iron makes them particularly beneficial for preventing anemia. Incorporating locust meal into animal and human diets enhances protein digestibility, growth performance, and metabolic efficiency. Additionally, chitin positively influences gut microflora and helps reduce cholesterol levels. In Africa, Asia, and Latin America, the consumption of locusts is an ancient tradition. In Europe and the United States, however, widespread adoption requires raising consumer awareness, developing new dishes, and offering the products in familiar forms (such as protein powder or bakery ingredients). For farmers, locust farming can help diversify income sources and create new employment opportunities. Locusts represent a food source that fully aligns with the principles of sustainable physiological nutrition. Their high protein and micronutrient content, environmental efficiency, and economic benefits position them as a valuable component in ensuring global food security. With proper safety measures, social acceptance, and political support, locusts can play a significant role in building a sustainable future food system.

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CHANGES IN BLOOD BIOCHEMICAL PARAMETERS (ALT, AST, ALP, GLUCOSE) IN PARENTS AND OFFSPRING UNDER EXPERIMENTAL HYPOTHYROIDISM WITH PROPHYLACTIC POLYPHENOL THERAPY

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The study investigates the effects of prophylactic polyphenol therapy on blood biochemical indicators – liver enzymes (ALT, AST, ALP) and glucose levels – in parents and their offspring under experimental hypothyroidism. The relevance lies in the impact of thyroid hormone deficiency on liver and carbohydrate metabolism. Polyphenols, due to their antioxidant and hepatoprotective properties, may help normalize cellular metabolism and reduce oxidative stress.

Keywords: hypothyroidism, polyphenols, ALT, AST, ALP, glucose.

Thyroid hormones (T3 and T4) are central regulators of energy metabolism, and their deficiency causes disturbances in protein, lipid, and carbohydrate metabolism [1]. Hypothyroidism has a significant effect on liver function, leading to alterations in ALT, AST, ALP, and glucose levels [2]. Therefore, studying the potential of polyphenols – natural antioxidants – to mitigate these biochemical changes is of scientific importance [3].

The experiment was carried out on healthy adult male and female Wistar rats (6 per group). The animals were divided into three groups: (1) healthy control, (2) hypothyroid group, and (3) polyphenol-pretreated group followed by hypothyroidism induction. Experimental hypothyroidism was induced according to the method of Sabanov et al. (2018) by administering methimazole at a dose of 1.2 mg/100 g body weight for 21 days [4]. At the end of the experiment, serum ALT, AST, ALP enzyme activities and glucose levels were measured using a biochemical analyzer.

It is expected that prophylactic polyphenol therapy will bring liver enzyme activities in parents and offspring under hypothyroid conditions closer to physiological norms, stabilize glucose levels, and reduce oxidative stress. Furthermore, administration of polyphenols to parent rats may contribute to maintaining metabolic stability in their offspring.

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THE EFFECT OF PROPHYLACTIC POLYPHENOL THERAPY ON PANCREATIC, HEMATOLOGICAL, INTESTINAL ENZYMATIC, COGNITIVE AND GROWTH PARAMETERS IN PARENTS AND OFFSPRING UNDER EXPERIMENTAL HYPOTHYROIDISM

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The study investigates the effects of prophylactic polyphenol therapy on the histological condition of the pancreas, hematological parameters (erythrocytes, leukocytes, thrombocytes), intestinal enzyme activity (sucrase, lactase, maltase, amylase, lipase), cognitive function, and growth development in parents and their offspring under experimental hypothyroidism. The relevance of this research is determined by the systemic impact of thyroid hormone deficiency on various organs, particularly the digestive and central nervous systems.

Keywords: hypothyroidism, polyphenols, pancreas, intestinal enzymes, cognitive function.

Thyroid hormones (T3 and T4) are crucial regulators of metabolic processes in the body. Their deficiency leads to a decrease in energy metabolism, disruption of protein and lipid metabolism, and weakening of nervous system activity [1]. In experimental hypothyroidism, exocrine pancreatic activity decreases, and intestinal enzyme secretion and absorption processes become impaired [2]. Therefore, it is important to explore the potential of natural antioxidants such as polyphenols in correcting these disorders.

Polyphenols reduce oxidative stress, stabilize cell membranes, and normalize the functional activity of the endocrine and digestive systems [3]. According to Sabanov's method, hypothyroidism was induced by administering methimazole at a dose of 1.2 mg/100g for 21 days [4]. Each experimental group consisted of 6 male and 6 female rats, divided into the following groups: Healthy control group; Hypothyroidism group

Polyphenol pretreated + hypothyroid group.

The experiment was carried out on white laboratory Wistar rats (Rattus norvegicus, Wistar line), both males and females, maintained under standard laboratory conditions. After hypothyroidism induction, blood samples were collected to determine erythrocyte, leukocyte, and thrombocyte counts using a hematological analyzer. The activities of intestinal enzymes – sucrase, lactase, maltase, amylase, and lipase – were assessed using biochemical analysis.

Histological examination of the pancreas was performed to evaluate the proliferation rate of alpha, beta, and acinar cells using hematoxylin-eosin staining.

Cognitive function was assessed through the open-field maze and color maze tests. Growth dynamics were monitored by regularly measuring body weight and length.

Prophylactic polyphenol therapy is expected to normalize blood parameters toward physiological levels, restore pancreatic cell proliferation, and enhance intestinal enzyme activity in hypothyroid rats. Furthermore, administering polyphenols to parents is expected to improve cognitive performance and growth development in their offspring. These findings could provide a scientific basis for the protective potential of polyphenols against hypothyroidism.

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LABORATORY DIAGNOSIS OF ALZHEIMER'S DISEASE

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Alzheimer's disease is a progressive neurogenerative disease based on the accumulation of toxic proteins in the brain, leading to the death of neurons. This is a pathology that is becoming one of the main medical and social problems of modern society. Laboratory diagnosis of this disease is beginning to play a key role.

Keywords: Alzheimer's disease, Aß42 peptide, p-tau protein, laboratory diagnostics.

The diagnosis of Alzheimer's disease has long been clinical and could only be confirmed posthumously. PET scanning of amyloid plaques is expensive and inaccessible. It is necessary to find an available biomarker.

Currently, the key biomarkers are amyloid-β (Aß), especially the Aß42 peptide and the Aß42/Aß40 ratio, as well as tau protein (t-tau) and phosphorylated tau (p-tau). In Alzheimer's disease, Aß42 accumulates in the brain, which forms plaques. Its level in the cerebrospinal fluid decreases, as it "gets stuck" in the brain. The Aß42/Aß40 ratio is a more

accurate indicator. And when neurons die, the level of total tau (t-tau) in the cerebrospinal fluid increases as a marker of damage to the nervous tissue [1].

In a healthy neuron, tau protein stabilizes microtubules. Microtubules carry nutrients and other important molecules. To perform its function, the tau protein can be chemically modified - phosphorylated. Normally, this process is reversible and regulated. In Alzheimer's disease, tau protein is hyperphosphorylated. This causes tau protein molecules to lose contact with microtubules, stick together, and form insoluble neurofibrillary tangles inside neurons. These tangles destroy the internal structure of the cell, leading to its death [2]. p-tau is the hyperphosphorylated tau protein, which is a direct marker of this pathological process.

P-tau analysis solves several key tasks in the diagnosis of Alzheimer's disease. It allows us to distinguish Alzheimer's disease from other causes of dementia (for example, frontotemporal dementia, dementia with Lewy bodies), where the pathology of tau protein is less pronounced or has a different nature. Previously, the diagnosis could only be confirmed postmortem. Now, the presence of p-tau in the cerebrospinal fluid or blood objectively indicates a disease-specific process in the brain.

Studies have shown that different phosphorylation sites have different diagnostic value. For example, p-tau181, which is the first biomarker to be mass-measured in blood. He distinguishes Alzheimer's disease from healthy aging and from many other dementias. If we talk about p-tau217, which is considered the most promising and specific, then it increases earlier and more strongly compared to p-tau181, and also correlates better with the accumulation of amyloid plaques in the brain. The P-tau217 has high accuracy for detecting even the earliest stages. P-tau231 is also a promising marker. It increases at very early stages, perhaps even earlier than p-tau217 [3].

Today, the "gold" standard of lifetime diagnostics is cerebrospinal fluid analysis. The analysis makes it possible to measure the combination of Aß42, p-tau and t-tau. The characteristic pattern for Alzheimer's disease is low Aß42, high p-tau and high t-tau. This makes it possible to distinguish the disease from other dementias with high accuracy. But the breakthrough of recent years has been blood tests. Their goal is to achieve accuracy close to the analysis of cerebrospinal fluid, but in a non-invasive and cheap way. The analysis can be performed at any clinic and is suitable for screening. Now the analysis is being actively introduced into clinical research and is beginning to appear in specialized clinics. Successes are associated with the advent of hypersensitive methods (immunoprecipitation with mass spectrometry) [4].

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USING PLANTS TO REDUCE THE SYMPTOMS OF SICK BUILDING SYNDROME

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Providing environmentally safe housing is the most important aspect of human ecology, which today attracts the close attention of specialists in the field of ecology, hygiene, architecture and construction. This is due to the fact that the modern living environment often contains factors that pose a real threat to health. One of the ways to improve the air quality in residential areas is the use of tropical and subtropical plants, the range of which is constantly expanding, which requires studying the features of their adaptation and maintenance in indoor conditions [1].

Keywords: plant, "sick building syndrome", vertical landscaping.

The modern term "sick building syndrome" describes situations when people, while in a building, experience various symptoms such as headache, irritation of mucous membranes, cough, dizziness, nausea, dry skin, sensitivity to odors, difficulty concentrating and fatigue, the cause of which cannot be determined. The causes of this syndrome are often associated with inefficient operation or breakdowns of ventilation, heating and air conditioning systems. Toxins from mold and fungi that develop in damp, poorly ventilated areas can also be a cause. In addition, pollutants released by some building materials, volatile organic compounds and high concentrations of ozone (which can be released as a byproduct of office equipment) also contribute to its development [2].

The solution may be to use vertical landscaping in the design of premises, including a variety of plants with high biofiltration and phytoncidal activity. During biofiltration, carbon dioxide and harmful compounds are effectively absorbed by plants and the substrate. Phytoncides and medicinal properties of tropical and subtropical plants have a healing effect in residential and public spaces.

Blum's coleus, which is a popular species, has an amazing variety of leaf shapes and colors. Low-growing, compactly deciduous varieties can be recommended for vertical landscaping in interiors: Ferry, Tammy, White Line and many others. It releases oxygen and absorbs carbon dioxide at night, making it ideal for the bedroom.

Chlorophytum ("Spider") is an excellent fighter against formaldehyde, benzene and carbon monoxide. It is especially effective in the kitchen, where formaldehyde can form during the combustion of gas. It forms "babies", which reproduce very easily.

Golden pipremnum is the leader in the rate of absorption of formaldehyde and carbon monoxide (CO). It effectively combats exhaust fumes that can enter from the street.

Dracaena (especially Dracaena marginate) effectively removes benzene, formaldehyde, trichloroethylene and xylene from the air. These compounds are isolated from varnishes, solvents, and synthetic materials [2].

Pelargonium has a powerful phytoncidal effect and is able to purify the air from pathogenic microorganisms, which helps reduce the risk of allergic reactions.

Spathiphyllum is a powerful multifunctional filter. Removes a wide range of pollutants: ammonia (found in cleaning products), formaldehyde, benzene, xylene and toluene.

An important step in prevention is the introduction of comprehensive measures aimed at improving the microclimate. In turn, the use of phytofiltering plants is an integral part of it. The implementation of such solutions will help reduce the level of pollutants, thereby increasing the comfort and health of people in the premises. Monitoring of the microclimate and regular maintenance are an important contribution to preventing the manifestations of sick building syndrome.

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RESEARCH ADVANCES IN GREEN EXTRACTION TECHNOLOGIES FOR PLANT-DERIVED MEDICINES

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This article reviews three novel green extraction technologies which offer a greener alternative to conventional methods, addressing key environmental and scientific challenges.

Keywords: Plant-derived medicines, Extraction techniques, Green technology

Plant-derived medicines, comprising single or complex mixtures of active ingredients from botanicals, are used for disease prevention and treatment. Traditionally used herbal medicines have garnered global interest due to their natural origins and health potential [1], particularly in chronic disease management. However, their complex composition makes extraction challenging. Traditional methods often involve lengthy processes or hazardous solvents like chloroform, raising environmental concerns. Consequently, various green extraction techniques are being implemented. Ultrasound-Assisted Extraction (UAE).

UAE utilizes ultrasonic cavitation and mechanical effects to disrupt cell walls, enhancing the release and dissolution of intracellular compounds, thereby improving extraction yield [2]. This method is straightforward and applicable to compounds regardless of polarity or molecular weight, generally preserving the structural integrity of extracts. A key limitation is the temperature rise during processing, which may degrade thermolabile components, and its scalability for industrial production remains challenging.

Flash extraction employs high-speed mechanical shear force to pulverize plant material into fine particles within seconds, enabling rapid equilibrium of active components for efficient extraction [3]. It is a high-efficiency technique for extracting bioactive constituents from herbs, offering advantages in processing time, and efficiency.

Supercritical Fluid Extraction (SFE). SFE uses supercritical fluids as solvents to isolate specific components, earning its reputation as a "green technology" [4]. Carbon dioxide (CO_2) is the most widely used solvent due to its chemical inertness, cost-effectiveness, non-toxicity, and status as a food-grade solvent.

In recent years, modern green extraction methods have gained significant attention to reduce energy and solvent consumption. The three technologies reviewed here represent viable, environmentally sustainable options. Their continued development is expected to contribute significantly to sustainable practices and reduce the reliance on organic chemicals.

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MITOCHONDRIAL MECHANISMS REGULATING APOPTOSIS, AUTOPHAGY, AND THE INFLAMMATORY RESPONSE

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Mitochondria act as integrative regulatory hubs, coordinating apoptosis, mitophagy, and innate immune inflammatory responses. In mitochondria-mediated apoptosis, BCL-2 family proteins control the permeability of the outer membrane: pro-apoptotic BAX/BAK form channels, leading to the release of cytochrome c and co-factors, assembly of the APAF-1 apoptosome, and sequential activation of CASP9→CASP3. Key accompanying events include opening of the mitochondrial permeability transition pore (mPTP) and loss of membrane potential ($\Delta\psi m$), which reinforce the irreversibility of the process under stress conditions [1].

Keywords: mitochondria; apoptosis; mitophagy; cGAS–STING; BAX/BAK; PINK1–PRKN.

Selective removal of dysfunctional mitochondria is ensured by mitophagy: PINK1 stabilizes on the outer membrane of damaged organelles and recruits the E3 ubiquitin ligase PRKN, initiating ubiquitination of outer membrane proteins; subsequently, adaptor receptors OPTN, NDP52, and others bind LC3, enabling autophagosome formation and lysosomal degradation. Receptor pathways BNIP3, NIX, and FUNDC1 operate as PRKN-independent and complementary mechanisms, expanding the spectrum of damage detection[2].

At the level of inflammation, damaged mitochondria release reactive oxygen species and mitochondrial DNA (mtDNA) as danger signals. This activates the NLRP3 inflammasome and maturation of IL-1β/IL-18; moreover, oxidized mtDNA exiting through BAX/BAK channels engages the cGAS–STING pathway with induction of type I interferons, while TLR9 recognizes unmethylated CpG motifs of mtDNA in endosomes.

These circuits are tightly interconnected. Effective mitophagy, by removing sources of ROS and mtDNA, restrains apoptosis and inflammation, maintaining homeostasis; conversely, under severe or prolonged stress, caspase-dependent apoptosis and inflammatory cascades exacerbate mitochondrial dysfunction and bias cellular fate toward death. Thus, by integrating the initiation of apoptosis, selective autophagic clearance, and activation of innate immunity, mitochondria determine the trajectory of the cellular response depending on the degree of damage and tissue context.

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ONCOLOGICAL SITUATION AND CANCER CARE SYSTEM IN THE REPUBLIC OF BELARUS: A TEN-YEAR ANALYTICAL REVIEW (2010-2019)

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As a result of the analysis, key trends in the dynamics of cancer incidence and mortality in the Republic of Belarus from 2010 to 2019 were identified. There is a noted increase in the number of diagnosed malignant neoplasms. In 2019, the most frequently diagnosed cancers were: among men – prostate, lung, colorectal, stomach, oral cavity and pharynx, and kidney cancers; among women – breast, colorectal, uterine body, thyroid, stomach, kidney, and ovarian cancers.

Keywords: cancer epidemiology, Belarus, incidence, mortality, screening, rural population.

Cancer is one of the most significant medical and social problems in modern society, greatly affecting life expectancy and quality of life. Globally, there is an increasing trend in both cancer incidence and mortality. This is attributed to natural demographic changes (e.g., population aging), environmental factors, lifestyle, and advances in diagnostic technologies that enable early disease detection. The Republic of Belarus, with a developed healthcare system, faces similar challenges that necessitate a comprehensive analysis of the epidemiological situation and the effectiveness of existing oncological care mechanisms.

The objective of this study was to analyze the levels of incidence and mortality from malignant neoplasms, as well as to assess the current state of the cancer care system in Belarus from 2010 to 2019.

Based on statistical data from 2010–2019, there has been a steady increase in cancer incidence in the country. The total number of new malignant neoplasm cases increased by 24.7%. Among the working-age population, the increase was 29.0%, indicating growing epidemiological pressure from oncological pathologies.

In terms of gender, the incidence among working-age men rose from 237.7 to 317.8 per 100,000 population (an increase of 33.7%), while among women it rose from 211.3 to 259.4 (an increase of 22.8%). This may be due to later medical consultations among men and occupational hazards. Analyzing the disease structure shows that in men, lung, prostate, and digestive system cancers predominate, while in women, breast, thyroid, and uterine cancers are most

common. Cancer incidence is increasing in both urban and rural areas, with a 10-year rise of 25.5% in urban areas and 23.8% in rural areas.

In the mortality structure, the leading causes of cancer death among men were lung, stomach, prostate, oral cavity and pharynx, colorectal, and pancreatic cancers. For women, the leading causes were breast, stomach, colorectal, pancreatic, and ovarian cancers. The crude mortality rate increased from 187.5 per 100,000 in 2010 to 198.6 in 2019; however, the standardized mortality rate declined from 110.3 in 2010 to 105.9 in 2019.

The analysis highlights the necessity for further development of the cancer care system in Belarus. In particular, there is a need to strengthen preventive measures, expand screening programs, improve oncological awareness at the primary care level, and ensure equitable access to medical services regardless of location. A comprehensive approach will help identify the most critical areas for improvement, enhance prevention and treatment efforts, and develop strategies aimed at reducing cancer mortality and improving patients' quality of life [1].

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EPIDEMIOLOGICAL ANALYSIS OF POTENTIALLY MALIGNANT DISEASES OF THE ORAL CAVITY IN THE REPUBLIC OF BELARUS

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This article examines the epidemiological situation in the Republic of Belarus regarding the incidence of potentially malignant diseases of the oral cavity.

Keywords: potentially malignant diseases, oral cavity, oncology.

According to the Belarusian Cancer Registry, over a 10-year period, the incidence of malignant neoplasms (MN) of the head and neck (C01-C14) increased by 1.3 times among the entire population of the country: from 14.0 per 100,000 population in 2014 to 18.4 in 2023 (growth rate of +31.4%); among people of working age: from 12.9 to 17.4 per 100,000 working-age population (growth rate +34.9%). Moreover, cancer of the lip, oral cavity (OC) and oropharynx (C01-C06, C10) accounts for an average of 53.4% of all cases of cancer of the head and neck [1].

Malignant tumors of the oral cavity and pharynx account for approximately 3% of the total number of oncological diseases in Belarus. This figure is higher among men (5.5% of the total number of oncological diseases in men) compared to women (1.0%) [2].

One of the priority tasks of modern dentistry and maxillofacial surgery remains the timely diagnosis and treatment of oral diseases that precede the development of the most common histological variant of oral cancer - squamous cell carcinoma.

In the initial stage, painless nodules, lumps, superficial ulcers, or fissures are observed that do not respond to conservative treatment. Patients may also complain of discomfort when eating, such as a burning or tingling sensation. In the advanced stage, pain is observed in almost 100% of cases. Despite the oral cavity being easily accessible for medical examination, only approximately 34% of oral cancers worldwide are diagnosed at an early stage. Mortality rates from cancers of the lip, oral cavity, and oropharynx also remain high, reaching 57.1%, and 59% among the working-age population.

Most biological tests for potentially malignant diseases turn out to be false negatives. This can usually be explained by technical errors made by doctors when collecting biopsy material. Furthermore, pathologists lack sufficient knowledge, their assessments are subjective, and they are limited by traditional examination methods. The difficulty of diagnosing potentially malignant oral diseases in the early stages is compounded by their similarity to benign lesions.

Oral cancers can develop at the site of established dysplasia, which can be formed due to constant mechanical damage to the tissues of the oral cavity.

Mortality rates from oral cancer have increased by 32% over 20 years. Comparatively higher mortality rates were found in the Minsk and Grodno regions (8.1 per 100,000 population). Men are more often affected (15.3 per 100,000 population), while women are more often affected (2.4 per 100,000 population, according to data for 2018-2022 [2].

The number of detected cases is increasing due to improved laboratory diagnostics and the introduction of new testing methods for detecting oral cancer.

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EPIDEMIOLOGICAL ASSESSMENT OF THE INCIDENCE OF PNEUMONIA AMONG CHILDREN'S POPULATION

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The study analyzes the dynamics of the overall incidence of pneumonia among the child population in the Republic of Belarus for the period from 2019 to 2023. Pneumonia is an acute inflammatory disease of the lung tissue of infectious origin. The study shows that during the investigated period, a decrease in the incidence of pneumonia among the child population was observed. At the same time, the highest level of pneumonia incidence among the child population was recorded in 2019. The reduction in pneumonia incidence in the Republic of Belarus in subsequent years was achieved through the implementation of a series of sanitary and epidemiological measures. Timely diagnosis and treatment of pneumonia allow for the prevention of complications and improvement of the disease prognosis.

Keywords: pneumonia, morbidity, diagnosis, mortality, treatment, population.

Pneumonia is a pressing issue in pediatric pathology and the leading single infectious cause of child mortality worldwide. Pneumonia is among the most common acute illnesses, affecting 10-15 people per 1000 population annually, and in older age groups (over 60 years), it occurs in 25-44 cases per 1000 people per year. The mortality rate for community-acquired pneumonia is lowest (13%) in young and middle-aged individuals, while in older age groups, this figure reaches 15-30%. Mortality from hospital-acquired pneumonia can be as high as 50%. The significance of the problem is determined by high morbidity, substantial labor losses, and financial costs associated with the diagnosis, treatment, and rehabilitation of pneumonia. Due to changes in the etiological structure of pneumonia and the immunological background of the population, early clinical, radiological, and laboratory signs of pneumonia are increasingly losing their classic manifestations and are presenting with atypical courses and more diverse clinical pictures.

The study showed that during the investigated period from 2019 to 2023, the Republic of Belarus has observed a decrease in pneumonia incidence among the pediatric population, with a negative growth rate. The highest level of infectious morbidity was recorded in 2019. At the same time, the lowest pneumonia incidence was observed in the

Mogilev region (4.8-11.8 cases per 1000 pediatric population), and the highest in the Grodno region (9.7-18.9 cases per 1000 pediatric population).

In 2022, the overall incidence of pneumonia decreased by 1.7 times compared to the previous year. However, in 2022, the highest incidence was observed among children under 1 year of age and children aged 1-4 years (15.36 and 15.35 cases per 1000 pediatric population, respectively), while the lowest incidence was among children aged 14 years (2.45 cases per 1000 pediatric population).

Thus, the highest level of pneumonia incidence during the investigated period was noted in 2019, followed by a pronounced and stable trend of decreasing incidence. The reduction in pneumonia incidence in the Republic of Belarus was achieved through the implementation of sanitary and epidemiological measures. Timely diagnosis and treatment of pneumonia allow for the prevention of complications and improvement of the disease prognosis.

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MOLECULAR DIAGNOSTICS OF HIGH-GRADE GLIAL BRAIN TUMORS

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In the present study, the expression levels of the *EGFR* and *TP53* genes were determined. Preliminary results showed positive *EGFR* gene expression in 7 patients with glioblastomas and in 2 patients with astrocytomas. Expression of the *TP53* gene was observed in 10 patients with glioblastomas and in 5 patients with astrocytomas.

Keywords: glioblastomas, astrocytomas, EGFR, p53, immunohistochemistry

Brain tumors represent a heterogeneous group of malignant neoplasms with an incidence rate of 4-15 cases per 100,000 population. About 400 cases of primary brain tumors are registered annually in the Republic of Belarus. More than half of them are glial tumors. In recent decades, there has been a tendency toward an increase the incidence of malignant gliomas by 1% across all age groups [1].

Glial tumors can be either primary, forming in the brain tissues and its membranes, or secondary, representing metastases of tumors from other organs. Depending on the degree of differentiation, gliomas are divided into highly differentiated and poorly differentiated tumors. The group of high-grade gliomas includes glioblastomas that occur in 80% of patients, as well as anaplastic astrocytomas, anaplastic oligodendrogliomas, and anaplastic gangliogliomas [2].

At the present stage, priority in the diagnosis and monitoring of CNS tumors is given to molecular genetic methods. Determination of target gene expression levels and identification of chromosomal aberrations are carried out using immunohistochemistry and fluorescence in situ hybridization (FISH) [3].

Genetic markers of glial tumors include such genes as ATRX, BRAF, EGFR, IDH, MGMT, PI3K, PTEN, TP53 [4].The epidermal growth factor receptor (EGFR) belongs to the family of epidermal growth factor receptors and possesses tyrosine kinase activity. Mutations in the EGFR gene lead to uncontrolled tumor cell division. The tumor suppressor and transcription factor p53 plays a critical role in preventing tumor growth, which is associated with the activation of various cellular responses, including apoptosis, inhibition of angiogenesis, maintenance of genomic stability, and regulation of cell metabolism. Abnormalities in the p53 signaling pathway are observed in 30% of primary and 70% of secondary glioblastomas [5].

The present molecular biological study was performed using biomaterial from 24 patients of the N. N. Alexandrov National Medical Research Center of Oncology in order to determine the expression levels of the tumor markers EGFR and p53. The study material consisted of tumor tissue from 16 patients with glioblastoma and 8 patients with

astrocytoma. The analysis was performed by immunohistochemical determination of the expression levels of EGFR receptor and the tumor suppressor protein p53. The study was conducted according to the standard avidin-biotin peroxidase immunohistochemical method.

The tumor was considered EGFR-negative in the absence of membrane staining or when the number of stained cells was less than 10%, and p53-negative in the absence of nuclear immunoreactivity.

The expression levels of genetic markers were tested for normality using the Shapiro-Wilk test. Correlation analysis was performed using Spearman's rank correlation coefficient (R), the differences were considered statistically significant at $p < 0.05$.

Immunohistochemical analysis of EGFR expression revealed a positive reaction in 43.75 % of glioblastoma cases (7 patients) and 25% of astrocytoma cases (2 patients). Expression of the apoptosis-related marker p53 was observed in 62.5 % of patients with glioblastoma and 62.5 % patients with astrocytoma.

The results of comparative analysis showed co-expression of *EGFR* and *TP53* in 43.75% of glioblastoma cases ($r=0.26$; $p < 0.05$). In astrocytomas, combined expression of these markers was detected in a single case (12.5%).

Based on the previously obtained data, pathological expression of the *EGFR* and *TP53* genes was confirmed by immunohistochemistry in patients with glioblastoma and astrocytoma. The study is ongoing.

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QUANTITATIVE ASSESSMENT OF RESPIRATORY DISTORTIONS OF TUMOR VOLUME DURING PET/CT IMAGING

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A mathematical model was developed to quantitatively assess the impact of respiratory motility on the visualization of pathological lesions during PET/CT scanning of malignant tumors. Experimental verification demonstrated high reproducibility and reliability of the method.

Keywords: mathematical model, intervention, PET/CT, phantom, size uncertainty, respiratory movements.

The use of PET/CT in oncological imaging presents a number of technological challenges, one of which is the impact of patient breathing on tumor contours, increasing their size, and reducing the accuracy of numerical measurements, which negatively impacts patient examination and treatment. The relevance of studying flow monitoring methods in PET/CT scanning has driven the need to improve visualization quality and, from a theoretical perspective, to ensure diagnostic accuracy.

Modern imaging techniques, particularly combined PET/CT tomography, are key tools for diagnosis, staging of malignant processes, and planned radiation therapy [1]. When performing 4D scanning using gating, one of the pressing problems is that the volume of space actually traversed by the tumor during respiration does not correspond to the

volume reconstructed in healthy images [2]. This is a consequence of systematic assumptions, and the theory leads to errors in numerous estimates of the volume of the pathological lesion.

To quantitatively analyze and correct for these effects, a mathematical model of respiratory effects in PET/CT imaging was developed, the operating principle of which is shown in Figure 1.

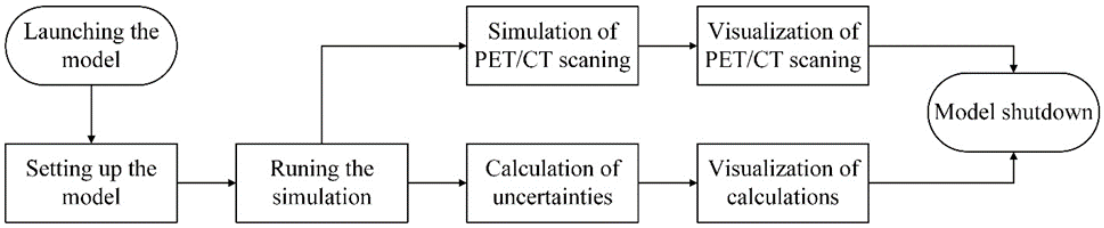

Fig. 1. – Simulation block operation diagram

The model is based on data obtained using a physical PET/CT phantom created at the N. N. Alexandrov Republican Scientific and Practical Center of Oncology and Medical Radiology (Republic of Belarus) and is implemented as an algorithm for predicting absolute and relative uncertainties in assessing the size of a fall based on the dependence of the relative uncertainty on the diameter of the pathological lesion and the absolute uncertainty on the diameter of the pathological lesion. Furthermore, the model provides visualization of a conventional PET/CT scan, i.e., a cable free of any movement caused by respiratory motion.

Verification was performed based on the analysis of PET/CT images contoured using Ellipse v.16.1 software. Data analysis revealed that for CT scanning, the relative error of absolute and relative uncertainty was 2.07% ± 1.01% and 2.10% ± 0.99%, respectively. For PET scanning, the same figures were 1.99% ± 0.87% and 2.69% ± 0.77%. A comparison of the study results with experimental data confirmed the reliability of the proposed method and a high degree of measurement reproducibility.

Along with its positive results, the model has a number of limitations, namely the need for detailed tuning of the modeling parameters and the model's applicability only to spherical or nearly spherical lesions. These limitations make it difficult to apply the model to a wide range of clinical scenarios with varying lesion morphologies and complex trajectories. Further development of the model could be aimed at expanding its clinical applicability, i.e., introducing the ability to define arbitrary shapes and sizes of lesion.

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EPIDEMIOLOGIC FEATURES OF KIDNEY CANCER INCIDENCE IN URBAN AND RURAL POPULATIONS OF THE REPUBLIC OF BELARUS

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Keywords: malignant neoplasms, kidney cancer, epidemiological assessment, morbidity, rural population, urban population, regions of the Republic of Belarus.

The work examines the dynamics of kidney cancer incidence among the population of the Republic of Belarus for 2014-2023. During the study, it was established that over the period 2014-2023, there is a steady trend of increasing kidney cancer incidence in the Republic of Belarus among the entire population, as well as among men and women. The

highest incidence rate of kidney cancer during this period is noted in the older age group, as well as among men compared to women. Regional differences are observed, with the greatest increase in the Grodno region and a decrease or unclear trend in certain regions, such as the Gomel region.

Kidney cancer (KC) is one of the leading malignant neoplasms in oncourology, accounting for about 5% of cases among men and 3% among women. Annually, more than 400 thousand new cases and 175 thousand deaths from KC are registered worldwide. The risk increases from 40 years, reaching a peak at 70 years, with a predominance among men 3 times more often than among women. Incidence varies geographically: high in North America, Europe, Australia; low in Africa and Asia. [1-3]. In Belarus, the problem is relevant due to risk factors such as smoking and obesity. Early symptoms are often imperceptible, leading to late diagnosis and metastases in 30-40% of cases. Based on the above, the aim of our work was to assess the incidence of kidney cancer among the male and female population of the Republic of Belarus.

The data obtained by us show that the incidence of kidney cancer in the population of the Republic of Belarus in 2023 was 4.75% of all localizations. Since 2014, it has grown by 0.55%. The highest incidence rate in 2023 was observed in the age range of 60-79 years. It was 59.16% among the male population, and 62.74% among the female population. The lowest incidence of kidney cancer was observed among men (1.54%) and women (2.02%) aged 20-39 years. The morbidity rate of the population of the Republic of Belarus increased by 44.23% among the urban population and by 56.47% among the rural population from 2014 to 2023. The most noticeable increase was observed among urban residents in the Grodno and Minsk regions – by 1.8 – 2.1 times compared to other regions. In Gomel region, there was also an increase in morbidity among men and women in urban areas, and in Mogilev region – mainly in rural areas. In contrast, in the Grodno, Brest and Vitebsk regions, the incidence was higher among the rural population. In the Vitebsk region, this difference reached 12.37%, mainly due to a twofold increase in morbidity rates among women. Among all regions of Belarus, the highest incidence of kidney cancer in 2023 was recorded in the Grodno region among both urban and rural residents. Urban residents in the Gomel region have the lowest, while rural residents in Mogilev region have the lowest.

Thus, based on all the data presented in the study, it is shown that kidney cancer incidence has a steady increase in Belarus, especially among men and in older ages, with regional differences between urban and rural populations. KC remains a significant problem requiring improved prevention, early diagnosis, and consideration of risk factors.

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THE IMPACT OF ENVIRONMENTAL POLLUTION ON THE DEVELOPMENT OF PERINATAL PATHOLOGY

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This article examines the influence of environmental pollution on the development of perinatal pathology in the population of the Republic of Belarus.

Keywords: perinatal pathology, pollution, perinatal period, ecology

Perinatal pathology refers to pathological conditions and diseases that arise from the moment of germ cell maturation, conception, and throughout the perinatal period. The perinatal period includes the time from the 22nd week of gestation until birth, the period of birth itself, and the early neonatal period, ending 7 days after birth. Perinatal

pathology includes congenital anomalies, asphyxia, birth trauma, intrauterine infections, central nervous system lesions, and other disorders affecting the viability and health of the child [5].

The problem of perinatal pathology remains one of the most pressing issues in modern medicine. Adverse environmental factors are increasingly cited among its leading causes. Air, water, and soil pollution, as well as exposure to chemical substances of anthropogenic origin, create risks for the health of pregnant women and fetuses, contributing to the development of pregnancy complications and intrauterine developmental disorders. Issues related to the impact of ecology on perinatal health are particularly important for urban regions with high levels of pollution, where pregnant women and newborns are at greater risk [1].

Environmental toxicants can affect the mother and fetus through various routes: inhalation (via air), orally (via food and water), and transdermally (via skin). These substances are capable of penetrating the placental barrier, accumulating in fetal tissues, and causing congenital anomalies [3].

The main components of anthropogenic pollution include fine particulate matter (PM2.5 and PM10), nitrogen oxides, carbon monoxide, heavy metals, as well as persistent organic compounds – phthalates, pesticides, and bisphenol-A. Under their influence, processes of oxidative stress are activated, endothelial functions of placental vessels are disrupted, and hormonal regulation of pregnancy is altered. As a result, preconditions are created for the development of chronic fetal hypoxia, placental insufficiency, and premature birth. Some compounds possess mutagenic and epigenetic effects, which can affect the child's health [2].

Reducing the negative impact is possible only through the integration of medical and environmental approaches. Key aspects include: monitoring the state of the environment and assessing individual ecological risk for pregnant women, informing women about ways to reduce household toxic exposure, and efforts aimed at reducing emissions and improving air quality [4].

Thus, environmental pollution is an important determinant of perinatal morbidity, influencing pregnancy outcomes and the subsequent health of the child. Awareness of the role of ecological factors and the implementation of preventive measures can significantly reduce the prevalence of perinatal pathology and improve the demographic indicators of society.

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MAIN FACTORS CONTRIBUTING TO THE DEVELOPMENT OF A DEFICIENCY OR EXCESS OF SELENIUM IN THE HUMAN BODY

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The relevance of selenium research in biology stems from its specific, vital functions, including reducing the risk of certain cardiovascular diseases; preventing heavy metal accumulation in animals; the use of certain organic selenium compounds for the prevention and treatment of cancer; and its high antioxidant activity, which is 500-1000 times greater than that of alpha-tocopherol (vitamin E).

Keywords: selenium excess and deficiency, pathologies, Se doses, toxicity.

Pathologies associated with Se deficiency are rare, particularly due to the widespread use of Se-containing dietary supplements in regions with low Se soil levels (Tibet, some regions of China). Se deficiency leads to decreased appetite, stunted growth, and decreased overall muscle mass. It also affects the thyroid, cardiovascular, and immune systems and can cause infertility, among other things. Severe selenium deficiency in the food chain leads to the development of specific endemic diseases, such as Keshan disease (cardiomyopathy) and Kashin-Beck disease (osteochondropathy) in humans, as well as myopathy and general muscular dystrophy in animals.

The important role of Se in maintaining human health has been demonstrated in patients with muscular dystrophy. Specifically, symptoms of this disease disappeared in patients receiving Se through parenteral nutrition (intravenous injections). Currently, dietary supplements containing Se are considered an integral part of parenteral nutrition [3].

The pathological effects associated with Se deficiency in vivo are due to a decrease in the production of vital selenoproteins. Animal studies have shown that inhibition of the biosynthesis of certain selenoproteins or Se-specific transporters leads to a significant increase in intracellular free radical levels, leading to cell death and, therefore, is incompatible with life [1].

The symptoms of Se poisoning (selenosis) are well studied in humans and animals. An extremely high dose of Se ingested in the diet over a short period of time causes acute toxicity, rapidly leading to death. However, moderately elevated Se intake over a longer period causes chronic selenosis, characterized by weight loss, hair loss, changes in nail structure, dermatitis, gastrointestinal disturbances, decreased fertility, and abnormalities in offspring.

Se toxicity can be caused by the nonspecific substitution of sulfur for Se in sulfur-containing amino acids and subsequent changes in the tertiary structure of proteins. According to another hypothesis, an increased concentration of Se disrupts the oxidation-reduction balance in the body with all the ensuing consequences [2].

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USE OF PLATELET-RICH PLASMA IN THE TREATMENT OF EXPERIMENTAL ANIMALS (RATS) WITH ACUTE NECROTIZING PANCREATITIS

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The management of acute necrotizing pancreatitis (ANP) remains a challenging problem in abdominal surgery, with persistently high patient mortality rates reaching 15-40%. This study explores the possibility of using a plasma-derived biologic product, platelet-rich plasma (PRP), for local adjuvant therapy of ANP, aimed at reducing the inflammatory process and enhancing the regeneration of pancreatic tissue.

Keywords: platelet-rich plasma, acute necrotizing pancreatitis, rats.

Acute pancreatitis is a polyetiological disease characterized by the development of aseptic demarcation-type inflammation. The pathogenesis of this condition is based on pancreatocyte necrobiosis and enzymatic autoaggression, followed by necrosis and dystrophy of the pancreatic parenchyma. The severity of the disease is determined by the intensity of three pathogenetic mechanisms: intracellular activation of pancreatic enzymes via the trypsin-dependent pathway, direct damage to the organ's tissue structures with the development of coagulative necrosis, and intensification of the systemic inflammatory response with the release of pro-inflammatory cytokines.

Among the new directions in the biotherapy of ANP, the use of PRP is of interest. PRP is a biological product obtained by centrifuging whole blood, containing a 3-5 fold concentration of platelets. PRP is a lysate of concentrated platelets, enriched with growth factors (PDGF, TGF-β, VEGF, EGF), cytokines, and chemokines, which provide suppression of inflammation, stimulation of angiogenesis, and remodeling of damaged tissue and organs. The supraphysiological concentration of bioactive substances in PRP allows it to suppress inflammatory reactions, stimulate angiogenesis, and remodel damaged tissues, thereby potentiating natural reparative mechanisms.

Preclinical studies in animals allow for the evaluation of the biological activity, safety, and efficacy of new biological products. Modeling ANP in rats using detergents corresponds to the pathogenesis of acute pancreatitis in humans. The histological picture of ANP is characterized by foci of necrosis in the pancreas, as well as lung and liver damage, and changes in peripheral blood characteristic of sterile inflammation.

The application of PRP via local injection into the affected area of the pancreas demonstrates a complex therapeutic effect, including local stimulation of regeneration and a pronounced systemic anti-inflammatory response. Available literature data indicate both local and systemic effects of PRP: local administration leads to improved histological architecture and function not only of the pancreas but also of distant organs (e.g., lungs, liver), along with a significant decrease in the level of pro-inflammatory cytokines in the systemic circulation. These positive changes correlate with increased survival and improved integral indicators of the quality of life in animals with an ANP model.

The results of preclinical studies on PRP indicate the promise of its local application in ANP. Clinical studies are required to determine the treatment regimen for its use to achieve a favorable clinical effect.

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INFLUENCE OF SLEEP ON HUMAN HEALTH

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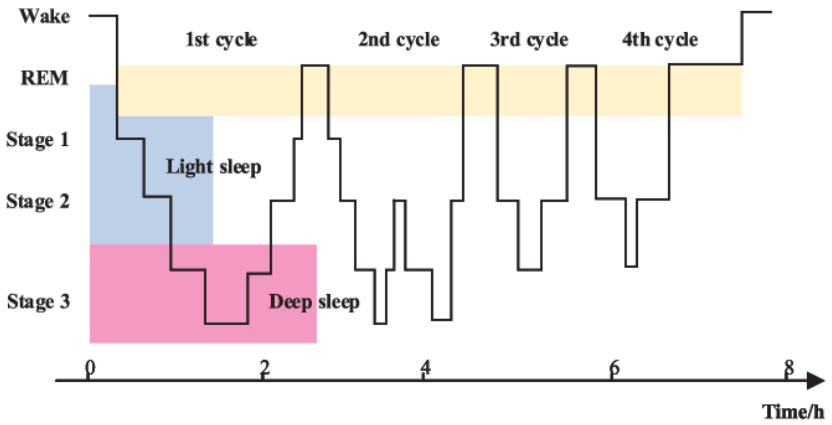
This article examines the influence of sleep quality and duration on a person's physical and mental health.

Keywords: sleep, health, physiology, cognitive functions, chronic diseases.

Sleep is a complex and vital biological process that has a profound impact on all aspects of human health. Sleep quality is directly linked to the functioning of the immune, endocrine, cardiovascular, and nervous systems. Chronic sleep deprivation is a risk factor for the development of numerous diseases, including obesity, type 2 diabetes, depression, and cardiovascular pathologies [1].

Key physiological processes such as tissue repair, memory consolidation, and the production of key hormones (e.g., growth hormone and melatonin) occur primarily during sleep. The slow-wave sleep stage is critical for physical restoration, while the REM sleep stage is closely associated with emotional processing and cognitive functions [2].



Ris. 1 – Cyclic alternation of slow and rapid sleep stages in humans

Sleep disorders, such as insomnia or obstructive sleep apnea syndrome, lead to sleep fragmentation and a reduction in its restorative function. This manifests as daytime fatigue, decreased concentration, impaired memory, and increased irritability. Long-term sleep restriction (less than 7 hours per night for an adult) causes metabolic disturbances, increasing cortisol levels and reducing insulin sensitivity.Optimizing sleep patterns and sleep hygiene is the key to maintaining health, improving productivity, and enhancing quality of life. Adhering to a regular schedule, creating comfortable sleep conditions, and managing stress are effective measures for preventing sleep disorders [2].

The study of sleep mechanisms and its influence on the body continues to reveal new opportunities for the prevention and therapy of a wide range of diseases, making somnology one of the most promising fields in modern medicine.

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METHODS OF ISOLATION OF DENDRITIC CELLS

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This article describes methods for isolating dendritic cells: monocyte cultivation, use of immunoregulatory drugs and biological agents, immunomagnetic separation.

Keywords: dendritic cells, cultivation, biological agents, immunomagnetic separation.

Dendritic cell isolation is used to study their functions, interactions with other cells, and the development of therapeutic vaccines.

There are several methods that allow you to obtain dendritic cells of varying degrees of purity and maturity. The choice of method depends on the purpose of the experiment, the availability of equipment, and the required number of cells. The aim of the study was to investigate methods for isolating dendritic cells.

Monocyte culture. This process allows for the isolation of monocytes from human or animal blood, followed by their differentiation into dendritic cells, which play a crucial role in activating the immune response. The main steps involved in monocyte culture include cell isolation (using centrifugation to separate monocytes from peripheral blood), culture, dendritic cell activation, and cell collection and analysis [1].

Application of immunoregulatory drugs and biological agents. Immunoregulatory drugs and biological agents that can induce immunological tolerance in dendritic cells include IL-10, TGF-B, G-CSF, PGE2, histamine, vitamin D, and its analogues, glucosamine, HLA-G, and cobalt protoporphyrin, which induces the expression of heme oxygenase-1 (HO-1). In addition, different immunosuppressive drugs, such as corticosteroids, cyclosporine, tacrolimus, rapamycin, aspirin, deoxynergualin, and mycophenolate mofetil, have been used to modulate the differentiation and functional

activity of tolerogenic dendritic cells. Typically, these molecules can prevent the maturation and/or activation of dendritic cells, as well as reduce the production of IL-12 by dendritic cells [2].

Immunomagnetic separation of cells – method allows for the isolation of cells, proteins, and nucleic acids by specifically capturing biomolecules using small magnetized particles, beads containing antibodies and lectins, attached to them. These beads are coated with a substance that binds to the target biomolecules, which are then carefully separated and subjected to multiple washing cycles to obtain the target molecules bound to these superparamagnetic beads, which can be differentiated based on the strength of the magnetic field and the target molecules. They are then eluted to collect insufficient liquid, and the concentration of the target biomolecules can be determined. Immunomagnetic separation allows for the specific concentration of target molecules in target bacteria.

Thus, the study, use, and isolation of dendritic cells opens up new horizons for the development of vaccines and immunotherapies, including cancer and infectious disease therapies. They can also be used in research to model immune diseases and test new medications [3].

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EPIDEMIOLOGICAL ANALYSIS OF THE INCIDENCE OF MALIGNANT NEOPLASMS OF THE UPPER JAW

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The work shows that the risk of developing malignant neoplasms of the upper jaw is higher among the male population than the female population. High rates of detection of malignant neoplasms in stage IV in 2023 were revealed. Nationwide (for all forms and stages of neoplasms), the five-year adjusted patient survival rate increased from 22.7% in 2014 to 32.7% in 2023. Survival rates depend on the stage at which the disease was detected.

Keywords: oncoepidemiology, upper jaw, morbidity, five-year survival rate.

The problems of timely diagnosis and radical treatment of malignant tumors of the head and neck are becoming relevant all over the world due to the increasing incidence in the last decade. Due to the rapid increase in the incidence, the Republic of Belarus is included in the group of countries with a high risk of developing malignant neoplasms of the head and neck [1].

It should be noted that the nasal cavity and paranasal sinuses are in a complex anatomical and topographic relationship with the oral cavity, which is why the malignant tumor is rapidly spreading to neighboring structures and several areas are already infiltrating by the time of recognition, in addition, the early symptoms of a malignant disease are often identical to those of chronic inflammatory processes, or there is an asymptomatic course of the initial stage diseases [2].

The epidemiological situation in malignant neoplasms involving the maxilla in the pathological process in the Republic of Belarus has been characterized by a slight decrease in morbidity over the last more than ten years (a rough intensive indicator, a standardized World indicator). This incidence rate is noted among both the male and female populations. Given the tendency to increase life expectancy, as well as the phenomenon of aging, an increase in the number of cancer cases in the study area should be expected. This is evidenced by the dynamics of the registered incidence.

The aim of the work is to analyze the main statistical indicators of the incidence of malignant neoplasms of the upper jaw in the Republic of Belarus for the period from 2014 to 2023.

In general, for the entire group of malignant neoplasms (C03.0, C05.0, C31.0), the risk of the disease is higher among the male population than the female.

High rates of detection of malignant neoplasms in stage IV have been revealed. In 2023, 64.3% of neoplasms of the hard palate were diagnosed in stage IV of the disease, 71.9% of the maxillary sinus and 81.3% of the upper jaw gum. Thus, the frequency of diagnosis of malignant neoplasms in stages III-IV increased from 58.9% in 2014 to 78.3% in 2023 (an increase rate of +19.4%). At the same time, it should be noted that the use of modern diagnostic capabilities (CT, MRI, PET-CT) leads to the detection of small distant metastases, clarification of the local spread of the tumor, and, accordingly, to an increase in the proportion of cases of late diagnosis.

Nationwide (for all forms and stages of neoplasms), the five-year adjusted patient survival rate increased from 22.7% in 2014 to 32.7% in 2023. Survival rates depend on the stage at which the disease was detected. High survival rates are detected in the group of patients treated under the radical program, the 5-year adjusted survival rate among those treated under the radical program increased from 35.1% in 2014 to 40.9% in 2023. Surgical removal of a neoplasm in the upper jaw area with the formation of an oronasal and orosinous communication leads to the need for prosthetics of the resulting defect, which requires the provision of qualified and timely dental and orthopedic care.

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EFFECT OF REGULAR PHYSICAL ACTIVITY OF VARYING INTENSITY ON LIFE EXPECTANCY

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The aging process is a complex biological process associated with deterioration of physiological functions and increased susceptibility to diseases. Physical activity is a key factor that can slow down aging and increase life expectancy. Studies show that even moderate physical activity significantly improves overall health and slows down the aging process, emphasizing the importance of an active lifestyle [1, 3].

Keywords: aging; physical activity; markers; life expectancy.

The World Health Organization emphasizes the importance of physical activity for maintaining health and preventing diseases, recommending that adults engage in physical activity for at least 150 minutes per week [2].

The study, which involved 40 people, whose age group ranged from 18-61 years, collected data on the frequency of physical activity, preferred types of physical activity and their opinion on the impact of physical activity on overall health and aging processes.

The effect of regular physical activity of varying intensity on markers of aging and life expectancy has been analyzed. The majority of respondents (56.1%) were under the age of 20, reflecting the younger generation's interest in physical health, while 19.5% belong to the 31-40 age group, which broadens the understanding of the impact of activity on different age categories.

The frequency of classes showed that 53.7% rarely practice (1-2 times a month), while 24.4% train 3-4 times a week, indicating a group actively leading a healthy lifestyle. Cardio was the most popular (58.5%), strength training was the most popular among 13 participants.

The majority (80.5%) positively assess the impact of physical activity on overall health, while 78% believe that sport slows down aging. At the same time, 78.1% rate their health higher than that of sedentary people, confirming the importance of an active lifestyle for health and well-being.

Thus, the majority of respondents of different ages recognize the benefits of physical activity for improving well-being and consider their health to be better than those who lead a sedentary lifestyle. These data indicate that regular physical activity of varying intensity is perceived by people as a significant factor in maintaining health and slowing down aging, which is important for improving the quality and longevity of life [4, 5].

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ANALYSIS OF HUMORAL IMMUNE RESPONSE IN HEALTHY DONORS

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This article discusses the definitions of standard and additional indicators of the humoral immune response in a group of conditionally healthy donors.

Keywords: B-lymphocytes, immunoglobulins, humoral immune response.

Studies have shown that antibody levels in healthy donors vary depending on age, gender, and other factors. On average, IgG levels are the highest among all classes of antibodies, which indicates the presence of immune memory and previous contact with antigens. IgM levels tend to be higher in young people, which may indicate a more active humoral response to new infections. It was also noted that in donors with chronic diseases, the level of antibodies may be reduced, indicating possible abnormalities in the humoral immune response. This highlights the importance of regular monitoring of immune response parameters in donors, especially before transfusions or transplants [2].

A comparative analysis of the results obtained with the literature data showed that the reference intervals for most indicators correspond to the results of other studies. However, there was some difference in the concentration of serum IgG in donors permanently residing in Minsk, compared with the literature data.

The number of B lymphocytes and their subpopulations in the peripheral blood of healthy donors was determined by flow cytometry using monoclonal antibodies to CD19 and CD5 membrane antigens [1].

The percentage of B-lymphocytes in peripheral blood varies from 4.8 to 18.7%. In this case, the predominant population in the bloodstream are B2 lymphocytes expressing CD19 glycoprotein. B1 lymphocytes, along with the presence of CD19 on the cell surface, express the T-cell antigen CD5 and, accordingly, are characterized by the CD19+5+ phenotype. The number of B1-lymphocytes in peripheral blood is very low and does not exceed 2.5% of all circulating lymphocytes.

The results obtained in the study of healthy donors in Minsk are fully consistent with the data presented in the literature. According to the data of S.V. Khaidukov and co-authors for 2009, the normal number of CD19+ B-lymphocytes is 7-17%, B2–lymphocytes - 6.5-14.9%, B1–lymphocytes - 0.5–2.1%.

Immunoglobulins are globular proteins that are contained in blood serum and other body fluids, and have the ability to specifically interact with an antigen.

Immunoglobulins exist in the form of circulating antibodies, receptors on immunocompetent cells. There are five classes of immunoglobulins: IgG, IgA, IgM, IgD, and IgE. Despite the variety of classes of immunoglobulins, they all

have the same structure. Each class differs in structure, antigenic composition, and function. Each class has a unique specificity, but they are involved in different immunological reactions to varying degrees [2].

It was found that the reference range for serum IgG concentration in donors permanently residing in Minsk does not match the literature data, while the reference ranges for other indicators correspond to the results of other studies described in the literature.

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NEURODEGENERATION: EFFECT OF EXOGENOUS TOXINS AND CHRONIC STRESS

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Neurodegenerative diseases (NDDs) are a group of central nervous system (CNS) pathologies characterized by the progressive loss of neuronal structure and function. Their etiology is multifactorial and includes genetic predisposition and environmental factors. This article examines the contribution of exogenous neurotoxins and chronic stress as modifiable risk factors, and the mechanisms through which a beneficial external and internal ecology provide neuroprotection. [1].

Keywords: Neurodegeneration, neurotoxins, chronic stress, neuroprotection

The progressive aging of the population is increasing the prevalence of NDDs, such as Alzheimer's disease (AD), Parkinson's disease (PD), and amyotrophic lateral sclerosis (ALS), posing a serious challenge to modern healthcare.

Exogenous Neurotoxins and their Impact on the Brain. Exposure to various chemical agents from the environment is an established risk factor for the development of several NDDs. Their mechanisms of action include the induction of oxidative stress, neuroinflammation, mitochondrial dysfunction, and direct damage to neurons.

• Atmospheric Air Pollution (AAP): Components of AAP (particulate matter PM2.5, NO2, polycyclic aromatic hydrocarbons) can penetrate the CNS through the olfactory tract and the blood-brain barrier (BBB). Epidemiological studies link prolonged exposure to AAP with an increased risk of AD and PD. [1]

• Heavy Metals: Lead (Pb), mercury (Hg), and potentially aluminum (Al) are neurotoxic elements. They cause oxidative stress, mitochondrial dysfunction, disrupt calcium homeostasis, and promote the aggregation of toxic proteins, which is associated with the pathogenesis of various NDDs.

• Pesticides and Herbicides: Certain classes of agrochemicals, particularly organophosphates, paraquat, and rotenone, demonstrate neurotoxicity. They cause mitochondrial dysfunction and oxidative stress, selectively damaging dopaminergic neurons, which serves as a model for studying PD.

• Industrial Chemicals and Endocrine Disruptors: Bisphenol A (BPA), phthalates, polychlorinated biphenyls (PCBs) can disrupt neurodevelopment, synaptic plasticity, and contribute to neuroinflammation by affecting hormonal balance and signaling pathways in the brain.

• Mycotoxins: Toxins produced by certain types of mold can cause chronic inflammation and neurological dysfunction, including cognitive impairment

Chronic psychoemotional stress represents a potent modifiable risk factor for the development of NDDs, affecting the brain through activation of the hypothalamic-pituitary-adrenal (HPA) axis and associated neuroendocrine and immune changes.

The way we live directly impacts brain health. Neurodegenerative processes develop slowly, and over a long period, we can actively influence them, resisting the development of diseases. Simple yet regular actions in daily life help to delay the manifestation of hereditary predisposition [2].

Lifestyle and the environment significantly influence how quickly the brain will lose its functions. The concept of "ecology" in the context of neuroprotection encompasses both minimizing exposure to adverse external factors and optimizing the internal physiological environment of the body through lifestyle.

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ANALYSIS OF THE PREVALENCE OF UROGENITAL DISEASES AMONG THE POPULATION OF THE REPUBLIC OF BELARUS

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The study shows that circulatory diseases rank first in the morbidity structure of the population of the Republic of Belarus (25.8%), respiratory diseases rank second (17.6%), and genitourinary diseases rank third (7.4%). Furthermore, it has been established that genitourinary diseases are most common in the 65-69 age group among both men and women, while the lowest incidence rate is observed among those aged 15-19.

Keywords: prevalence of genitourinary diseases, incidence, status, incidence dynamics, population, growth rate.

Genitourinary diseases are common conditions affecting people of all ages and, according to medical statistics, rank fourth, behind heart disease, respiratory disease, and cancer. Due to their anatomical and physiological characteristics, the genitourinary system is susceptible to a number of factors, both endogenous and exogenous.

The urinary system consists of the organs that produce and excrete urine. They are responsible for filtering the blood and removing excess fluid and metabolic waste from the body. The organs that make up the urinary system are identical in men and women: two kidneys, two ureters, a bladder, and the urethra. The kidneys constantly filter the blood, removing excess water, waste, and toxic substances. Electrolytes (sodium, potassium, calcium, and chloride) and nutrients are returned to the bloodstream. On average, the kidneys clear the entire circulating blood volume of the body in 5 minutes. Each kidney is connected to the bladder through a special tubular structure called the ureter. The ureter transports urine to the bladder, where it is stored until the brain signals the bladder muscles to contract and the muscles of the urethra, which exits the bladder, to relax. This allows urine to flow forcefully from the urethra.

General incidence of genitourinary diseases in the Republic for 2019-2023 amounted to 2019- 68.3%; 2020 - 61.05%; 2021 - 61.65%; 2022 - 65.99%; 2023 - 66.33%, which is 64.7% per 100,000 population. Among urological diseases, the prevalence of urolithiasis (33.9%), chronic pyelonephritis (15%), onco-urological diseases (19%) is noted, the prevalence of renal dysfunction reaches (5%), cystitis (27.1%). There is an increase in the number of patients with prostate diseases. In the structure of morbidity of the population of the Republic of Belarus, the 1st place is occupied by diseases of the circulatory system 25.8%, 2nd place - respiratory diseases 17.6%, 3rd place - diseases of the genitourinary system - 7.4%. Urogenital diseases are most common in the 65-69 age group among both men and women, with the lowest incidence rates observed among those aged 15-19. The increase in incidence is most pronounced among men. In urban areas, the incidence rate is lower than in rural areas, due to more accessible and high-quality diagnostics. The incidence of malignant tumors of the genitourinary system has also increased significantly among the population of the Republic of Belarus. Based on the analysis of the obtained results, it can be seen that the problem of urolithiasis remains extremely pressing today. Over the study period from 2019 to 2023, the incidence rate in the Republic of Belarus decreased slightly.

Similarly, global medical statistics indicate that genitourinary diseases have been steadily increasing in recent years. These diseases affect people of all ages, genders, and social statuses, indicating that the phenomenon is widespread.

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ANALYSIS OF MORBIDITY IN THE CHILDREN'S POPULATION SERVED BY THE BOBRUISK CITY CHILDREN'S POLYCLINIC №2

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A retrospective analysis of morbidity rates among children served by the Bobruisk City Children's Polyclinic No. 2 from 2019 to 2023 was conducted. A steady increase in morbidity was revealed. Among all cases, the most frequent cases are recorded in children aged 5-9 and 10-14 years. Overall morbidity rates in children aged 1-4 and under one year are significantly higher than in older children. The overall morbidity patterns of the child population served are determined by respiratory diseases, endocrine diseases, nutritional and metabolic disorders, and diseases of the eye and adnexa.

Keywords: morbidity, child population, structure, dynamics, trends, growth rates.

Analyzing the level, structure, and dynamics of childhood morbidity is a crucial tool for assessing public health and the effectiveness of the healthcare system. Systematic research into childhood morbidity, including assessing its level, long-term dynamics, and structure, is driven by the need to identify key risk factors specific to a given region. The data obtained can serve as a scientific basis for substantiating management decisions and planning interventions to preserve and improve the health of the younger generation.

Based on official data on the incidence of children served by the Bobruisk City Children's Polyclinic No. 2 in 2019-2023, a retrospective analysis of primary morbidity was conducted, dynamics were analyzed, and key trends were identified.

When analyzing the dynamics of overall morbidity, a steady increase was revealed (R^2=0.7013) of overall morbidity. In 2019, the overall morbidity rate was 1746.4 cases per 1000 children, while in 2023, the rate increased to 1988.9 cases per 1000 children. The average annual overall morbidity rate (A0) was 1798.74 per 1000 children. The trend coefficient (A1) was 66.43 per 1000 children. The analysis shows that the most vulnerable age group is school-age children: those aged 5-9 and 10-14. At the beginning of the study period (2019), the proportion of total incidence in the 10-14 age group was 26.93%. It is worth noting that the proportion of children aged 5-9 had a proportion of 28.30%. At the end of the study period (2023), the proportion of total incidence among children aged 10-14 was 30.21%, and among children aged 5-9 – 28.84%. The smallest proportion of cases occurred in children under one year of age.

A comparative analysis of the average annual age-specific indicators of general morbidity in children served by the Bobruisk City Polyclinic No. 2 showed that the levels of general morbidity in children aged 1-4 years and up to one year are significantly higher than in older children.

In the structure of the general morbidity of the child population served by the Health Institution “Bobruisk City Children’s Polyclinic No. 2”, the first places in the ranking are occupied by diseases of the respiratory system (60-63%), diseases of the endocrine system, nutritional disorders and metabolic disorders (11-12%), diseases of the eye and its adnexa (5%).There is a tendency towards an increase in the dynamics of incidence rates for all of the above-mentioned nosologies.

Thus, the conducted analysis demonstrates the need for a prompt response to existing trends. Identifying priority disease classes will facilitate further targeted interventions and formation of priority vectors for the development of programs to improve the health of this age group.

EFFECT OF PROLONGED Γ -IRRADIATION ON THE STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF HEMOGLOBIN IN EXPERIMENTAL ANIMALS

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Hemoglobin (Hb) is the main component of red blood cells and performs specific functions: it performs gas exchange, participates in maintaining blood pH, and performs antioxidant functions. The structural and functional characteristics of Hb are important for performing these functions. In the post-radiation period, the intrinsic fluorescence Hb, the energy of the excited state, changes in waves (from decrease to increase). In the nearest time after training, the efficiency of extinguishing the energy of tryptophanils of hydrophobic hemoglobin zones with the 1,8-ANS acceptor decreased, indicating a denser packaging of these areas. Studies on day 30 showed that conformational rearrangements of hemoglobin are reversible.

Keywords: Prolonged γ - irradiation, red blood cells, hemoglobin.

The object of the study was the hemoglobin of rats exposed to prolonged radiation for 42 days. The age of the subjects at the beginning of the experiment was 120 days. Animals were tested on days 3, 10.30 of the affected period. Animals of appropriate age were used as controls. Prolonged irradiation was carried out at the GAMMARID-192/120 installation from a cesium source with a dose rate of $2.8 \cdot 10^{-7}$ Gy/s to a total absorbed dose of 1 Gy.

The conformational state of hemoglobin was evaluated by its intrinsic protein fluorescence, as well as by the kinetic characteristics of the interaction of hemoglobin molecules with the fluorescent probe 1-anilino-8-naphthalene sulfonate (1,8-ANS). Hemoglobin molecules have the property of radiative deactivation of an externally stimulated singlet electron-excited state (fluorescence), which is due to the presence of aromatic amino acids in the molecule, among which tryptophan makes the greatest contribution to this phenomenon. Changes in the structural characteristics of the protein, which determine the violation of the microenvironment of chromoform amino acids, are reflected in a change in the parameters of the protein's own fluorescence. As follows from the presented data, the intensity of the intrinsic fluorescence of Hb on the 3rd day after irradiation drops by 20%, but increases on the 30th day. Post-radiation changes are noted not only for the energies of the main, but also the excited state of hemoglobin. The pattern of structural post-radiation changes in hemoglobin can be analyzed using a 1,8-ANS fluorescent probe capable of quenching tryptophan fluorescence when bound to positively charged regions of the protein. The efficiency of fluorescence quenching by the acceptor is determined by the type of tryptophan amino acids involved in energy transfer. Type 1 - sedentary forms of tryptophanils, located mainly in hydrophobic zones, λ_{vials} = 330-332 nm. Type 2 - tryptophanils oriented in the polar regions, their mobility is limited by interaction with water dipoles λ_{vial} = 340-342 nm. Type 3 - polar mobile tryptophanils, weakly interacting with water λ_{vial}. = 350-352 nm. An ANS fluorescent probe capable of interacting with positively charged protein regions of both hydrophilic and hydrophobic zones preferably penetrates and binds at the hydrophobic regions. In this regard, the compared values of tryptophanyl fluorescence quenching with the 1,8-ANS acceptor (Fo - fluorescence in the absence of 1,8-ANS and F - in the presence) were evaluated at λ_{vials} = 330-335 nm. It was revealed that on days 3 and 10 after training, the effectiveness of extinguishing the energy of tryptophanils of the hydrophobic zones of hemoglobin with the 1,8-ANS acceptor decreased, indicating a denser packaging of these areas. Studies on day 30 showed that these conformational rearrangements of hemoglobin are reversible.

The most common cause of post-radiation effects in biological molecules is peroxidation activation. It is known that certain ratios of various forms of hemoglobin, including the representation of its oxidized forms (methemoglobin, hemichrome) are necessary for the successful operation of adaptation mechanisms. Naturally, various forms of hemoglobin have certain structural features. Are there changes after irradiation in the ratio of hemoglobin forms, in particular, an increase in the representation of its oxidized forms and, therefore, the presence of post-radiation structural rearrangements at their expense? The data obtained indicate that the amount of methemoglobin after irradiation does not change, while, as previously shown, the concentration of Hb in the red blood cell increased significantly. Based on this, it can be assumed that the post-radiation attenuation of the interaction of 1,8-ANS with positively charged regions

in the region of heme pockets Hb may be due to changes in the availability of positive charges and sign modification in the surface regions of hemoglobin molecules.

SELECTION OF CULTURE MEDIA AND DISHES AS A TOOL FOR OPTIMIZING CULTIVATION CONDITIONS AND IMPROVING THE QUALITY OF PREIMPLANTATION EMBRYOS IN IVF

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Achievements in the field of in vitro fertilization (IVF) are due to deep knowledge in the field of embryonic physiology and metabolism, which makes it possible to develop improved conditions for the cultivation of preimplantation embryos. The relevance of medical environmental at the embryological stage of embryo cultivation increases in artificially created conditions.

Keywords: Infertility, IVF, OPU, in vitro fertilization, IVF laboratory, embryo toxicity, environmental factors, oocyte quality, embryo quality, MEA testing, embryo culture media, plastic toxicity.

Introduction

In the field of assisted reproductive technologies (ART), the most important issue in the study of embryonic development remains the influence of anthropogenic factors (chemical, physical, biological) on the preimplantation human embryo and the development of preventive methods, such as the creation and implementation of preventive measures to prevent the negative impact of the environment on the development of the embryo. Nutrient media play a crucial role in optimizing embryo cultivation in the early days of development, but a number of other factors are equally important: the purity of the air in the embryological laboratory, the plastic used, pH, temperature, osmolality, and the concentration of gases that create the necessary conditions to prevent stress and ensure optimal development and implantation [1-5].

The aim of the study was to create a healthy environment by optimizing the interaction with the environment of gametes and embryos during the preimplantation period of development in the light of the use of various cultural media.

Research materials and methods: a prospective cohort study was conducted, which included 43 pairs of patients undergoing infertility treatment at the Doctor D-IVF clinic between August 2024 and September 2024. The patients were treated with IVF/ ICSI with controlled stimulation of the ovaries with gonadotropins, aged from 20 to 45 years, the average age was 32.5 years (± 12.5 years). Ejaculated or microsurgically obtained spermatozoa of the spouses were used to fertilize the oocytes. In 36 cases, the programs resulted in the development of embryos to the blastocyst stage. The embryos were cultured in a Vitrolife EmbryoScope+ multigas time-lapse incubator at a temperature of 37^0C, with a CO_2 level of 6.2% and an O_2 level of 5.0%.

The separation of patients' gametes and embryos for cultivation in two different commercial media ("VV" and "VL") was carried out randomly. Of the 36 programs, the "VV" group includes 19 programs, and the "VL" group includes 17.

The composition of the media and the quality controls carried out were studied. All media underwent an osmolality test, pH control, bacterial endotoxins (LAL test), 1-cell analysis of mouse embryos (MEA test) and were filtered using an aseptic technique. Due to trade secrets, a full examination of the ingredients is not possible. The results of the study: a comparison of the cultivation results showed that in the "VV" group (N=19) fertilization rate was 57.0%, blastocyst rate was 58.9%, the utilization rate was 60.8%, and in the "VL" group (N=17) fertilization rate was 73.1%, blastocyst rate - 68.0%, utilization rate – 46.6% (Table 1). The differences are statistically significant ($p<0.05$)

According to the Vienna Consensus, the recommended values of efficiency indicators for fertilization rate are: competent - 65% and reference 80%, blastocyst rate - 40% and 60%.

Table

№	Groups	M2	2pN		Blastocyst		Utilization	
1	“VV” (n=19)	128	73	57.0%	43	58.9%	34	46.6%
2	“VL” (n=17)	171	125	73.1%	85	68.0%	76	60.8%

Conclusion: it was revealed that embryo cultivation in the "VL" medium showed better results in terms of fertilization rate, blastocyst rate and utilization rate than in the "VV" medium. The difference in indicators is statistically significant ($p<0.05$).

The study has a number of limitations, as it was conducted on a small sample of patients. Further research is needed.

Conclusions: achievements in the field of ART are due to in-depth knowledge in the field of embryonic physiology and metabolism, which makes it possible to develop improved conditions for the cultivation of preimplantation embryos in in vitro fertilization (IVF) procedures. Ovarian stimulation, egg production, sperm fertilization, embryo cultivation and transfer into the uterus affect normal embryonic development and are responsible for the outcomes of IVF programs.

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DEMOGRAPHIC AND BMI CHARACTERISTICS OF HEMODIALYSIS PATIENTS IN IRAQI PATIENTS INFECTED WITH HEPATITIS B VIRUS

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This study focuses on assessing demographic characteristics and body mass index (BMI) of patients infected with the hepatitis B virus (HBV) who are undergoing hemodialysis. The research aims to analyze their relationship with patient age, gender, and body composition.

Keywords: Hepatitis B virus, hemodialysis, demographic characteristics, BMI.

As of 2019, the World Health Organization (WHO) estimated that 296 million people were infected with the hepatitis B virus (HBV), making it a persistent global health issue [1]. Both acute and chronic forms of the infection are possible. The chronic stage, which is often asymptomatic at onset, can lead to severe complications such as cirrhosis, hepatocellular carcinoma, and ultimately liver failure.

This study was conducted to evaluate the demographic and BMI characteristics of patients undergoing hemodialysis at the City of Medicine Hospital (Iraq). The study included 20 patients (12 males and 8 females) selected based on eligibility criteria, including age, gender, and clinical condition. Participants were divided into three age groups: 50-59 years (5 patients), 60-69 years (7 patients), and 70-79 years (4 patients).

Data were analyzed using IBM SPSS 22 software with both descriptive and analytical statistical methods.

The mean demographic and anthropometric characteristics of the patients revealed an average age of 48.9 ± 16.5 years, indicating that the sample primarily consisted of middle-aged and older adults. The mean height was 176.5 ± 12.5 cm, and the average body weight was 91.6 ± 17.4 kg, suggesting that most individuals maintained a relatively high nutritional status. The calculated BMI averaged 29.96 ± 8.0, placing a significant proportion of participants within the overweight category according to WHO classification. These findings indicate that, in addition to HBV infection and

renal impairment, excess body weight may contribute as an additional risk factor influencing disease progression and metabolic stability.

The mean age of the total cohort was 65.0 ± 7.6 years, confirming that the majority belonged to an older age group - a known risk factor for renal complications and HBV progression. A slight male predominance (12 males vs. 8 females) was observed, consistent with broader epidemiological patterns of HBV-related disorders.

The obtained results suggest that older age and elevated BMI may exacerbate the metabolic burden in HBV-infected individuals undergoing hemodialysis. These parameters are likely to affect not only renal function but also the overall course of hepatic injury and recovery potential. Moreover, the predominance of overweight and elderly patients supports existing evidence linking obesity and age with increased vulnerability to both hepatic and renal dysfunction. Continuous monitoring of BMI and demographic indicators may therefore enhance risk stratification and facilitate personalized therapeutic approaches for HBV-positive patients on dialysis. Further research involving larger patient cohorts is needed to confirm these associations and explore the underlying biochemical mechanisms.

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CIGARETTE SMOKE EXTRACT AS MODEL FOR STUDYUNG OF TOBACCO ADDICTION

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This article describes a procedure for obtaining an aqueous extract of cigarette smoke by passing cigarette smoke through RPMI-1640 culture medium. Cigarette smoke extract can be used for preclinical studies on tissue and cell cultures to study the mechanisms of influence of smoking on cellular, biochemical and molecular genetic processes.

Keywords: smoking, experimental model in vitro, cigarette smoke extract

Smoking is a significant social problem in the Republic of Belarus, and its prevalence has increased over the past decade. According to the National Statistical Committee, in 2023, the number of smokers amounted to 22.1% of the total population. Animal models are used to study many human diseases, including the mechanisms of tobacco addiction. A limitation of such preclinical models is their incomplete coverage of cigarette smoke exposure, as they use only nicotine, even though tobacco smoke contains approximately 7000 other components. Furthermore, non-nicotine components of cigarette smoke have also been shown to play an important role, including enhancing the effects of nicotine. Consequently, experiments using nicotine alone do not allow for a full assessment of health risks. Preclinical models used to study tobacco addiction include inhalation of cigarette smoke, the use of smokeless tobacco extracts and cigarette smoke extracts [1, 2].

The aim of the study was to develop a method for obtaining an aqueous cigarette smoke extract.

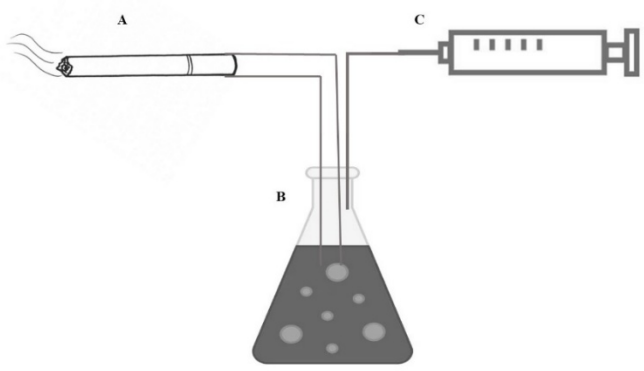

Fig. 1. Schematic representation of aqueous cigarette smoke extract generation

The scheme for preparing cigarette smoke extract is shown in figure 1. A cigarette (A) was inserted into one end of a polymer tube, and the other end was placed in a flask (B) containing 20 ml of sterile RPMI-1640 medium. Air was pumped out of the flask through another polymer tube using a 50 ml syringe (C). A roller clamp on the polymer tube was used to change the position of the syringe plunger. The extract was obtained from five cigarettes, filtered through a 0.22-μm filter, supplemented with 100 IU/ml penicillin and 100 μg/ml streptomycin. Aliquots of the resulting extract were stored at -80°C for further analysis. The described method for preparing cigarette smoke extract is cost-effective and highly reproducible in laboratory conditions. The resulting extract can be used to model the effects of cigarette smoke on cell cultures and tissues, as well as on experimental laboratory animals. The proposed model can be used to study the effects of cigarette smoke on oxidative stress, the functional activity of immune cells and respiratory system cells, the ability of cells to undergo tumor transformation, the effectiveness of the development of antibacterial and antiviral responses, etc.

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RETROSPECTIVE ANALYSIS OF THE INCIDENCE OF DIGESTIVE DISEASES IN THE ADULT POPULATION OF BOBRUISK (2019-2023)

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Abstract: The paper presents a retrospective analysis of the incidence of digestive diseases in the adult population of Bobruisk from 2019 to 2023 in terms of primary and general morbidity over time, and identifies the main trends.

Keywords: digestive diseases, general and primary morbidity, growth rates, prevention.

When analyzing the structure of the primary morbidity of digestive system diseases in the adult population of Bobruisk at the beginning of the study period (2019), it was revealed that the first rank was occupied by diseases of the esophagus, stomach, and duodenum (38.4%), the second place – by diseases of the gallbladder and biliary tract (25.6%), and the third place – by hernias (17.6%). By the end of the study period (2023), the rank distribution of digestive system diseases remained the same as in 2019. However, it is worth noting that the contribution of diseases of the esophagus, stomach, and duodenum to the structure of primary morbidity increased by 16.7% and amounted to 55.12%, while the contribution of diseases of the gallbladder and biliary tract and hernias decreased by 5.14% and 7.04%, respectively.

When analyzing the dynamics of the primary morbidity of diseases of the esophagus, stomach, and duodenum in the adult population, a trend towards an increase in incidence is observed. The average annual incidence rate was 28.15 per 10,000 adults, with an annual trend indicator of 8.67.

When analyzing the structure of the general morbidity of digestive system diseases in the adult population of Bobruisk at the beginning of the study period (2019), it was revealed that the first rank was occupied by diseases of the esophagus, stomach, and duodenum (65.51%), the second place was taken by diseases of the gallbladder and biliary tract (14.14%), and the third place was occupied by diseases of the pancreas (7.76%). By the end of the study period (2023), the rank distribution of the general morbidity of digestive system diseases remained unchanged. In first place were diseases of the esophagus, stomach, and duodenum (66.75%), in second - diseases of the gallbladder and biliary tract (14.78%), and third place was occupied by diseases of the pancreas (6.72%).

Thus, the greatest contribution to the structure of the morbidity of digestive system diseases in the adult population of Bobruisk is made by diseases of the esophagus, stomach, and duodenum.

During the analysis of the dynamics of the general morbidity of diseases of the esophagus, stomach, and duodenum in the adult population, a steady decrease in incidence was noted. However, from 2019 to 2023, the primary morbidity of diseases of the esophagus, stomach, and duodenum in the adult population increased 3.5 times.

It was noted that the general morbidity of diseases of the esophagus, stomach, and duodenum in the adult population exceeded the primary morbidity by an average of more than 15 times during the study period, and the general morbidity of hernias exceeded the primary morbidity by an average of more than 3.5 times during the study period.

During a quantitative assessment of the morbidity of digestive diseases in the population of Bobruisk from 2019 to 2023, it was noted that during the study period, the primary morbidity of digestive diseases in the adult population of Bobruisk was characterized by a steady increase; the general morbidity of liver diseases in the population had a tendency to a steady increase, while the morbidity of diseases of the esophagus, stomach, and duodenum and the pancreas had a steady tendency to decrease.

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THE INFLUENCE OF THE CHEMICAL STRUCTURE OF DEXTRAN- AND POLY-N-ISOPROPYLACRYLAMIDE-BASED STAR COPOLYMERS ON THE ADSORPTION OF TETRAPYRROLE COMPOUNDS

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Using fluorescence spectroscopy methods, the dependence of the sorption capacity of thermosensitive copolymers based on dextrans of various molecular weights and poly-N-isopropylacrylamide to Temoporfin on their phase state (coil/globule), regulated by temperature changes, was shown. Differences in the complexes stability of Temoporfin molecules with copolymers were established. It is assumed that differences in the interaction mechanism of copolymers with Temoporfin are determined by the structural characteristics of copolymers intermolecular aggregates.

Keywords: Temoporfin, thermosensitive copolymers, poly-N-isopropylacryliamide, dextran.

Thermosensitive polymers are high-molecular compounds capable of step nonlinear changes in their physical properties in response to variations in ambient temperatures. The most studied of their representative is poly-N-isopropylacrylamide, which undergoes a coil-globule phase transition in the region of the lower critical solution temperature (LCST). Materials based on it are used in industry to remove contaminants from water, to manufacture sensor materials, to create gel electrolytes and in other areas.

The aim of this work was to study the interaction processes features of copolymers based on dextrans of different molecular weights (M_w = 6 10^3 and M_w = 7 10^4 g/mol) and poly-N-isopropylacrylamide (D6P and D70P) and the photosensitizer (PS) Temoporfin.

Previously, a method for assessing the complexes stability and the PS release rate constant was developed, based on the analysis of the Temoporfin spectral characteristics associated with copolymers of dextran and poly-N-isopropylacrylamide [1]. It was established that in an aqueous solution at temperatures below the LCST, no adsorption of Temoporfin by D70P and D6P macromolecules is observed (the copolymers are in a statistical coil conformation), while the PS molecules in the solution are in an aggregated state. It was established that in an aqueous solution at temperatures below the LCST, no adsorption of Temoporfin by D70P and D6P macromolecules is observed (the copolymers are in a statistical coil conformation), while the PS molecules in the solution are in an aggregated state. At the same time, a sharp increase in the D70P and D6P affinity to Temoporfin is observed, as a result of which the PS is completely bound by the polymer globule. It takes less than a minute for the PS molecules to be incorporated into the copolymer globules. It was found that the spectral-fluorescent characteristics of Temoporfin (relative fluorescence

quantum yield, shape and position of the fluorescence excitation and emission spectra, etc.) in the composition of complexes, D70P and D6P are practically identical.

The Temoporfin rate release upon dilution of PS complexes with copolymers was assessed. It has been shown that almost all Temoporfin molecules remain in the D70P copolymer globule for 24 hours, while complete Temoporfin dissociation from D6P is observed within 4 hours. The observed differences are probably due to the rheology of the copolymer globules. A poly-N-isopropylacrylamide molecules denser grafting in the D6P copolymer prevents the implementation of a complete coil-globule phase transition, which leads to a reduction in steric hinderance [2].

The obtained data indicate that thermosensitive copolymers based on dextran and poly-N-isopropylacrylamide can be used as adsorbents in water purification.

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LACK OF SLEEP AND ITS IMPACT ON THE HUMAN BODY

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The article examines the problem of sleep deprivation and its impact on the human body. Despite extensive research on the issue of insufficient sleep, the number of people with chronic sleep deprivation is increasing. It is estimated that approximately 35% of the global population suffers from chronic sleep deprivation.

Keywords: sleep, performance, and lifestyle.

About 34% of our lives are spent sleeping, a physiological process that is essential for our survival. Sleep is a period of active rest and recovery, during which our metabolism slows down, our muscle tone weakens, our nervous system slows down, and the formation of new neural connections in our brains slows down. Lack of sleep increases our risk of death and cardiovascular diseases, as well as diabetes. If you sleep less than 6 hours per day and suffer from insomnia, your risk of dying from cardiovascular diseases increases by 48%, and your risk of dying from a stroke increases by 15% [1].

Insufficient sleep is a condition in which a person consistently sleeps less than what is necessary for proper rest and recovery. The recommended sleep duration varies depending on age, individual characteristics, and other factors, but it typically ranges from 7 to 9 hours for adults. Chronic sleep deprivation can manifest in various forms, such as reduced sleep time, interrupted sleep, and disrupted circadian rhythms (e.g., shift work). Insufficient sleep has significant implications for various aspects of human health, including physiological, cognitive, and emotional consequences.

The physiological consequences of sleep deprivation include a weakened immune system. People who suffer from sleep deprivation are more likely to develop colds, flu, and other infections. Additionally, there is an increased risk of inflammatory bowel diseases due to the disruption of the gut microbiome caused by insufficient sleep. There may also be hormonal imbalances, as sleep deprivation affects the secretion of hormones such as cortisol (a stress hormone), leptin (a satiety hormone), and ghrelin (a hunger hormone), which can lead to increased appetite, weight gain, and metabolic disorders. Lack of sleep leads to increased activity in the sympathetic nervous system and impaired regulation of blood pressure, which increases the risk of hypertension and cardiovascular diseases.

Decreased cognitive functions manifest themselves in the form of impaired attention and concentration, memory disorders. Lack of sleep disrupts the processes of memory consolidation, which leads to a deterioration in the

memorization of new information and the reproduction of old. It has been established that lack of sleep makes people more irritable and hot-tempered, worsens mood and increases the likelihood of conflicts, increases the risk of depression and anxiety disorders.

A professor from California, M. Karimi, studied the relationship between circadian rhythm disorders and the development of cancer. The study found that reducing sleep duration, especially to less than six hours per day, can increase the risk of developing polyps in the colon, which can develop into colon cancer. A later population-based case-control study found that the risk of developing colorectal cancer was significantly higher in patients with sleep disorders, especially those who also suffered from sleep disorders and depression. It was also found that reducing sleep increases the risk of developing breast cancer [2].

In today's world, people face a multitude of stress factors that need to be managed through proper rest and sleep. To reduce the impact of sleep deprivation, it is important to establish a consistent sleep schedule, avoid using smartphones, tablets, and computers 1-2 hours before bedtime, and limit caffeine and alcohol consumption before bed. Additionally, creating a comfortable sleep environment is crucial, with a dark, quiet, and cool bedroom. Regular exercise can improve sleep, but it is important to avoid intense exercise right before bedtime. Relaxation techniques such as meditation, yoga, or deep breathing can be used to reduce stress and improve sleep. If you have chronic insomnia or other sleep disorders, it is important to consult a healthcare professional for diagnosis and treatment. [3].

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ASSESSMENT OF THE DYNAMICS OF CELLULAR REACTIVITY IN PATIENTS WITH CIRRHOSIS OF THE LIVER DURING TREATMENT

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The study evaluated the cellular homeostasis system of peripheral blood in 15 patients with cirrhosis of the liver during combined treatment, in which the content of hemoglobin, erythrocytes, leukocytes, and platelets in peripheral blood was studied before and after therapy. The results of the study showed that in patients suffering from cirrhosis of the liver, the cellular reactivity of the body to the treatment was characterized by a statistically significant ($p<0.05$) increase in the total hemoglobin content by 1,35 times, erythrocytes by 1,53 times, leukocytes by 1,31 times, platelets by 1,8 times.

Keywords: liver cirrhosis, homeostasis, peripheral blood, hemoglobin, erythrocytes, platelets, leukocytes.

The liver is one of the most important organs of the human body, purifying the blood from toxins. The organ also takes an active part in digestion, carbohydrate, lipid and protein metabolism. Any malfunction of the liver negatively affects the entire body and the patient's quality of life [1]. Cirrhosis of the liver is a chronic progressive disease characterized by impaired liver structure and function due to fibrosis and death of hepatocytes. Cirrhosis is one of the most common causes of morbidity and mortality worldwide, which makes it an urgent topic for medical research [2].

Studying the dynamics of cellular and biochemical parameters of peripheral blood allows an objective assessment of the effectiveness of therapy and the reactivity of the body [3].

The object of the study was the clinical data of 15 patients with cirrhosis of the liver. The subject of the study is the indicators of a general blood test.

The study included data from 15 patients diagnosed with cirrhosis of the liver who were treated at the Doctor Light Diagnostic clinic (Tashkent, Republic of Uzbekistan). In the course of the work, the dynamics of cellular reactivity of homeostasis during treatment was studied in terms of peripheral blood parameters: hemoglobin, erythrocytes, leukocytes, and platelets. Laboratory tests were performed using hematological analyzers Hemacomp 10 (Italy) and Sysmex XN-350 (Japan). Statistical data processing was carried out in the STATISTICA 13 program using the Wilcoxon criterion.

When analyzing the total hemoglobin level in patients suffering from cirrhosis of the liver, it was found that hemoglobinemia was observed before the start of treatment, this indicator was 90 g/l [90; 101], which indicates the presence of anemia characteristic of cirrhosis of the liver. After therapeutic intervention, the hemoglobin level increased statistically significantly ($p_{(Wilkinson)}$ = 0,0065) by 1,35 times to 130 g/l [127; 133] and tended to reference values (120-155 g/l). When analyzing the total content of erythrocytes in the peripheral blood of patients, it was found that before the start of treatment, this indicator was $3,0\times10^{12}$/l [2,8; 3,3], which indicates erythrocytopenia. After treatment, the red blood cell count tended to the reference values (4,0–5.1×1012/l) and statistically significantly increased by 1,53 times ($p_{(Wilcoxon)}$ = 0,00056), and amounted to $4,6\times10^{12}$/g [4,4; 4,8]. The total content of leukocytes in the peripheral blood of patients before the start of treatment was $3,9\times10^{9}$/l [3,6; 4,3], which was below the reference values ($4\text{-}9\times10^{9}$/l), this may indicate the development of severe pathological processes associated with complications of liver cirrhosis. After treatment, the leukocyte level increased statistically significantly to $5,1\times10^{9}$/l [4,9; 5,4] by 1,31 times ($p_{(Wilcoxon)}$ = 0,03349). Analysis of the platelet count in this group of patients during treatment showed a statically significant ($p_{(Wilcoxon)}$ = 0,007689) increase in the studied parameter and a 1,80-fold tendency to reference values (180-320) from 83×10^{9}/l [70; 95], which is typical for severe thrombocytopenia up to 150×10^{9}/l [145; 160].

Thus, the study showed that combination therapy of liver cirrhosis contributes to a statistically significant improvement in peripheral blood parameters. The results obtained confirm the effectiveness of the treatment and its positive effect on the restoration of the homeostasis system in patients with cirrhosis of the liver.

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RATIONAL NUTRITION WITH LOW PHYSICAL ACTIVITY: MODERN SCIENTIFIC APPROACHES

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This article presents modern approaches to balanced nutrition during periods of reduced physical activity. It examines mechanisms for correcting energy balance and optimizing nutrients during periods of reduced physical activity. The focus is on evidence-based nutrition principles for preventing nutrition-related diseases and maintaining metabolic health.

Keywords: physical inactivity, energy balance, balanced nutrition.

Physical inactivity reduces energy expenditure and disrupts metabolism, increasing the risk of obesity, metabolic syndrome, and type 2 diabetes. It is recommended to reduce calories by 15–20%, reduce simple carbohydrates and saturated fats, and increase protein and dietary fiber to maintain metabolic health.

The main principle is to match the caloric intake of the diet to the reduced energy expenditure. According to the WHO, in cases of hypokinesia, it is recommended to reduce caloric intake by 15–20% of the norm while maintaining adequate intake of essential micronutrients [1].

Diet correction includes optimization of macronutrients: plant proteins (legumes, nuts, seeds) – 50–55% of total protein, limiting saturated fats and added sugars with replacement with ω–3 and ω–6 (fish, flaxseed oil, nuts), complex carbohydrates with a low glycemic index (whole grains, vegetables) for stable glucose levels and long-lasting satiety.

Eating small, balanced meals 4–5 times a day with evenly distributed calories maintains a stable metabolism and reduces the risk of overeating. Ideally, the last meal should be 3–4 hours before bedtime, which aligns with circadian rhythms and improves nutrient absorption.

Dietary fiber (25–30 g/day) is recommended from whole grains, vegetables, fruits, bran, and seeds. It normalizes gastrointestinal function and supports intestinal microbiome, which is especially important for people with low mobility.

Fluid requirements vary with body weight, age, and metabolism. According to the EFSA, adequate intake is 2.0 L/day for women and 2.5 L/day for men (including all sources). The primary source is clean drinking water [2].

Thus, following the principles of a balanced diet while experiencing low physical activity is a scientifically proven method for preventing metabolic disorders. Dietary modification – managing energy balance, optimizing nutrients, and maintaining a healthy eating pattern – supports health and quality of life in individuals with low physical activity.

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THE INFLUENCE OF POLLUTED AIR ON ALLERGIC RHINITIS

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Polluted air is a significant factor that increases the prevalence, severity, and chronicity of allergic rhinitis. Inhalation of aerosols and gaseous pollutants (PM2.5, PM10, NO2, O3, SO2, volatile organic compounds) causes direct damage to the respiratory epithelium of the nasal cavity, disrupting the epithelial barrier and increasing transepithelial permeability to allergens [1].

*Keywords***:** allergic rhinitis, air pollution, inflammation, exposure.

At the cellular level, exposure to pollutants initiates oxidative stress and induces the formation of reactive oxygen species, leading to activation of epithelial cells and the release of alterative cytokines and allergen-alarm signals (IL-33, TSLP, IL-25). These mediators contribute to the polarization of the immune response towards Th2/Type 2: activation of ILC2 and Th2-lymphocytes with subsequent increased production of IL-4, IL-5, and IL-13, which causes eosinophilic infiltration of the mucosa, mucus hypersecretion, tissue remodeling, and increased neuro-reflex sensitivity. Particles and chemical substances adsorbed on them modify the physicochemical properties of pollen aerosols and other allergens, increasing their allergenicity and retention on the mucous membrane; simultaneously, the ability of antigen-presenting cells to stimulate allogeneic sensitization increases [2].

Exposure to polluted air in early childhood is associated with an increased risk of primary sensitization and the formation of an atopic phenotype; in adults, constant exposure contributes to the chronicity of the inflammatory process and frequent exacerbations, requiring more intensive pharmacotherapy. Epidemiological data demonstrate a reliable correlation between the concentration of PM2.5 and NO2 and the frequency of exacerbations of allergic rhinitis is also exacerbated by the interaction of pollution with respiratory infections: damage to the epithelium and a decrease in local antimicrobial mechanisms increase susceptibility to viral and bacterial superinfections, which is accompanied by a more severe and prolonged course of rhinitis [1].

From a therapeutic point of view, constant exposure to pollution can reduce the effectiveness of topical anti-inflammatory therapy, increase the need for combined therapeutic approaches, and increase the likelihood of prescribing systemic corticosteroids and antibacterial agents in case of complications. Prevention requires a multi-level approach:

from policies to reduce emissions from transport and industry, air quality monitoring and public awareness, to targeted optimization of allergy control, early diagnosis and treatment of concomitant infections, as well as limiting outdoor activities during periods of high pollution, using air filtration systems in premises and masks with high particle filtration efficiency [3].

For further progress in understanding and controlling the impact of polluted air on allergic rhinitis, prospective cohort studies with accurate individual exposure assessment (personal monitors), molecular stratification of patients (inflammation biotopes, cytokine profile), as well as interventional studies evaluating the clinical effectiveness of measures to reduce pollution and individual protection are needed. The introduction of multidisciplinary protocols combining epidemiology, molecular immunology and environmental medicine will allow the formation of evidence-based recommendations for the prevention and treatment of allergic rhinitis in the context of persistent anthropogenic air pollution [3].

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THE IMPACT OF SOLAR RADIATION ON HUMAN SKIN COVERINGS

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This article examines the beneficial and negative effects of UV radiation on humans, as well as methods of protection from solar radiation and recommendations for the prevention of skin diseases.

Keywords: olar radiation, UV rays, infrared radiation, visible light, photoaging, melanoma, burns, dermis.

The spectrum of solar radiation reaching the Earth's surface and affecting humans includes UV rays, visible light, and infrared radiation. UV rays are divided into UVA, UVB, and UVC. The most harmful to all living things are UVC rays (200-280 nm); however, the ozone layer of the atmosphere surrounding our Earth absorbs them, protecting flora and fauna from their effects.

For a long time, the main focus was on UVB rays. The action of UVB rays is primarily directed at the dilation of dermal vessels, but the main changes caused by these rays are observed in the epidermis. UVB radiation causes inflammatory reactions in the skin, leading to redness, pain, and swelling. Repeated burns increase the risk of developing melanoma.

UVA rays can penetrate deeply into the skin. By penetrating into the papillary and reticular layers of the dermis, these rays can cause destruction of collagen and elastin, which leads to a decrease in skin elasticity and firmness, resulting in the appearance of wrinkles, folds, pigmented, and keratotic lesions due to premature skin aging (photoaging). It is important to note that photoaging can be observed long before the symptoms of chronological aging of the skin appear (chronoaging).

UV radiation undoubtedly also has positive effects on humans. Sunbathing provides excellent strengthening effects: metabolism increases, the function of endocrine glands improves, hemoglobin levels rise, and vitamin D is synthesized (which is especially important during pregnancy to prevent rickets in the fetus, as well as for the prevention of osteoporosis in the elderly). Sunlight has a pronounced antidepressant effect and contributes to positive dynamics in the treatment of psoriasis, atopic dermatitis, and various forms of ichthyosis.

Sensitivity to UV radiation directly depends on skin type. People of European descent are considered more susceptible to the sun–protection is required for them already at an index of 3, while an index of 6 is considered

dangerous. For Indonesians and African Americans, an index of 6 indicates that protection is necessary, while an index of 8 is unfavorable for health.

The use of high-SPF sunscreens, wearing protective clothing, and avoiding sunlight during peak hours (from 10 AM to 4 PM) help reduce the risk of skin damage; regular check-ups with a dermatologist, especially for individuals at high risk, are an important part of skin disease prevention.

Thus, under the influence of UV light, the skin undergoes certain changes to provide protection against damage. The longer one stays in the sun, the higher the risk of developing precancerous skin formations and skin cancer, including malignant melanoma. Increasing awareness about the harms of solar radiation and methods of protection is a key factor in preventing skin diseases.

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EVALUATION OF THE EFFECTIVENESS OF COMMERCIAL HAND ANTISEPTICS AGAINST TEST BACTERIAL CULTURES

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A comparative evaluation of the efficacy of four commercial hand antiseptics against *Staphylococcus aureus* and *Escherichia coli* was conducted using the disk diffusion method. The study revealed that alcohol-based formulations (96% ethanol and 70% isopropanol) demonstrated high antibacterial activity. The triclosan-based product showed limited effectiveness, while the lotion with declared 70% alcohols exhibited no significant antimicrobial activity. *E. coli* was less susceptible to alcohol-based antiseptics compared to *S. aureus*. The results highlight the importance of selecting antiseptics with proven efficacy for effective hand hygiene.

Keywords: hand antiseptics, Staphylococcus aureus, Escherichia coli, disk diffusion method, antimicrobial efficacy, alcohol-based sanitizers.

The growing emphasis on public health and personal hygiene has led to the widespread use of hand antiseptics as a primary measure for preventing the transmission of pathogenic microorganisms. This study focuses on evaluating the efficacy of various commercially available hand sanitizers against common bacterial contaminants, a subject of significant practical importance for consumer awareness and infection control. The research employs a standardized disk diffusion assay to quantitatively assess and compare the antimicrobial activity of selected antiseptics against reference strains of Staphylococcus aureus and Escherichia coli, representing Gram-positive and Gram-negative bacteria, respectively. The findings aim to provide an objective comparison of the products' effectiveness and contribute to a better understanding of bacterial susceptibility to different antimicrobial agents [1-3].

The aim of the study: To evaluate the in vitro antimicrobial efficacy of commercially available household hand antiseptics against reference strains of Staphylococcus aureus and Escherichia coli using the disk diffusion method.

The investigation utilized reference strains Staphylococcus aureus ATCC 6538 and Escherichia coli ATCC 25922. Five test samples were evaluated: 1) "Septocide-Synergy" (96% ethanol), 2) "Viksan" (70% isopropanol), 3) "CLERK" (triclosan-based), 4) "STOP" lotion (declared 70% alcohols), 5) distilled water as negative control. Antimicrobial activity was assessed using the standard disk diffusion method on Mueller-Hinton Agar. Bacterial suspensions standardized to 0.5 McFarland were lawn-inoculated onto agar plates. Sterile paper disks (6 mm) were impregnated with 10 µL of each test substance, applied to inoculated plates, and incubated at 37°C for 24 hours. Inhibition zone diameters were measured with 1 mm accuracy; all tests were performed in duplicate.

The results of the disk diffusion assay demonstrated significant variation in the antimicrobial efficacy of the tested antiseptics against both Staphylococcus aureus and Escherichia coli. The data, including the average diameter of the growth inhibition zones and standard deviation, are summarized in Table 1.

Table 1

Antibacterial activity of commercial hand antiseptics

Antiseptic Sample (Active Agent)	Avg. Zone of growth inhibition ± SD for S. aureus, mm	Avg. Zone of growth inhibition ± SD for E. coli, mm
Septocide-Synergy (96% Ethanol)	26.0 ± 1.0	17.5 ± 1.5
Viksan (70% Isopropanol)	33.5 ± 1.5	24.0 ± 1.0
CLERK (Triclosan)	7.0 ± 0.0	11.0 ± 1.0
Lotion "STOP" (Unknown 70% Alcohols)	7.0 ± 1.0	7.0 ± 0.0
Control (Distilled Water)	6.0 ± 0.0	6.0 ± 0.0

Against both test strains, the most effective antiseptics were alcohol-based. Viksan (70% Isopropanol) showed the largest zones of inhibition (33.5 mm for S. aureus and 24.0 mm for E. coli), followed by Septocide-Synergy (96% Ethanol) (26.0 mm and 17.5 mm, respectively). The antiseptic based on Triclosan (CLERK) showed negligible activity against S. aureus (zone equal to control) and very weak activity against E. coli. Lotion "STOP", despite containing declared 70% alcohols, demonstrated no significant antibacterial effect on either bacterium, with inhibition zones virtually identical to the negative control. The negative control (Distilled Water) confirmed the absence of antimicrobial activity, as the zone diameter was equal to the disk itself (6 mm). A notable difference in susceptibility was observed: E. coli was less susceptible to alcohol-based antiseptics than S. aureus. The low standard deviation values across replicates indicate high reproducibility of the results.

In conclusion, the study demonstrated a significant disparity in the efficacy of commercially available hand antiseptics. Alcohol-based formulations, particularly Viksan (70% isopropanol), proved to be the most effective against both test cultures. In contrast, the triclosan-based product and the lotion with unknown 70% alcohols showed little to no reliable antibacterial activity. The results clearly indicate that the specific composition of an antiseptic, rather than the mere presence of alcohols, is the critical determinant of its antimicrobial effectiveness. Furthermore, the observed higher resistance of E. coli compared to S. aureus underscores the importance of considering the spectrum of activity when selecting a hand sanitizer for effective hygiene.

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THE INFLUENCE OF TUMOR CELLS ON THE IMMUNOPHENOTYPE OF LYMPHOCYTES FROM HEALTHY DONORS IN VITRO

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The study presents an analysis of changes in the immunophenotype of peripheral blood lymphocytes from healthy donors under the influence of tumor cells under *in vitro* conditions.

Keywords: lymphocytes, tumor cells, immunophenotype, flow cytometry, immunosuppression, apoptosis, T-regulatory cells.

The ability of malignant neoplasms to evade immune surveillance remains one of the central problems of modern oncological immunology. Despite the existence of a complex immune control system, tumor cells demonstrate a remarkable ability to avoid recognition and destruction by the immune system [1]. This phenomenon is explained by the development of numerous immune suppression mechanisms, among which the direct modulating effect of tumor cells on lymphoid cells of the immune system holds a special place [2].

Studying the interaction between tumor and immune cells is of significant theoretical and practical interest. Experimental *in vitro* models are becoming particularly valuable, as they allow investigating these processes under controlled conditions, minimizing the influence of the organism's systemic factors [3]. Such research contributes to a better understanding of the fundamental mechanisms of immunosuppressive tumor microenvironment formation and may form the basis for developing new approaches in immunotherapy of malignant neoplasms.

The aim of the study was to assess the influence of tumor cells on the immunophenotype of peripheral blood lymphocytes from healthy donors under *in vitro* co-cultivation conditions.

The research material consisted of peripheral blood lymphocytes from healthy donors (n=10) and a culture of tumor cells from the MCF-7 line (breast cancer). Lymphocytes were isolated by density gradient centrifugation using Ficoll-Verografin. Cultivation was carried out for 72 hours under co-culture conditions of lymphocytes with tumor cells (at a 10:1 ratio). For immunophenotyping, monoclonal antibodies to CD3, CD4, CD8, CD25, CD69, CD95 were used. Analysis was performed on a flow cytofluorimeter (CytoFlex, Beckman Coulter). Statistical data processing was performed using STATISTICA 10.0 software.

As a result of the study, statistically significant changes in the lymphocyte immunophenotype after co-cultivation with tumor cells were revealed. A significant decrease in the relative number of CD3+ lymphocytes from 72.15% to 65.30% ($p < 0.05$) and CD3+CD4+ T-helpers from 45.60% to 38.25% ($p < 0.01$) was noted. A parallel increase in the proportion of CD3+CD8+ cytotoxic lymphocytes from 28.40% to 32.80% ($p < 0.05$) was detected. Of particular note is the significant increase in the number of CD4+CD25+ T-regulatory cells from 5.20% to 8.90% ($p < 0.005$), which may indicate the development of an active immunosuppressive state.

An important aspect of the study was the detection of a significant increase in the number of CD3+CD95+ apoptotic cells from 8.50% to 15.30% ($p < 0.005$). This result convincingly demonstrates the ability of tumor cells to induce programmed cell death of lymphocytes. Simultaneously, a decrease in the number of activated CD8+CD69+ cytotoxic lymphocytes from 12.30% to 7.80% ($p < 0.01$) was found, indicating suppression of their functional activity.

The increase in the number of T-regulatory cells and the simultaneous induction of lymphocyte apoptosis can be considered as key mechanisms of tumor evasion from the immune response. The revealed redistribution of subpopulations towards an increase in cytotoxic lymphocytes with a simultaneous decrease in their activation potential reflects the complex nature of the interaction between tumor and immune cells.

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"USELESS" MUSHROOMS WITH VALUABLE PROPERTIES: USING PARASITIC AND SAPROTROPHIC FUNGI IN THE SEARCH FOR NEW ANTITUMOR AGENTS

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The search for new antitumor agents of natural origin remains a priority in modern oncology. This review examines the potential for using basidiomycetes, a group of parasites and saprotrophs considered "useless," as a promising resource for the discovery of new drugs thanks to their unique metabolic capabilities and ecological adaptations.

Keywords: basidiomycetes, parasitic fungi, saprotrophic fungi, antitumor activity, cytotoxic activity.

The study of basidiomycetes, which belong to the ecological groups of parasites and saprotrophs, is of significant scientific interest. A systematic analysis was conducted of 45 fungal species collected from various forest ecosystems in Belarus between 2020 and 2023. Methanol and aqueous extracts were prepared from the samples and screened for cytotoxic activity against human tumor cell lines (MCF-7, A549, HeLa) using the MTT assay. The results revealed significant differences in biological activity among the species studied. The highest cytotoxicity was demonstrated by extracts of the following species: *Fomitopsis pinicola* (IC50 = 32.5 μg/ml against MCF-7), *Ganoderma applanatum* (IC50 = 28.7 μg/ml against A549) and *Trametes versicolor* (IC50 = 35.2 μg/ml against HeLa). Chemical analysis allowed us to identify several groups of biologically active compounds: β-glucans with immunomodulatory properties, triterpenoids inducing apoptosis via the mitochondrial pathway, steroids suppressing angiogenesis, and phenolic compounds with antioxidant activity.

Studies conducted within the framework of the research project «Assessment of the biological activity of basidiomycetes as potential substances with antitumor activity in vitro model conditions», task 3.03.02 "Develop methods for enhancing the body's adaptive capacity and reducing the negative impacts of anthropogenic and natural factors" of the State Program of Scientific Research «Natural Resources and Environmen» (2021-2025), showed that mushroom extracts are capable of modulating the secretion of immunoactive molecules (cytokines) by normal (lymphoid) human cells in vitro. The studied substances: PI-1 and PI-2 - ethanol extracts of stinkhorn fruiting bodies, GL-1 - an aqueous extract of reishi fruiting bodies, LE-1 - an aqueous extract of shiitake fruiting bodies. Adding mushroom extracts to PHA-induced cell cultures resulted in a statistically significant increase in IL-2 and IFN-γ concentrations compared to the control. Immunocompetent cells were shown to respond to polysaccharide-containing mushroom extracts with increased production of IL-2 and IFN-γ cytokines in the supernatants of the activated K562 tumor cell line, indicating activation of natural immune response mechanisms. The potential for using mushroom extracts in oncology stems from their multicomponent effects on the mechanisms of carcinogenesis. The ability of this complex of biologically active substances to modulate immune responses and inhibit malignant cell proliferation opens up new therapeutic possibilities. However, the introduction of such substances into clinical practice requires standardization of cultivation and extraction methods, as well as preclinical studies to assess efficacy and safety.

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MODERN PERSPECTIVES ON FUNGOTHERAPY: FROM TRADITIONAL USE TO MOLECULAR ONCOLOGY

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Fungotherapy – the therapeutic use of medicinal mushrooms is undergoing a paradigm shift from ethnopharmacological tradition to evidence-based integrative oncology. Contemporary research confirms that basidiomycetes produce a diverse array of bioactive metabolites with multimodal antitumor mechanisms, including immunomodulation, apoptosis induction, cell cycle arrest, antiangiogenesis, and epigenetic regulation.

Keywords: fungotherapy, medicinal mushrooms, β-glucans, triterpenoids, integrative oncology, tumor microenvironment.

Recent advances highlight that the efficacy of fungal preparations depends not only on isolated compounds but also on synergistic interactions within whole extracts. For instance, *Ganoderma lucidum* polysaccharides enhance dendritic cell maturation via Dectin-1 and TLR4, while its triterpenes (e.g., ganoderic acid T) suppress NF-κB and STAT3 signaling in breast and lung cancer models (Wu et al., 2023). Similarly, *Trametes versicolor* PSP and PSK fractions are now clinically used as adjuvants in gastric and colorectal cancer therapy in Asia, improving survival and reducing chemotherapy-induced immunosuppression (Standish et al., 2022). Importantly, ecological and cultivation factors significantly influence metabolite profiles. Wild strains from pristine ecosystems show 2–3-fold higher cytotoxic activity than cultivated counterparts, likely due to stress-induced secondary metabolism (Mikhailova et al., 2023). Submerged fermentation now enables standardized production of biomass with consistent β-glucan (15–22%) and triterpenoid (1.8–3.5%) content, meeting pharmaceutical requirements (Zhang et al., 2024). Emerging data also reveal that fungal compounds modulate the tumor microenvironment: β-glucans reprogram tumor-associated macrophages toward an M1 phenotype, while phenolic antioxidants mitigate oxidative stress that drives mutagenesis (Li et al., 2023). Moreover, mycochemicals exhibit low systemic toxicity and high biocompatibility, making them ideal candidates for combination regimens with checkpoint inhibitors or targeted kinase inhibitors. Despite promising results, challenges remain in standardization, pharmacokinetic profiling, and regulatory approval. Future directions include nano-encapsulation for improved bioavailability, CRISPR-based strain engineering for enhanced metabolite yield, and large-scale randomized trials to validate clinical efficacy in Western oncology protocols.

The studies conducted within the framework of the research project «Assessment of the biological activity of basidiomycetes as potential substances with antitumor activity under in vitro model conditions», task 3.03.02 "Develop methods for increasing the adaptive capacity of the body and reducing the negative impacts of anthropogenic and natural factors" of the State Program of Scientific Research «Natural Resources and the Environment» 2021-2025, are consistent with the above-mentioned data from other researchers.

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ECO-BIOTECHNOLOGICAL ASPECTS OF OBTAINING ANTITUMOR SUBSTANCES FROM BASIDIOMYCETES

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The integration of ecological principles with advanced biotechnological approaches represents a promising strategy for sustainable production of antitumor compounds from basidiomycetes. This study presents a comprehensive eco-biotechnological platform for the selection, cultivation, and extraction of bioactive metabolites with demonstrated cytotoxicity against human cancer cell lines.

Keywords: basidiomycetes, eco-biotechnology, antitumor substances, sustainable production, submerged cultivation, metabolic engineering

The growing demand for novel antitumor agents necessitates the development of sustainable production methods that minimize ecological impact while maximizing yield and efficiency. Basidiomycetes, with their diverse metabolic capabilities, offer immense potential as sources of anticancer compounds. However, traditional collection methods threaten natural populations and lack standardization. Our research addresses these challenges through an integrated eco-biotechnological approach that combines ecological understanding with advanced cultivation technologies. The study encompassed 35 basidiomycete species collected from various ecological niches in Belarusian forests (2021-2024). We implemented a multi-stage selection process: ecological profiling of natural habitats, in vitro cytotoxicity screening against MCF-7, A549, and HT-29 cell lines, metabolic fingerprinting using UPLC-MS/MS, and optimization of submerged cultivation parameters. Innovative cultivation strategies included development of agro-industrial waste-based media, implementation of two-stage fermentation processes, application of elicitors for metabolic pathway activation, and optimization of oxygenation and mixing parameters. Our eco-biotechnological approach yielded significant improvements in both biomass production and metabolite yield. Cultivation optimization resulted in biomass production increased to 18-23 g/L, representing a 2.5-fold improvement over conventional methods, reduction in production costs by 40% through utilization of agricultural by-products, and decreased energy consumption by 35% via optimized process parameters.

The studies conducted within the framework of the research project «Assessment of the biological activity of basidiomycetes as potential substances with antitumor activity under in vitro model conditions», task 3.03.02 "Develop methods for increasing the adaptive capacity of the body and reducing the negative impacts of anthropogenic and natural factors" of the State Program of Scientific Research «Natural Resources and the Environment» 2021-2025, are consistent with the above-mentioned data from other researchers.

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PHENOTYPIC CHARACTERISTICS OF T-LYMPHOCYTES IN NEOPLASMS

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The study presents the phenotypic characteristics of T-lymphocyte subpopulations in neoplasms.

Keywords: T-lymphocytes, antibodies, flow cytometry, neoplasms, tumor cells.

The study of the functioning of the immune system in the occurrence and development of malignant neoplasms (MN) is of great interest because, despite significant advances in the study of molecular and genetic aspects of oncogenesis, there is currently no sufficiently clear understanding of the role of antitumor immunity, the relationship that develops between the host immune system and developing tumors. The special relevance of such research for oncology is due to the growing number of diseases associated with neoplasms. The lack of available knowledge about the various mechanisms of tumor effects on the body, in particular, on the functions of the immune system, makes it difficult to develop new methods of early diagnosis and effective immunotherapy. The study of T-lymphocyte subpopulations in MN plays a key role in understanding the mechanisms of the antitumor immune response, predicting the course of the disease, and developing new diagnostic methods [1, 2].

The aim of the study was to evaluate the phenotype of T-lymphocyte subpopulations in neoplasms.

The study material was peripheral blood from patients with squamous cell carcinoma of the head and neck (n=8) and inverted papilloma (IP) (n=7). Monoclonal antibodies (CD45-FITC, CD4-PE, CD8-ECD, CD3-PC7) were used for phenotyping isolated peripheral blood T-lymphocytes. Statistical data processing was carried out in the STATISTICA 10.0 program.

Using flow cytometry analysis, five T-lymphocyte subpopulations were identified: $CD3^+$T-lymphocytes, $CD3^+CD4^+$T-helper (Th), cytotoxic $CD3^+CD8^+$T-lymphocytes (CTL), double positive $CD4^+CD8^+$T-lymphocytes (DP) and double negative $CD4^-CD8^-$T-lymphocytes (DN). The subpopulation composition of T-lymphocytes of the studied groups is presented in the table.

The number of T-lymphocytes in peripheral blood in patients with malignant neoplasms and inverted papilloma median (25-75 percentile)

Subpopulations	Patients with MN	Patients with IP	p
$CD3^+$, %	67,00 (65,05÷74,85)	70,63 (64,70÷79,70)	0,73
$CD3^+CD4^+$Th, %	58,51 (52,89÷67,15)	59,60 (54,80÷68,30)	0,95
$CD3^+CD8^+$CTL, %	40,20 (30,50÷43,45)	38,34 (31,30÷43,10)	0,90
$CD4^+CD8^+$DP, %	0,24 (0,13÷0,73)	0,31 (0,12÷1,34)	0,73
$CD4^-CD8^-$DN, %	2,48 (2,31÷5,14)	1,99 (1,11÷4,13)	0,14

A study of the subpopulation composition of T-lymphocytes in patients with MN and IP revealed no statistically significant differences in the content of $CD3^+$T-lymphocytes, $CD3^+CD4^+$ T-helper cells, $CD3^+CD8^+$ T-lymphocytes, $CD3^+CD4^+CD8^+$T-cells, $CD3^+CD4^-CD8^-$T-cells, this indicates the involvement of immune cells, both in the case of squamous cell carcinoma of the neck and head, and in inverted papilloma to the same extent. Cytotoxic $CD8^+$ T-cells are able to recognize and destroy tumor cells expressing foreign or altered antigens, release perforins and granzymes, triggering apoptosis (programmed death) of cancer cells. In addition, $CD4^+$ T-lymphocytes regulate the immune response by enhancing the activity of other immune cells, including macrophages and B-lymphocytes, which is important for the formation of long-term antitumor immunity. A high level of tumor infiltration by $CD8^+$ T-cells is associated with a better response to therapy and a more favorable prognosis in many types of cancer (for example,

melanoma, colorectal cancer). On the contrary, a decrease in the number of T-lymphocytes may indicate the immune escape of the tumor when it suppresses the immune response, which worsens the prognosis.

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DIAGNOSTIC MARKERS OF LYMPHOMAS IN THE ADULT POPULATION

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Diagnosis of lymphomas requires detailed knowledge of morphology, clinical data, and is often impossible without immunohistochemical examination. The use of a wide differential diagnostic panel of antibodies makes it possible to make a correct diagnosis in a timely manner, to identify variants of an extensive family of lymphomas. The need for differential diagnosis of lymphomas is due to differences in therapeutic tactics and prognosis of the disease. The study presents diagnostic parameters of lymphomas in the adult population in an oncological dispensary.

Keywords: non-Hodgkin's lymphoma, Hodgkin's lymphoma antibodies, immunohistochemistry, tumor cells.

Lymphoproliferative disease can develop in any organ or tissue where there are lymphoid cells (lymphoblasts, lymphocytes, cells of the follicular center – centrocytes and centroblasts). Lymphoid cells are usually found in the lymph nodes, in the lymphatic pharyngeal ring (palatine tonsils, tonsils of the tongue, adenoids), thymus, aggregated lymphatic follicles (Peyer's plaques) of the small intestine, spleen, and extra-lymphatic organs. From a practical point of view, timely identification of a lymphoproliferative disease and the corresponding division of lymphoma variants according to the degree of malignancy is of great importance.

It is important to emphasize that with the variety of different diagnostic methods for lymphoproliferative diseases, the main method for making a diagnosis is morphological with immunohistochemical (IHC) examination of biopsy material or tissue obtained during surgery. In some cases, bone marrow aspirate or peripheral blood cells may also be used for immunophenotyping. But in any case, the immunological characteristics of tumor cells obtained by methods of flow immunofluorometry or IHC are necessary for the subsequent adequate appointment of immunochemotherapy. Verification of the lymphoma variant is possible with immunohistochemical examination using a well-formed panel of poly- and monoclonal antibodies, which makes it possible to identify a "diagnostic" complex of positive reactions or a "marker" antigen [1]

The aim of the study was to analyze the immunohistochemical markers of lymphomas in the adult population.

The study material included lymph nodes of patients with large cell (follicular) non-Hodgkin's lymphoma (n=6), large cell (diffuse) non-Hodgkin's lymphoma (n=10), small cell (diffuse) non-Hodgkin's lymphoma (n=8) and Hodgkin's disease (n=10). The following markers were used for immunohistochemical analysis: CD3, CD5, CD10, CD15, CD20, CD23, CD79a, bcl6, bcl2, Ki67. Statistical data processing was carried out in the STATISTICA 10.0 program.

Using immunohistochemical analysis, the most common markers in various forms of lymphomas were determined (table).

Frequency of occurrence of diagnostic markers in various forms of lymphomas, %

	Large cell follicular non-Hodgkin's lymphoma	Large-cell diffuse non-Hodgkin's lymphoma	Small cell diffuse non-Hodgkin's lymphoma	Hodgkin's disease
CD3	0	10	0	0
CD5	0	0	50	0
CD10	100	20	25	0
CD15	0	0	0	100

CD20	100	90	75	0
CD23	66,7	0	50	0
CD79a	100	90	75	0
bcl6	66,7	60	25	0
bcl2	100	90	100	0

In patients with large cell (follicular) non-Hodgkin's lymphoma, high expression (in 100% of cases) of key markers CD10, CD20, CD79a, and bcl2 was detected, with Ki67 expression level of 16.6%. While CD20, CD79a, and bcl2 expression was detected in 90% of cases in patients with large-cell (diffuse) non-Hodgkin's lymphoma, however, the CD10 marker was detected in 20% of cases and the Ki67 expression level was 57.9%. Patients with small cell (diffuse) non-Hodgkin's lymphoma were characterized by high expression of bcl2 in 100% of cases and low incidence of bcl6 in 25% of cases, Ki67 expression was 14.3%. A distinctive feature of patients with Hodgkin's disease was CD15 expression in 100% of cases and high Ki67 expression in 73.5%.

Thus, it is important to study immunohistochemical markers of lymphomas in the adult population to determine the prognosis and aggressiveness of the disease, select targeted therapy, evaluate the response to therapy and identify minimal residual disease.

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ANALYSIS OF ATMOSPHERIC AIR POLLUTION IN MINSK

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An analysis of atmospheric air pollution in 2010-2022 was carried out. There is a favorable tendency to decrease the total amount of polluting emissions into the atmospheric air in the period 2010-2022. Mobile sources account for about 80% of all emissions. In general, during the study period, the annual average concentrations of major and specific pollutants remained at a consistently low level and were below hygienic standards. The amount of emissions per capita and per unit of territory is steadily decreasing.

Keywords: Atmospheric air pollution, sources, maximum permissible concentrations, dynamics

More than two hundred large and medium-sized industrial enterprises are located on the territory of Minsk. The main sources of atmospheric air pollution in Minsk and its region are enterprises producing building materials, chemical products, energy, motor transport, etc. Despite the continuing trend of reducing harmful emissions and a general decrease in the content of major pollutants in the atmospheric air (nitrogen oxides, sulfur dioxide, carbon oxides, and others), monitoring the level of atmospheric air pollution by major and, especially, specific substances continues to be relevant.

The work carried out an analysis of atmospheric air pollution in 2010-2022. The dynamics of the share of emissions into the atmospheric air of Minsk from stationary and mobile sources was considered. Emissions of pollutants into the atmosphere of Minsk from mobile sources are significantly higher than from stationary ones. Mobile sources account for about 80% of all emissions. However, we can note a downward trend in this proportion.

In 2010-2022, there is a favorable trend towards a decrease in the total amount of polluting emissions into the atmospheric air. Thus, the dynamics of the total amount of pollutants in the atmospheric air of Minsk in the period from 2010 to 2022 showed a moderate decrease (R2 =0.61). The average value of the indicator for the study period was 22.1 thousand tons.

A comparative analysis of the annual emissions of each substance into the atmospheric air with the maximum permissible concentration was carried out. Thus, the average annual emissions of particulate matter were below the

maximum permissible concentration (40 micrograms/m3), except for 2010 (44.3 micrograms/m3) and 2022 (46.9 micrograms/m3). Moreover, it can be noted that since 2011, a decrease in emissions has been recorded that does not exceed the maximum permissible concentration of this substance per year. The maximum permissible concentration for average annual emissions of carbon monoxide and methane into the atmospheric air has been exceeded throughout the entire period. With a maximum permissible concentration for carbon monoxide of 50 micrograms/m3, the average annual emissions into the atmospheric air of Minsk in the period from 2010 to 2022. They were 72 micrograms/m3 and higher. The average annual emissions of methane into the atmospheric air of Minsk have exceeded the maximum permissible concentration (50 micrograms/m3) three times since 2015. During the study period, annual average concentrations of nitrogen oxide and sulfur dioxide remained at a consistently low level and were below hygienic standards.

In addition, the dynamics of indicators of total emissions of pollutants into atmospheric air per capita and per unit of territory for the period from 2010 to 2023 was analyzed. The dynamics of emissions of harmful substances per capita repeats the dynamics of emissions of harmful substances per unit of territory and has a steady downward trend, which may indicate systematic work to protect atmospheric air.

EPIDEMIOLOGICAL ASSESSMENT OF THE INCIDENCE OF ENDEMIC GOITER IN THE REPUBLIC OF BELARUS

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In the work, an assessment of the level of incidence of the population of the Republic of Belarus with endemic goiter in 2008-2023 was carried out. Endemic goiter ranks 2-3 in the structure of thyroid diseases. During the studied period, there is a tendency to decrease, both in the general and in the primary incidence of the population of the Republic of Belarus in all age groups. The highest incidence rates of endemic goiter are noted in the Gomel and Mogilev regions. In 2008, the relative epidemiological risk of getting sick with endemic goiter in all regions belonged to the range of increased risk, with the exception of the Minsk and Gomel regions, and in 2023, risk levels decreased in all regions of the Republic of Belarus to acceptable.

Keywords: thyroid gland, endemic goiter, incidence, dynamics, trend, epidemiological risk.

The problem of thyroid diseases does not lose its relevance for the population of Belarus, determining the relevance of the issue and the need for research in this area. This problem is a priority for the country's healthcare system and is due to a combination of two factors: the consequences of the accident at the Chernobyl nuclear power plant and the persistent natural iodine deficiency. Constant monitoring of this pathology is not only a medical necessity, but also an important element of state policy aimed at preserving the health of the nation, preventing disability and ensuring the demographic security of the country [1,2]. In this regard, the purpose of this work is to assess the level of incidence of the population of the Republic of Belarus with endemic goiter in 2008-2023.

In the work, a retrospective analysis of the indicators of the incidence of the population of the Republic of Belarus with endemic goiter for the period 2008-2023 was carried out, the dynamics were analyzed and the main trends were determined. In addition, relative epidemiological territorial risks were calculated. In the Republic of Belarus, endemic goiter occupies a leading position in the structure of thyroid diseases, but it is possible to note a decrease in its share in 2023 (9%) compared to 2008 (28%).

During the studied period, there is a tendency to decrease, both general and primary incidence of the population of the Republic of Belarus by more than 60%. The average annual indicator of the general incidence (A0) was 427.87 0/0000, the annual indicator of the trend A1 = -26.6 0/0000. For the primary incidence, the average annual indicator (A0) was 56.53 0/0000, the annual indicator of the trend A1 = -3.6 0/0000. It is necessary to note that the incidence rates of the child population exceed the similar indicators of the incidence of the adult population by approximately 6 times.

In addition, an assessment of the territorial features of the incidence of the population by regions of the Republic of Belarus was carried out. During the analysis, it was revealed that the distribution of the general incidence of the population across the country is uneven. In 2008-2023, the highest average annual indicators of the general incidence were noted in the Gomel and Mogilev regions, and they are approximately 5 times higher than the indicators in the other regions (respectively, 1149.43 and 699.13 0/0000). In 2008, the relative epidemiological risk of getting sick with endemic goiter in all regions belonged to the range of increased risk, with the exception of the Minsk and Gomel regions, and in 2023, risk levels decreased in all regions of the Republic of Belarus to acceptable.

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ANALYSIS OF THE INCIDENCE OF BRAIN AND CENTRAL NERVOUS SYSTEM CANCER IN THE POPULATION OF BELARUS

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The article presents the results of an epidemiological analysis of statistical data on the incidence of primary brain tumors in the population of the Republic of Belarus. From 2003 to 2022, an upward trend in the incidence of brain and CNS cancer was observed among the population of the Republic of Belarus. During the observed period, the incidence of brain and CNS cancer in the rural population was higher than in the urban population. High incidence rates were recorded primarily in the 50-54 age group.

Keywords: oncology, incidence, growth rates, dynamics, structure.

Currently, there is a worldwide trend toward an increase in the number of patients with neoplasms. The proportion of brain tumors among neoplasms is low (1-2%), but the high mortality and disability rates of patients, as well as the significant social, economic, and moral damage this pathology inflicts on society, have generated well-founded interest in this aspect of oncology.

Based on data on the incidence of cancer in the population of the Republic of Belarus, an analysis of the incidence of malignant neoplasms of the brain and central nervous system from 2003 to 2022 was conducted. During the study period, the incidence of brain and central nervous system cancer remained virtually unchanged, amounting to 1.1-1.5% across all localizations.

As a result of a retrospective analysis of the incidence of malignant neoplasms of the brain and central nervous system in the population of the Republic of Belarus from 2003 to 2022, A pronounced upward trend in incidence was identified. The overall incidence rate increased by 1.4 times. The average annual incidence rate of malignant neoplasms of the brain and central nervous system in the republic (A0) was 5.7 cases per 100,000 population, while the annual trend rate (A1) was 0.122 per 100,000 population. The average annual growth rate was 2.26% for males, 4.01% for females, and 2.81% for both sexes. This overall increase in incidence may be due to a combination of factors, including improved diagnostic methods that increase detection; a real increase in the impact of potential risk factors (environmental, occupational, and lifestyle); and the aging of the population, given the pronounced age-related dependence of malignant neoplasms of the brain and central nervous system.

During the observed period, the incidence of brain and central nervous system cancer in males was higher than the incidence in females.

The key finding of the analysis is the identification of higher incidence rates of malignant neoplasms of the brain and central nervous system in rural areas compared to urban areas for most of the observed period. However, a trend

toward a narrowing of this difference was identified, driven by a more pronounced rate of incidence growth among the urban population. High incidence rates are recorded primarily in the 50-54 age group.

The highest incidence rates are recorded in older age groups. The peak consistently occurred in the 60-64 age group (2003, 2022) or 75-79 age group (2012).

The analysis revealed that the highest incidence rate in 2022 was recorded in the Minsk Region (315.7 cases per 100,000 residents), in 2022 in the Vitebsk Region (301, 2.6 cases per 100,000 residents), and in 2022 in the Gomel Region (344.9 cases per 100,000 residents). The lowest incidence rate in 2012 was recorded in the Brest Region (202.3 cases per 100,000), the Vitebsk Region (214.2 cases per 100,000), and the city of Brest and Minsk (228.7 cases per 100,000).

Analysis of the level, structure, and dynamics of cancer incidence is a crucial tool for assessing public health and the effectiveness of the healthcare system. Therefore, studying this problem highlights the need to develop targeted prevention programs and plan measures to maintain and improve public health.

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ANALYSIS OF CHILD MORBIDITY IN THE CITY OF FANIPOL IN 2019-2023

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retrospective analysis of the morbidity rates of the children's population in the city of Fanipol was conducted in 2019-2023. When analyzing the dynamics of the overall morbidity rate among children, a steady decrease in morbidity was observed. The morbidity rate among children of different ages remains approximately the same. In the structure of morbidity, the first rank is occupied by diseases of the respiratory system, diseases of the ear and mastoid process, as well as diseases of the skin and subcutaneous tissue, injuries, poisoning, and some other consequences of external causes. There is a tendency towards a decrease in the dynamics of morbidity rates for all of the above-mentioned nosologies.

Keywords: morbidity, child population, structure, dynamics, trends, growth rates.

The study of morbidity in individual age groups occupies a special place in the assessment of children's health. The morbidity rate allows us to assess the resistance of the child's body to adverse environmental factors, the functional state of the child's body at different age periods, and the quality of medical care. The study of this level, as well as the structure and dynamics of children's morbidity, serves as the basis for developing and implementing effective measures to promote health.

The purpose of the study is to analyze the morbidity of the children's population in the city of Fanipol in 2019-2023.

Based on official data on the incidence of childhood diseases in the city of Fanipol in 2019-2023, a retrospective analysis of primary morbidity was conducted, the dynamics were analyzed, and the main trends were identified.

The analysis of the dynamics of the overall morbidity of children revealed a steady decrease (R^2=0,8317) in morbidity. In 2019 it amounted to 756,5 cases per 1000 population, whereas in 2023 the indicator decreased to 634,7 cases per 1000 population. The average annual incidence rate (A_0) was 681,7 per 1000 children. The annual trend indicator A_1 =-34,09 per 1000 children. The average annual rate of decline is -2,5%. The most vulnerable age group is children aged 5-9 and 10-14. During the study period, the proportion of children aged 5-9 who fell ill was about 21%, and the proportion of children aged 10-14 was 24-26%. Children under the age of one and 15-17 years old make up the smallest proportion of patients. The incidence of children of different ages is approximately the same. The lowest average long-term incidence rates are observed in the 5-9 years old age group. In the structure of the incidence of the child population of the city of Fanipol, the first rank is occupied by diseases of the respiratory system, diseases of the ear and mastoid process, as well as diseases of the skin and subcutaneous tissue (2019), injuries, poisoning, and some

other consequences of external causes (2023). The percentage distribution is as follows: respiratory diseases – 76-77%, ear and mastoid diseases – 6-7%, skin and subcutaneous tissue diseases – 4%, injuries, poisoning and some other consequences of external causes – 4%. The average annual incidence of respiratory diseases among children was 536,5 cases per 1000 children. The average annual incidence rate of ear and mastoid diseases among children was 48,65 cases per 1000 population, of skin and subcutaneous tissue diseases – 23,6 cases per 1000, and of injuries – 24,6 cases per 1000. There is a downward trend in the incidence rates of all the above-mentioned diseases.

The study and analysis of the morbidity of the child population are of great importance, as knowing the level and structure of morbidity allows not only to assess the degree of health loss, but also to determine the amount of medical, social, and economic damage, and to develop priority areas for improving the health of the analyzed population group.

RETROSPECTIVE ANALYSIS OF THE INCIDENCE OF BRONCHIAL ASTHMA IN THE POPULATION OF THE REPUBLIC OF BELARUS FOR 2013-2022

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Bronchial asthma is a disease that significantly reduces the quality of life, disrupts social relationships, requires significant state financial expenditures, and represents a global medical and social problem. In the Republic of Belarus, bronchial asthma accounts for about 1.5% of all respiratory diseases. It can be noted that the proportion of bronchial asthma cases is increasing. During the study period (2013-2022), an increase in the incidence of bronchial asthma in the population was observed both in the Republic of Belarus as a whole and in all its regions.

Keywords: bronchial asthma, incidence, dynamics, trend.

Bronchial asthma is one of the most common human respiratory diseases, based on chronic inflammation of the airways. Asthma is a heterogeneous disease and manifests itself with respiratory symptoms such as wheezing, shortness of breath, chest tightness, and cough, which vary in time and intensity, accompanied by variable airway obstruction.

The aim of the work is to analyze the incidence of bronchial asthma in the population of the Republic of Belarus for 2013-2022.

Intensive incidence rates were calculated. At the beginning of the observation period in 2013, the intensive incidence rates for bronchial asthma were 619.2 cases per 100,000 population. Throughout the studied period, the dynamics of intensive incidence rates are characterized by a pronounced upward trend. The incidence rate among the population in 2022 increased 1.2 times compared to 2013 and amounted to 749.2 cases per 100,000 population. Peak rates in the studied time segment were recorded in 2020 and amounted to 854.7 cases per 100,000 population; compared to the initial observation period, the incidence increased 1.4 times. The average annual incidence rate of bronchial asthma (A_0) was 747.4 cases per 100,000 population, the annual trend indicator ($A_{1)}$ was 17 cases per 100,000 population.

A comparative analysis of the long-term average level of bronchial asthma incidence in the population of the Republic of Belarus by regions of Belarus was conducted. The highest average annual incidence rate was noted in the Vitebsk region – 991.5 cases per 100,000 population, which is 32% higher than the average national incidence rate (991.5 per 100,000 population). The Gomel region ranked second, where the average incidence rate was 910.2 per 100,000 population, which also exceeds the average incidence rate for the Republic of Belarus. The incidence rate of bronchial asthma in the Minsk region population (774.3 per 100,000 population) also exceeds the national average. This is followed by the city of Minsk – 682.4 per 100,000 population, which is below the national average, Brest region – 641.8 per 100,000 population, Mogilev region – 595.9 per 100,000 population, and Grodno region – 583.8 per 100,000 population.

An analysis of the year-on-year growth/decline rates of bronchial asthma incidence in the population of the Republic of Belarus by region showed that during the period 2014-2022, there were annual fluctuations in population incidence with periods of growth and decline. During the period from 2014 to 2022, the largest decline was recorded in the Mogilev

region in 2022, amounting to -14.2%. The largest increase in incidence rates was also recorded in the Mogilev region and amounted to 22.1%. It is worth noting simultaneous growth/decline in all regions of the Republic of Belarus. Thus, in 2014, 2015, 2017, 2019, and 2020, an increase in incidence was observed in all regions, while in 2016, 2021, and 2022 – a decline. The only exception was 2018, when a decline in incidence was registered in all regions except the Grodno region.

The average annual growth rates were: 1.9% for Brest region; 3.3% for Vitebsk region; 1.3% for Gomel region; 3.5% for Grodno region; 2.8% for Minsk region; 2.7% for Mogilev region and 2.2% for the city of Minsk.

Thus, it must be acknowledged that bronchial asthma represents a global medical and social problem, the solution of which requires the mobilization of resources from the scientific and medical community and healthcare authorities worldwide, as well as constant improvement of diagnostic criteria to detect bronchial asthma at early stages.

MODERN CONCEPTS OF THE EFFECTS OF LOW DOSES AND LOW-INTENSITY IONIZING RADIATION ON A LIVING ORGANISM

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Abstract: There are contradictions caused by the accumulated knowledge about the biological effects caused by the action of low-intensity ionizing radiation on the body. Approaches to rationing the radiation factor are considered: the concept of zero risk (threshold concept), threshold-free concept and the concept of hormesis (positive effect of ionizing radiation).

Keywords: radiation, ionizing radiation, low-dose radiation.

One of the main properties of a living organism is not only the response to low-intensity and low-dose radiation, but also the differentiation of differences in intensity and dose values during the formation of responses. As it has been found from observations in experiments and in nature, the effects of ionizing radiation can be 1) damaging, 2) neutral, 3) beneficial. Currently, there are several points of view from different groups of researchers to explain such different evidence. Despite the variety of points of view put forward, they are all based on the same base - the dose of radiation absorbed by the body, and hence the following problem arises - the problem of rationing the radiation factor, since a person currently comes into contact with radiation at home, at work, during medical examinations, etc. In this regard, several approaches to the rationing of the radiation factor have been formed: the threshold concept, the threshold-free concept and the concept of hormesis. Proponents of the threshold concept proceed from the idea that the effect on the irradiated object has a threshold character, i.e. some kind of maximum allowable value (threshold) of the absorbed dose, above which radiation effects manifest themselves clinically (deterministically), and the severity of their manifestation depends on the absorbed dose. With this concept, the permissible radiation dose should be below the threshold. However, there is no specific single dose threshold for ionizing radiation yet. It should be noted here that there is no threshold of action for energies in accordance with physical laws. Regulations have been legislatively adopted that set maximum permissible doses separately for the public and separately for personnel [1]. The essence of the threshold-free concept is that the effects after irradiation depend linearly on the dose. Thus, it is assumed that even with minimal doses of radiation, there is a risk of effects that will be proportional to the radiation dose received. The concept of radiation hormesis postulates the existence of a threshold dose below which ionizing radiation does not cause negative effects in the irradiated object. The essence of the concept is that small doses can induce positive biological processes and have a stimulating effect on the body [2]. In 2004, an information theory of the effect of low-intensity ionizing radiation was proposed [3], when the energy component of radiation is considered only as a material carrier (and not an active energy factor) of natural signaling information that has a code significance for the body in accordance with I.P. Pavlov's signaling theory on the perception of environmental factors. As for the threshold, there really are thresholds for the perception of signals, they have already been overcome for radiation, since life originated in a background radiation

environment. The positive, negative and neutral effects of radiation are realized in the body in accordance with the content of information and its volume. The information concept makes it possible to explain the radiation paradox, the long-term effects of radiation, the phenomenon of hormesis, the peculiarities of organisms' response to different doses of radiation, the nonlinear nature of the dependence of the biological effect on radiation doses, bystander effect, etc.

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STUDY OF THE EFFECT OF ELECTROMAGNETIC RADIATION (RADIO FREQUENCY - 39.5 GHZ, WAVELENGTH - 7.5 MM) ON THE HEMATOLOGICAL CHARACTERISTICS OF AN ORGANISM IRRADIATED AT A DOSE OF 1 GU

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Abstract: Experimental evidence has been obtained for normalization of stimulated platelet activity in animals irradiated at a dose of 1 Gy, followed by exposure to 7.5 mm EHF radiation for 1 hour.

Keywords: radiation, ionizing radiation, low-dose radiation, EHF radiation.

The experiments studied the effect of EMR with a frequency of 39.5 GHz on the ADP-stimulated platelet activity of rats that were previously exposed to ionizing radiation at a dose of 1 Gy in comparison with similar indicators of animals exposed only to EMR. The general control was a group of intact rats. The parameters of stimulated platelet activity were studied on day 3, 10, 30. In healthy rats, after EMP exposure, no changes in the degree and rate of ADP-stimulated platelet aggregation were detected at all specified times in comparison with the indicators of intact animals. The data obtained indicate that there are no changes in the aggregation activity of platelets in the blood of healthy animals when exposed to EMR at a frequency of 39.5 GHz. In animals exposed to acute gamma radiation at a dose of 1 Gy on the 3rd day of rehabilitation, a clear division of the sample of irradiated animals by the nature of responses to ADP into 2 groups was revealed: 1) with a reduced degree of platelet reactivity and 2) with high reactivity, i.e., a tendency to thrombosis. On the 10th day after irradiation, all animals showed reduced reactivity to ADP. On the 30th day, the sample was again divided into 2 groups with reduced and increased platelet functional activity. After exposure to EMR in animals exposed to ionizing radiation, the parameters of ADP-stimulated aggregation did not differ from the norm in all studied periods. This indicates that the EMR frequency of 39.5 GHz contributes to the normalization of platelet functional activity in irradiated animals.

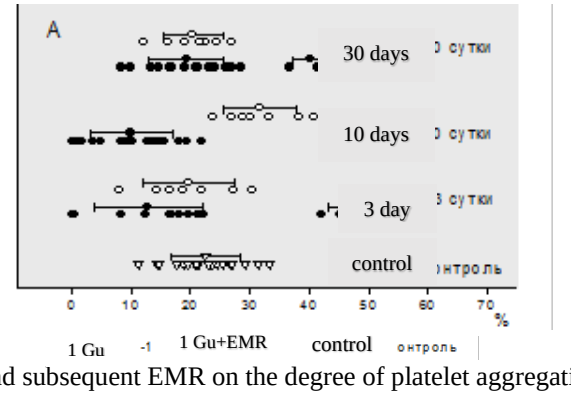

Fig.1. Effect of gamma radiation and subsequent EMR on the degree of platelet aggregation stimulated by $2.4 \cdot 10^{-6}$ M ADP

It has been experimentally proven that the most adequate and pronounced response to EHF EMR occurs in cases where the intensity of the influencing factor falls on the zone of information interaction [1] with the disturbed structures of the body, while frequency characteristics are a signal for the formation of mm-band waves (acoustic and acousto-electric) in resonant systems of the substructures of the body, thus thus contributing to the correction of homeostasis disorders. When homeostasis is normalized, these structures disintegrate [2]. With a single exposure to a healthy body, EHF radiation may not cause any changes, but repeated and chronic exposure negatively affects many organs and tissues.

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COMPARATIVE ANALYSIS OF BEHAVIORAL RESPONSES IN HEALTHY RATS AND RATS WITH EXPERIMENTALLY INDUCED PARKINSON'S DISEASE

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Keywords: Neurodegenerative diseases, cognitive functions, rotenone, Parkinson's model, maze.

Parkinson's disease is one of the most prevalent and rapidly progressive neurodegenerative disorders. Its development is associated with a complex set of pathophysiological mechanisms, including genetic predisposition, dopamine deficiency, degeneration of dopaminergic neurons in the substantia nigra, as well as the influence of previous infectious diseases and traumatic brain injuries. However, despite extensive research, the exact causes of the disease remain unknown. It is assumed that Parkinson's disease arises as a result of the interaction of multiple contributing factors.

Objective: To investigate behavioral responses in healthy rats and rats with an experimentally induced model of Parkinson's disease.

Materials and Methods: The research was performed on male outbred rats, 180–200 g in weight, divided into groups of six. The animals were maintained under standard vivarium conditions, ensuring proper ventilation and controlled temperature. Diet was identical for all rats, with unrestricted access to food and water. To minimize stress and account for the chronobiological characteristics of the animals, all experimental procedures were initiated at the same time each morning, facilitating the establishment of conditioned reflexes. Each rat was individually identified by fur markings using picric acid and brilliant green solutions.

Rotenone was initially dissolved in DMSO, after which approximately 0.1 mL of this solution was mixed with olive oil to achieve a final concentration of 0.5 mg/mL. Rats received intraperitoneal injections of the solution at 2.5 mg/kg to establish an experimental Parkinson's disease model.

The assessment of cognitive functions in rats was carried out using a maze. It is well known that maze testing allows researchers to evaluate factors influencing animals' decision-making and their ability to adapt to changing environmental conditions. This method is applied to assess spatial orientation, memory, and locomotor-exploratory activity in laboratory animals during the development of food-seeking behavior. The approach enables the use of various locomotor-exploratory strategies to evaluate motor performance and its role in the formation of spatial memory in rats under normal conditions and in pathology.

Research results: Training in maze navigation was conducted over several days, with control testing of rats based on maze-running time, exploratory activity, and adaptation speed. The animals were divided into three groups: group 1 – rats with fast responses; group 2 – rats showing average performance; group 3 – rats that poorly completed the assigned tasks. The parameters we evaluated included various forms of motor-exploratory actions that together constitute

locomotor activity during maze navigation. The following behavioral patterns were identified: movements across the maze loci without food reinforcement, goal-directed movements associated with reinforcement, exploration of all maze areas, freezing behavior at the starting platform, number of standing ups, and grooming episodes.

During the study and comparison of behavioral and cognitive characteristics, it was observed that rats with the Parkinson's disease model exhibited impaired motor-exploratory activity. Their maze navigation was considerably slowed, and the number of freezing episodes at the starting point increased. The animals often refused to move through the maze, while the frequency of rearing and grooming behaviors was reduced compared with the control group.

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ISOLATION OF ENDOPHYTES FROM CATHARANTHUS ROSEUS AND THEIR ROLE IN SECONDARY METABOLITE SYNTHESIS AND ECOLOGICAL SIGNIFICANCE IN BIODIVERSITY CONSERVATION

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This study focuses on the isolation of endophytic microorganisms from Catharanthus roseus and the investigation of their role in secondary metabolite synthesis as well as their ecological significance in biodiversity conservation. The results indicate that endophytes enhance plant growth, tolerance to environmental stress, and the production of medicinal compounds. These findings highlight the potential of endophytes not only in biotechnological applications but also in maintaining the stability and sustainability of natural ecosystems.

Keywords: Endophytes, Catharanthus roseus, secondary metabolites, ecological significance, biodiversity conservation.

In recent decades, the conservation of biodiversity and the maintenance of ecological balance have become key priorities in modern scientific research. The discovery and utilization of bioactive natural products from plants have attracted significant attention in pharmaceutical and biotechnological industries[1]. Among the most promising natural sources of bioactive compounds are endophytic microorganisms – microbes that reside within plant tissues without causing any harm to their host. These endophytes are known to enhance plant growth, increase resistance to environmental stress factors, and play a vital role in the biosynthesis of secondary metabolites.Catharanthus roseus (commonly known as Madagascar periwinkle) is a medicinal plant belonging to the family Apocynaceae[3]. It produces a wide range of pharmacologically important alkaloids, such as vinblastine and vincristine, which are used in the treatment of cancer. Endophytic microorganisms associated with C. roseus possess diverse metabolic capabilities and often synthesize similar or novel bioactive compounds[4]. These microorganisms contribute to the plant's overall fitness, promote ecological balance, and have great potential in sustainable biotechnological applications.The main objective of this study is to isolate and characterize endophytic microorganisms from Catharanthus roseus, evaluate their potential in secondary metabolite synthesis, and assess their ecological role in biodiversity conservation. The findings of this research may provide valuable insights for future applications in biotechnology, pharmacology, and environmental sustainability[6].The ecological significance of endophytes is also substantial. They maintain a mutualistic relationship with plants and play an important role in preserving the food chain and microbiological balance within ecosystems[7]. Through endophytes, plants develop greater adaptability to their natural environment, which contributes to the conservation of biodiversity. Therefore, the isolation of endophytic microorganisms, the identification

of their biochemical properties, and the evaluation of their ecological functions are important not only from a scientific perspective but also from a practical standpoint.

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EFFECT OF LUTEOLIN ON THE FORMATION OF MALONIC DIALDEHYDE UNDER OXIDATIVE STRESS

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The study found that luteolin dose-dependently corrects the formation of malondialdehyde during oxidative stress induced by alloxan.

Keywords: luteolin, oxidative stress, malonic dialdehyde.

Oxidative stress (OS) is a process that develops as a result of an imbalance between the antioxidant and prooxidant systems, leading to disruption of metabolic and energy processes in the organism [1]. The development of oxidative stress in the organism can lead to DNA hydroxylation, protein denaturation, lipid peroxidation (LPO) and apoptosis, which ultimately leads to cell death [2]. It has been shown that many pathologies are associated with OS, especially diseases of the gastrointestinal tract, cardiovascular, excretory, respiratory and nervous systems [3; 4; 5; 6]. Free radicals generated as a result of OS have been found to indirectly influence the modulation of cellular processes such as autophagy, proliferation and apoptosis [7]. Thus, the formation of a large number of reactive oxygen species leads to the development of the OS process.

To study the effect of the flavonoid luteolin on the formation of malonic dialdehyde (MDA) in alloxan-induced OS in vivo.

The flavonoid luteolin, produced by MacKlin Chemicals (China), was used in the experiments. The purity of this flavonoid is 98%. Alloxan monohydrate (Chemapol, Czech Republic), tris-HCl, trichloroacetic acid (TCA) (Reaxim, Russia), and 2-thiobarbituric acid (TBA) (MacKlin Chemicals, China) were also used.

Ramkumar and colleagues [8] showed that alloxan, in addition to its pathological effect on pancreatic β-cells, leads to the development of the lipid peroxidation process in other organs and tissues. The animals were divided into 4 groups: Group I – control; Group II – animals that were administered alloxan subcutaneously at a dose of 150 mg/kg and OS was induced; groups of animals that were administered luteolin orally at a dose of 10 mg/kg (Group III) and 50 mg/kg (Group IV) for 10 days after the induction of OS. On the 11th day of the experiment, the animals were decapitated, blood was collected and the pancreas was removed. Blood from animals was collected in a 1:10 ratio with citrate buffer, centrifuged at 3000 rpm for 15 min, and serum was isolated.

The homogenate was prepared from the pancreas using 0.9% physiological NaCl solution in a ratio of 1:10. Determination of MDA in blood serum and pancreas homogenate. To 1.0 ml of blood serum or 1 ml of 4-fold diluted pancreas homogenate were added 1.0 ml of 0.1-molar phosphate buffer (pH 7.6), 0.5 ml of 30% TCA and 2.0 ml of 0.8% TBA, the tubes were covered with foil and placed in a boiling water bath for 15 minutes. The suspension was centrifuged at 3000 rpm for 10 minutes to sediment tissue particles. Then, the optical density of the supernatant was determined using a spectrophotometer at a wavelength of $\lambda = 532$ nm by comparing 2.0 ml of 0.1 molar phosphate buffer (pH 7.6), 0.5 ml of 30% TCA and 2.0 ml of 0.8% TBA [9].

According to the obtained results, in control animals of group I, the MDA content in the blood serum and pancreas was 6.9±0.72 μmol/ml and 5.5±0.48 μmol/g tissue, respectively, whereas in OS caused by alloxan, that is, in animals of group II, the MDA content was 17.0±0.54 μmol/ml and 17.3±0.54 μmol/g tissue, respectively. It was established that the MDA content in the blood serum and pancreas of animals of the third experimental group, corrected with 10 mg/kg of the flavonoid luteolin, was 9.1±1.2 μmol/ml and 10.0±0.92 μmol/g of tissue, respectively, and in the fourth experimental group, corrected with 50 mg/kg of the flavonoid luteolin, the MDA content was 7.3±0.31 μmol/ml and 5.35±0.77 μmol/g of tissue, respectively.

The results show that luteolin dose-dependently corrected oxidative stress and resulted in a statistically significant reduction in serum and pancreas MDA levels.

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BIOIMPEDANCE-BASED EVALUATION OF VISCERAL OBESITY IN PATIENTS WITH TYPE 1, TYPE 2, AND POST-COVID DIABETES

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Visceral fat plays a key role in the pathogenesis of metabolic disorders and is associated with an increased risk of complications diabetes mellitus. Following the COVID-19 pandemic, there has been a rise in cases of so-called post-COVID diabetes, the etiopathogenesis of which remains insufficiently studied, particularly in relation to fat distribution patterns.

*Keywords***:** visceral fat, bioelectrical impedance analysis, diabetes mellitus, post-COVID syndrome, fat amount, metabolism

Introduction

Visceral fat (VF) is not merely an energy reserve but a powerful endocrine organ. It actively secretes adipokines (such as resistin, IL-6, TNF-α), which directly contribute to insulin resistance, chronic systemic inflammation, and endothelial dysfunction. Therefore, its accurate quantitative assessment (for example, using bioimpedance analysis) is critically important for prognosis. Visceral fat is a type of adipose tissue that surrounds internal organs such as the liver, pancreas, and intestines. Unlike subcutaneous fat, which is located directly under the skin, visceral fat lies deeper within the abdominal cavity.

Literature review and methodology

The study is a pilot, single-center, cross-sectional, comparative study. It included men and women aged 50 to 65 years with an established diagnosis of diabetes mellitus (DM) or healthy volunteers. A total of 20 participants were included: 5 healthy individuals, 5 patients with type 1 diabetes, 5 patients with type 2 diabetes, and 5 patients with post-COVID-19 diabetes, aged 50–65 years.

The analysis was conducted using specialized equipment designed to assess body composition, water balance, muscle mass, and fat mass. The bioimpedance analysis method is based on measuring the resistance of biological tissues to electric current, which allows determination of the percentage ratio of various body components [10]. For result interpretation, standardized tables and reference values recommended by the World Health Organization (WHO) were used.

Statistical data processing included the use of Student's t-test to determine the significance of differences between groups. All data were presented as mean values ± standard deviation. A p-value < 0.05 was considered statistically significant.

Table 1. Body mass index, visceral fat level, and total fat content in patients with diabetes mellitus compared to the control group

Parameter	Control group (n = 20)	Type 1 diabetes (n = 20)	Type 2 diabetes (n = 20)	post-COVID diabetes (n = 20)
visceral fat	8,7±0,56125	10±1,27475▲	12,9±2,30976▲*	11,4±0,79687▲*
Total fat content, %	40,2±1,27043	29,24±4,806▲*	35,62±6,52376▲	41,26±4,76672▲
Body mass index, kg/m²	29,3±1,19206	27,74±0,54918▲*	30,72±2,70378*	31,24±1,43129*

Note:

* p < 0.05 compared with the control group;

** – p < 0.05 compared with patients with type 1 diabetes;

▲ – p < 0.05 compared with patients with type 2 diabetes.

Results and Discussion

A comparative analysis revealed significant differences in the level of visceral fat (VF) measured using the Tanita bioimpedance analyzer. The highest VF values (up to 21.0 units) were recorded in the group with type 2 diabetes mellitus (Group 3), which is consistent with the well-known role of visceral obesity in the pathogenesis of this type of diabetes.

The minimum VF level was highest in the post-COVID-19 diabetes group (9.5 units), which exceeds the minimum values observed in both the healthy control group (7.0 units) and the type 2 diabetes group (7.0 units). The range of VF levels in the type 1 diabetes group was shifted toward higher values compared to the healthy control group, indicating a high prevalence of "double diabetes" – a condition combining autoimmune β-cell destruction with acquired insulin resistance.

Conclusion

The results obtained demonstrate that patients with different types of diabetes mellitus exhibit pronounced alterations in water and fat balance compared to the control group. The most noticeable increase in total body water content was observed in patients with type 1 diabetes, which may be associated with osmotic disturbances and changes in intracellular hydration resulting from insulin deficiency. In patients with post-COVID-19 diabetes, water content values occupied an intermediate position, indicating the persistent influence of post-viral metabolic disturbances. Anthropometric analysis showed that patients with type 2 diabetes and post-COVID-19 diabetes displayed increased body mass index (BMI) and visceral fat levels, reflecting a tendency toward the development of metabolic syndrome and insulin resistance. In contrast, patients with type 1 diabetes demonstrated a reduction in total body fat mass, consistent with the catabolic processes' characteristic of insulin deficiency.

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COMPARATIVE ANALYSIS OF THE CONTRIBUTION OF *COL1A1* AND *COL1A2* GENES TO THE DEVELOPMENT OF OSTEOGENESIS IMPERFECTA IN BELARUSIAN PATIENTS

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The study presents the results of a genetic study of 92 patients with osteogenesis imperfecta. High-throughput sequencing of the protein-coding sequence of type I collagen genes has been performed. The probable pathogenicity and functional significance of the identified variations were assessed.

Keywords: osteogenesis imperfecta, COL1A1, COL1A2, type I collagen.

Osteogenesis imperfecta (OI) is a heterogeneous hereditary disease characterized by impaired synthesis and structure of type I collagen [1]. Mutations in the *COL1A1* and *COL1A2* genes encoding the alpha1(I)- and alpha2(I)-procolagen chains play a key role in pathogenesis. A violation in the structure of the triple helix of collagen procolagen leads to the formation of collagen with impaired stability and functionality [2].

The *COL1A1* gene contains 18,000 pairs of nucleotides and 51 exons. A wide range of mutations, including missense, nonsense, characterizes this gene and splice site mutations, as well as deletions and insertions leading to a shift in the reading frame [2, 3]. Most often, mutant *COL1A1* alleles cause a decrease in the production of functioning type I collagen, which is clinically manifested in mild to moderate forms OI with a relatively favorable prognosis. Mutations leading to impaired triplex formation and qualitative abnormalities of collagen in this gene, although less common, are associated with severe forms of pathology [4].

The second key gene, *COL1A2*, contains 38,000 pairs of nucleotides and 52 exons. It is known that mutations in *COL1A2* are predominantly associated with qualitative defects in collagen. The clinical phenotype of *COL1A2* damage is characterized by more severe lesions of the bone system, including fractures with a low-traumatic mechanism, pronounced skeletal deformities and a marked decrease in bone mineral density. Such mutations often affect critical regions of the gene responsible for the formation of the procolagen triple helix [3].

The object of the study was 92 blood samples from patients with osteogenesis imperfecta. High-throughput sequencing of the protein-coding sequence of type I collagen genes was performed using the pair-terminal reading method using the Illumina MiSeq device. According to the results of high-throughput sequencing, a total of 2139 variations in the protein-coding sequence of the *COL1A1* and *COL1A2* genes were detected in 92 patients. The assessment of the probable pathogenicity and the functional significance of the identified variations was carried out using the PoplyPhen-2, SIFT, and MutationTaster programs.

A comparative analysis of the mutant allele spectrum shows that variations in *COL1A1* are more common (about 70% of cases) than in *COL1A2* (about 30%), which is explained by their frequency in the population and the peculiarities of genetic expression. Glycine-altering missense mutations often turn out to be dominant-negative: they delay the formation of the triple helix, cause excessive posttranslational modification of procolagen and disruption of molecular

secretion. This usually leads to severe forms of OI (for example, type II–IV). On the contrary, nonsense and FS mutations usually lead to defective transcription of one allele, an approximately 50% decrease for collagen I, and, as a rule, a milder phenotype (type I OI).

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THE EFFECT OF FEED ADDITIVES PREPARED FROM LOCUSTS ON THE GROWTH RATE AND FEED UTILIZATION INDICATORS OF CHICKS

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In this thesis, scientific sources on the effect of feed additives prepared from locusts on the growth rate and feed utilization efficiency of chicks were theoretically analyzed. According to the results of various studies, the inclusion of 5–15% locust meal in feed increases the growth rate of chicks, promotes healthy development, and enhances feed utilization efficiency. In addition, the high protein content of locust meal, its balanced amino acid composition, and the presence of beneficial fatty acids are considered factors that improve its biological value.

Keywords: locust meal, feed additive, feed conversion ratio, biological value, protein sourc.

Introduction

In recent years, the global shortage of protein sources for animals has become one of the most pressing issues. In particular, in the poultry industry, protein components account for 60–70% of the total feed cost. Therefore, the need to find alternative, low-cost, and environmentally friendly protein sources to replace traditional fish meal or soybean meal is increasing.

Locusts have long been used in human food and animal feed. Their protein content ranges from 50–60%, and fat content reaches up to 20–25%, with a completely balanced amino acid composition. For this reason, feed additives made from locusts are considered not only biologically rich but also economically and environmentally promising.

The purpose of this study is to theoretically analyze, based on available scientific literature, the effects of feed additives prepared from locusts on the growth rate, feed efficiency, and biological development of chicks.

Literature revive and methodology

The use of locust meal in poultry feed has been discussed in numerous international studies. Rumpold and Schlüter (2013) analyzed the ecological and nutritional advantages of insect proteins and evaluated them as potential alternatives to traditional animal protein sources. Belluco et al. (2015) found that the inclusion of 5–15% locust meal in poultry feed increased growth performance and improved meat quality.[8]

According to Oniango (2018), chicks fed with locust meal had an average body weight gain that was 12–15% higher than that of the control group.[9] Khusainov et al. (2020) theoretically substantiated the production and artificial breeding technologies of locust meal under local conditions in Uzbekistan.[10]

Table 1. The Effect of Locust Meal on the Average Growth Rate of Chicks (Based on Theoretical Analysis)

Groups	Initial Weight (g)	42-day Weight (g)	Averange Daily (g/day	Growth Rate(%)
Control (0% locust meal)	42.1 ± 0.7	1345 ± 35	40.0 ± 1.3	100
5% locust meal	41.5 ± 0.9	1910 ± 40	44.6 ± 1.1	111.5
15% locust meal	42.3 ± 0.7	1980 ± 45	46.2 ± 1.4	115.5

Source: Summarized from Belluco et al. (2015), Oniango (2018), and Rumpold & Schlüter (2013).

Explanation:

As seen in the table, the inclusion of locust meal up to 10% in chick diets resulted in a notable improvement in growth performance. Compared to the control group, chicks receiving locust meal showed a 12–15% higher growth rate. This enhancement is mainly attributed to the high digestibility of locust protein and its well-balanced amino acid profile. Furthermore, locust meal provides valuable micronutrients and unsaturated fatty acids, which play an essential role in improving metabolism and muscle tissue development. The findings suggest that moderate inclusion of locust meal in feed can optimize nutrient absorption and support healthy physiological growth in poultry.

According to the reviewed literature, adding a certain amount of locust meal to poultry feed has a positive effect on the growth performance of chicks and improves feed utilization efficiency. This effect is mainly explained by the high digestibility of locust protein and its well-balanced amino acid composition.

The rich content of beneficial fatty acids and trace minerals in locust meal enhances metabolic activity, strengthens the immune system, and supports healthy development. Studies have shown that such feed composition can accelerate growth while reducing feed consumption.

Overall, feed additives made from locusts are considered an economically beneficial, environmentally friendly, and promising component in modern poultry nutrition

Discussion of results

The study of different sources shows that locust meal has a good effect on the growth and health of chicks. Many researchers said that when locust meal is added to the feed, the birds grow faster and use their food more efficiently.

Locust meal has a lot of protein that is easy to digest and contains all the important amino acids. It also has healthy fats, vitamins, and minerals that help the chicks grow well and stay strong. These nutrients make the metabolism work better and help improve the immune system.

In addition, locust meal can help the digestive system because it has some natural substances that support gut health. It can also replace other protein feeds like fishmeal or soybean meal, which are more expensive and less eco-friendly.

Using locust meal is also good for the economy and the environment. Locusts can be grown locally with little land and water, which makes them a cheap and sustainable source of protein. This helps reduce the need for imported feed and supports local feed production.

In general, locust meal is a good and safe feed additive for poultry. It helps chicks grow faster, eat better, and stay healthy, while also being friendly to nature and cost-effective for farmers.

This article was prepared within the framework of the applied research project No. AL-9524115100 titled “Development of technology for obtaining unconventional protein and nutrients from locusts in Uzbekistan”, conducted at the Faculty of Biology and Ecology, National University of Uzbekistan.

Conclusion

The theoretical analysis conducted throughout this study indicates that feed additives derived from locusts can serve as a sustainable and biologically valuable alternative to traditional protein sources in poultry production. The inclusion of 5–10% locust meal in the diet of chicks resulted in improved growth performance and higher feed utilization efficiency. Based on reviewed literature, the growth rate of chicks increased by approximately 12–15%, while the feed conversion ratio (FCR) decreased from 1.9 to 1.66.

These results are largely attributed to the high protein content of locust meal (55–60%), its balanced amino acid composition, as well as the presence of essential fatty acids and trace minerals. Such components stimulate metabolic activity in the organism, strengthen immune function, and contribute to the healthy physiological development of poultry.

From an economic perspective, incorporating locust meal into poultry diets helps to reduce dependence on imported protein sources such as fish meal and soybean meal. This reduction not only lowers feed production costs but also increases the profitability of poultry farms. Environmentally, locust rearing requires fewer resources compared to conventional livestock protein production, thereby supporting ecological sustainability.

Moreover, the development of locust farming and processing technologies under local conditions in Uzbekistan could help establish a stable domestic source of protein. This would enhance food security, reduce import dependency, and support a circular and environmentally friendly agricultural system.

In summary, the integration of locust-based feed additives into poultry nutrition can be considered a promising and innovative direction from biological, ecological, and economic viewpoints. Further experimental research is

recommended to determine the optimal inclusion rates, evaluate long-term physiological effects, and expand practical applications in sustainable animal feeding systems.

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INHIBITORY EFFECT OF CALCIUM IONS ON GLUCOSE ABSORPTION IN THE SMALL INTESTINE

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Glucose absorption was studied from isolated rat small intestines after adding calcium at various concentrations to the intestinal incubation. It was found that glucose absorption slows as calcium concentration in the small intestine increases. This phenomenon may be useful for diabetes management.

Keywords: white rats, small intestine, calcium gluconate, glucose absorption.

Studying glucose metabolism is crucial for understanding the mechanisms of many diseases, diagnosing them, and developing effective treatments, including new drugs. Preventing elevated blood glucose levels is essential for preventing complications, such as diabetes, which is characterized by high blood glucose levels impaired carbohydrate metabolism.

Mineral elements play a key role in the regulation of carbohydrate metabolism, as many of them act as coenzymes for carbohydrate metabolism enzymes. Magnesium, manganese, iron, zinc, copper, and cobalt are such cofactors. Being mineral components of coenzymes, [1]. However, despite the fact that many of mineral elements are consumed in food, their effect on glucose absorption has not been studied.

The aim of this research was - study the effect of calcium ions on glucose transfer from the small intestinal lumen to the bloodstream.

For this purpose, rats were anesthetized with ketamine-chelazine preparations (70 mg/kg). Anesthesia was performed in accordance with the IACUC University of Iowa's "Injection Anesthetic Agents" guideline for use in laboratory animal procedures [2} For study of glucose absorption the abdominal cavity was opened, and a 20 cm long section from the ileum was isolated using ligatures. Plastic tubes were inserted on both sides of the isolated intestine and the isolated intestine was washed from the proximal end to the distal one with 2 ml of physiological saline warmed to 37°C. Calcium gluconate was added to the incubation medium in the intestine at concentrations from 0.1 to 1.0 mmol/L. After this, a 0.5% glucose solution heated to 37-38° was introduced into the small intestine segment. Calcium gluconate was added to the incubation medium in the intestine at concentrations from 0.1 to 1.0 mmol/L. After 15 minutes of incubation, the amount of glucose in the intestinal in the incubate and in the blood from the rat's tail level of glucose was determined. To obtain blood the tail was immersed in water heated to 40°C for 3-5 minutes. An incision was made on the skin near the tip of the tail from the ventral side with a sharp knife, and a glucometer strip was placed

on the resulting drop of blood. Blood glucose was determined using a glucometer (Accu-Chek, Germany). It turned out that, that calcium exerted a concentration-dependent effect on glucose absorption as calcium concentration increased

Calcium is known to be one of the main universal signaling ions in the cell, which can activate or inhibit many enzymatic and transport processes [3]. Our observations showed that it can also inhibit glucose transport from the intestine into the bloodstream; i.e., when glucose enters intestinal epithelial cells, it can participate in the regulation of transporter activity. It can be hypothesized that calcium is capable of modulating the activity of these transport proteins through calcium-dependent protein kinases, influencing the expression and localization of transporters on the apical membrane of enterocytes.

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THE EFFECT OF INTERMITTENT FASTING ON HEMATOLOGICAL PARAMETERS UNDER ALLOXAN-INDUCED DIABETES CONDITIONS

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Diabetes mellitus is a metabolic pathology in which diet therapy plays an important role in treatment. It has been shown that intermittent fasting is of great significance in metabolic disorders [1]. However, there is almost no information about the effect of intermittent fasting in diabetes mellitus. Therefore, the aim of this study was to investigate the effect of intermittent fasting on certain hematological parameters in diabetes mellitus.

Materials and Methods.

In the study, sexually mature, white, non-pedigreed male rats weighing 180–200 g were used. The animals were randomly divided into three groups: control, diabetic, and diabetic + intermittent fasting.

Alloxan monohydrate (Sigma-Aldrich, USA) was administered intraperitoneally to the rats in the experimental group at a dose of 50 mg/kg in a volume of 0.3 ml for three consecutive days at 24-hour intervals. The control group rats received physiological saline using the same method and at the same intervals. The glucose level was measured by collecting blood samples from the tail vein of the rats. Rats with a blood glucose concentration higher than 15 mmol/L were considered diabetic.

The rats in the diabetic + intermittent fasting group were subjected to a feeding regimen in which they were given only drinking water three days a week and a low-calorie, diet-adapted laboratory feed for the remaining four days. This regimen was maintained for one month. Such a dietary approach was aimed at analyzing metabolic adaptation and homeostatic responses in the animal organism.

At the designated time, blood samples were collected from the tail vein, and hematological parameters such as red blood cell count, hemoglobin level, and white blood cell count were determined using a modern automatic hematology analyzer (DYMIND DH36).

For statistical analysis, the mean values were compared using Student’s *t*-test in the OriginPro 8.6 software. The results were considered statistically significant at *P* < 0.05.

Results and Discussion.

The table below presents the mean values of hematological parameters — leukocytes, erythrocytes, and hemoglobin – in all three groups.

Changes in the levels of leukocytes, erythrocytes, and hemoglobin in the blood of rats under alloxan-induced diabetes conditions (M±m; n=6)

Parameters	Control group	Diabetic group	Diabetic + short-term fasting	Difference (relative to diabetic group, %)
Leukocytes (10^9/L)	6,2 ± 0.4	10.1 ± 0.7*	8,1 ± 0.5	+81,1%
Erythrocytes (10^{12}/L)	7,5 ± 0.3	4.2 ± 0.2*	6,6 ± 0.3	–30,7%
Hemoglobin (g/dL)	14,1 ± 0.5	9.3 ± 0.4*	12,8 ± 0.6	–27,0%

Note:– statistically significant differences compared to the control group of rats.

As seen from the table above, in alloxan-induced diabetic rats, the number of leukocytes increased, while the number of erythrocytes and the level of hemoglobin significantly decreased. This condition is primarily explained by chronic inflammatory processes that develop against the background of hyperglycemia. Oxidative stress and elevated cytokine levels resulting from hyperglycemia suppress hematopoiesis, which leads to impaired bone marrow function and a slowdown in the formation of new erythrocytes [1]. In addition, in diabetes mellitus, an increase in glycated hemoglobin, a decrease in erythropoietin production in the kidneys, and enhanced hemolytic processes are also important factors contributing to the development of anemia [2,3].

The increase in the number of leukocytes is associated with the compensatory response of the organism against inflammation and oxidative stress, as activation of immune cells is observed under hyperglycemic conditions [4]. At the same time, the high concentration of glucose can also alter the activity of the neuroendocrine system, leading to an imbalance in the immune system.

However, in diabetic rats subjected to an intermittent fasting regimen for one month, these indicators approached those of the control group. This condition is probably explained by the relative stabilization of glucose and insulin levels under intermittent fasting, a decrease in oxidative stress markers, and the activation of metabolic adaptation mechanisms

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EFFECTS OF LOCUST PROTEIN ON THE IMMUNE SYSTEM OF CHICKS

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In recent years, the use of alternative protein sources in poultry nutrition has gained attention due to the rising cost of conventional feed ingredients. Insects such as locusts represent a sustainable and protein-rich alternative. This study focuses on evaluating the effect of locust-derived protein on the immune system of broiler chicks. The objective of this study was to determine the impact of locust protein inclusion on immune response parameters in chicks, including antibody production, leukocyte counts, and lymphoid organ development.

Keywords: riboflavin, Salmonella, chitin,immune cells, broiler chickens, fatty acids, locusts.

The most common type of grasshopper on the planet is the migratory locust. The protein content of some species of locusts ranges from 500g/kg of dry weight to approximately 600 g/kg, making them an excellent source of protein to animals. Locusts are an excellent source of protein (500–650 g/kg), poly- unsaturated fatty acids (omerga-3 and 6), minerals (phosphorus, iodine, iron), and vitamins (riboflavin, thiamine, niacin) [3].

A dried insect s considered suitable for poultry diet because the water content in fresh or live insect stimulates the degradation, antimicrobial activity, and Millard reaction [5,6].

The exoskeleton of insects mainly consists of chitin, which improves the immune system of chicken , however, chicken cannot synthesize the chitin [1,]. Chitin and chitin derivatives can stimulate the innate immune cells [8]. Broiler chickens fed the diet containing mealworm meal (MWM) have better disease resistance, and immune response due to prebiotic effect of chitin [2]. Chitin in diet also halts the growth of Escherichia coli, Salmonella, and Salmonella enterica serovar Typhimurium in broiler chickens [5].

Locust (Orthoptera) meal (OTM) is a rich source of protein, amino acids, fatty acids, minerals, and vitamins [7]. The concentration of CP ranged from 48% to 65% and crude fat ranged from 3% to 21%. Short horned grasshopper (Oxya hyla hyla) contains about 64.67% CP, 2.58% crude fat [8], reared African grasshopper (Acanthacris ruficornis) contains about 50.5% CP and 18.8% crude fat, desert locust (Schistocerca gregaria) contains about 50.9% CP and 20.5% crude fat, and wild edible grasshopper (Ruspolia nitidual) contains about 52% CP and 21.4% crude fat [9].

The Moroccan locust (Dociostaurus maroccanus) is one of the most widespread species in the desert and steppe regions of Uzbekistan, known for causing considerable damage to plant biomass [10]. However, its high protein (60–70%) and lipid (10–15%) contents make it a promising biotechnological resource with significant nutritional potential. Similarly, the haloxylon buck-tooth locust (Dericorys albidula) is a characteristic species adapted to semi-desert ecosystems and feeds primarily on vegetation [11].

Despite their abundance, there is a lack of comprehensive research on the ecological roles, biochemical composition, and nutritional value of these locust species under Uzbekistan's environmental conditions. While some studies have reported on the chemical composition of certain foreign locust species, detailed analyses of the local D. maroccanus and D. albidula populations remain scarce. Therefore, the primary objective of this study was to scientifically assess the chemical composition, ecological significance, and nutritional potential of these two locust species native to Uzbekistan's natural habitats.

Locusts (e.g., Schistocerca gregaria, Locusta migratoria) are nutrient-rich insects containing 55–70% crude protein, essential amino acids, and bioactive compounds such as chitin, antimicrobial peptides, and fatty acids. These components can stimulate immune functions and improve disease resistance in poultry.

Because the immune system plays a vital role in chick survival and growth, incorporating locust protein in feed can enhance both innate and adaptive immune responses.

The use of locust meal may enhance protein metabolism in the bloodstream and optimize metabolic processes that are closely associated with the immune system.

Table

Dociostaurus maroccanus and *Dericorys albidula* Immun and biochemical parameters of broiler chickens

Groups	IgG (g/l)	IgM (g/l)	Total Protein (g/l)	Albumin (g/l)	Globulin (g/l)
1.Control (standard grain)	3,7 ± 0,47	1,14 ± 0,21	18.71 ± 1,52	14,9 ± 0,61	14,82 ± 0,78
2.Locust (DM) meal 15% + 85% grain	4,21 ± 0,12	1,32 ± 0,41	19.12 ± 0,52	15,8 ± 0,77	15,62 ± 0,82
3.Locust (DM) meal 25% + 75% grain	4,62 ± 0,32	1,46 ±0,34	22.76 ± 0,61	15.5 ± 0,79	17,84 ± 0,54
4.Locust (DA) meal 15% + 85% grain	4,37 ± 0,4	1,38 ± 0,35	21.53 ± 0,76	16,1 ± 0,31	14,61 ± 0,61

The inclusion of locust meal in the diet of broiler chickens positively affected their immunological and biochemical parameters compared to the control group. Birds receiving locust meal showed higher levels of immunoglobulins (IgG and IgM), indicating improved immune response and resistance. In addition, the total protein, albumin, and globulin concentrations were increased, reflecting enhanced protein metabolism and better physiological status. The group with 25% locust (DM) meal showed the highest total protein and globulin levels, suggesting that a higher inclusion rate of locust meal can further strengthen immune function and metabolic efficiency in broiler chickens. Overall, the results demonstrate that locust-based protein can be used as an effective natural feed supplement to improve health and productivity in poultry.

Locust protein supports the immune system through several pathways: Amino Acids: Arginine, lysine, and methionine improve antibody synthesis and lymphocyte proliferation. Chitin and Chitosan: Found in locust exoskeletons

– act as natural immunostimulants that activate macrophages and T-cells.Antimicrobial Peptides (AMPs): Possess antibacterial and antiviral properties, supporting gut and systemic immunity.Fatty Acids: Lauric and oleic acids improve the immune barrier and inflammatory balance.

The findings of the present study indicate that the inclusion of locust meal as an alternative protein source in the diet of broiler chickens exerts a positive influence on their growth performance, physiological state, and immune function. In particular, the groups receiving 15% and 25% locust meal exhibited improved body weight gain, enhanced feed conversion efficiency, and better overall physiological condition compared to the control group.The immunological parameters further confirmed the beneficial effects of locust meal supplementation. The elevated levels of IgG and IgM suggest an enhanced immune response in the birds, while the increases in total protein, albumin, and globulin concentrations reflect an activation of protein metabolism and improved physiological balance.

Overall, the results demonstrate that feed formulations containing locust meal derived from Dociostaurus maroccanus and Dericorys albidula can serve as effective and sustainable protein sources in poultry production. These insect-based feeds not only promote growth and productivity but also strengthen the immune system, improve meat quality, and offer an economically viable alternative for the poultry industry.

This article was prepared within the framework of the applied research project No. AL-9524115100 titled “Development of technology for obtaining unconventional protein and nutrients from locusts in Uzbekistan”, conducted at the Faculty of Biology and Ecology, National University of Uzbekistan.

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CHALLENGES OF MODERNITY: ENVIRONMENTAL AWARENESS

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The paper considers environmental education as a response to the growing number of natural disasters and global environmental challenges. It’s role in achieving the UN Sustainable Development Goals is being investigated. The definition and goals of environmental education aimed at the formation of ecological culture in society are given. To assess the effectiveness of such programs, data from international ratings, in particular the Global Sustainable

Development Index, are analyzed. The importance of investments in this area is shown by the example of the progress of Russia and other countries. In the conclusion stated the key role of education for the future of the planet.

Keywords: environmental awareness, Sustainable Development Goals (SDGs), environmental culture, sustainable development, global issues, environmental protection.

On average, about 347-368 natural disasters occur annually, although the exact number varies and tends to increase. There is the Sustainable Development Goals (SDGs) program, which highlights 17 global challenges aimed at eradicating poverty, combating inequality, protecting the planet, and ensuring peace and prosperity for all by 2030. [1] These include eliminating poverty and hunger, ensuring health and quality education, achieving gender equality, access to clean water and sanitation, affordable and clean energy, decent work and economic growth, as well as combating climate change and protecting marine and terrestrial ecosystems. [2]

In this paper, we will touch upon one of the solutions to some problems: environmental awareness. Due to the growing number of environmental problems, it has become important to talk about how to avoid natural disasters and what should be followed in order to reduce our trace footprint on our planet.

Environmental problems began to be noticed and talked about in the early 20th century. The UNESCO International Conference in 1968 laid the foundations for environmental education, and the UN Conference in Stockholm in 1972 confirmed the link between education and the state of nature. In 1975, the International Environmental Education Program was established. That's how the Environmental awareness movement began. [3]

But it is important not to confuse environmental awareness with the field of education. Environmental education is not in the literal sense of getting degrees, it is a voluntary and additional activity. Environmental education is the process of spreading knowledge about the state of the environment, environmental safety and a healthy lifestyle, aimed at forming an ecological culture and responsible attitude towards nature among people. It includes educating, educating, and informing the public, which helps people better understand the importance of preserving nature and doing the right thing. Its goal is to create an ecological culture in society, as well as a careful and responsible attitude towards nature.

In order to assess the effectiveness of developing the right attitude and thinking within the framework of environmental education programs, it is important to see indicators that show changes in favor of improving the state of the environment. The United Nations Organization for Sustainable Development (Sustainable Development Solutions Network – SDSN) has published the "Global Index of Sustainable Development-2025". With it, we can see the results regarding our country: Russia has risen from 56th to 51st place in this ranking. Finland (87 points), Sweden (85.7 points) and Denmark (85.3 points) took the first places in the SDSN rating. South Sudan is in the last, 167th place (41.6 points). It is noteworthy that 18 positions in the top twenty are occupied by European countries. The United States is only on the 44th line (75.2 points), two positions lower than in 2024. India and China were able to rise to 99th and 49th places, respectively (109th and 68th last year). The United Arab Emirates lost ground, dropping from the 70th to the 80th position of the rating. The results have been achieved through huge investments and, of course, environmental education activities, which is typical for these countries. [4]

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STUDY OF THE EFFECT OF PLANT EXTRACTS ON BLOOD COAGULATION PARAMETERS IN RATS WITH ADRENALINE-INDUCED HEART INJURY

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This study investigated the effects of Crataegus turkestanica and Leonurus turkestanicus extracts on blood coagulation in rats with adrenaline-induced myocardial injury. The model was created by a subcutaneous injection of 0.1% adrenaline (0.15 ml/100 g). Fifteen minutes later, animals received plant extracts (100 mg/100 g). On day 5, prothrombin time, APTT, and fibrinogen levels were measured. Both extracts showed a normalizing effect on coagulation, reducing adrenaline-induced hypercoagulation.

Keywords: Crataegus turkestanica, Leonurus turkestanicus, adrenaline-induced injury, blood coagulation, hemostasis, rats.

Objective - To evaluate the effects of Crataegus turkestanica and Leonurus turkestanicus extracts on blood coagulation parameters in rats with experimental adrenaline-induced cardiac injury.

Materials and Methods. The experiment was conducted on male white rats weighing 250–300 g, which were kept in a vivarium for 14 days on a standard diet. Adrenaline-induced heart injury was modeled by a single subcutaneous injection of 0.1% adrenaline solution at a dose of 0.15 ml/100 g of body weight [1-2]. Fifteen minutes after adrenaline administration, the animals received Crataegus turkestanica or Leonurus turkestanicus extracts at a dose of 100 mg/100 g .

Blood samples were collected from the tail vein on the fifth day under light inhalation anesthesia. Hemostatic parameters – prothrombin time (PT), activated partial thromboplastin time (APTT), [3] and fibrinogen concentration – were measured using a TROM-2 thromboelastograph (Russia) and a Humo Clot coagulometer (Germany).

Statistical analysis was performed by calculating the mean (M) ± standard error of the mean (m); differences were considered significant at $p < 0.05$.

Table

Hemostasis parameters under the influence of the studied extracts

Group	PT (s)	APTT (s)	Fibrinogen (mg/dL)
Intact	21.1 ± 0.6	17.9 ± 0.5	434 ± 18
Control (adrenaline)	16.3 ± 0.5*	14.5 ± 0.4*	649 ± 22*
Crataegus turkestanica	22.6 ± 0.7#	26.5 ± 0.8#	579 ± 20#
Leonurus turkestanicus	17.1 ± 0.6#	17.5 ± 0.5#	542 ± 19#

Note: – significant differences compared with the intact group ($p < 0.05$); – significant differences compared with the control group ($p < 0.05$).

Discussion and Conclusions

Subcutaneous administration of adrenaline led to activation of the blood coagulation system, as evidenced by a significant reduction in prothrombin time and activated partial thromboplastin time, along with an increase in fibrinogen levels ($p < 0.05$). Administration of Crataegus turkestanica and Leonurus turkestanicus extracts contributed to the normalization of hemostatic parameters, showing moderate anticoagulant activity. The most pronounced effect was observed with Crataegus turkestanica extract, which produced statistically significant improvements across all measured parameters ($p < 0.05$).

Thus, the obtained data indicate a pronounced hemostatic and cardioprotective potential of Crataegus turkestanica and Leonurus turkestanicus extracts under stress-induced cardiovascular disorders.

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PROBLEMS OF ADAPTATION OF PLANTS-REGENERANTS OF FRUIT CROPS TO *EX VITRO* CONDITIONS AND THEIR SOLUTIONS

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When analyzing literary sources, it is noted that the process of plant adaptation to non-sterile conditions is a critical stage of clonal micropropagation, at which most plants can die. Therefore, the selection of optimal factors for the adaptation of various plant species will lead to an improvement in adaptation processes. The selection of substrates for adaptation, providing optimal physical and nutritional properties, is an important condition for increasing the survival rate and growth of plants in non-sterile conditions.

Keywords: clonal micropropagation, ex vitro conditions, adaptation of regenerated plants, substrates for adaptation.

Clonal micropropagation of plants is used to quickly obtain large quantities of genetically identical material. This method is necessary for the mass cultivation of valuable varieties, obtaining virus-free plants, and preserving rare species. The transfer of plants from *in vitro* to *ex vitro* conditions, the final stage on which the success of the entire procedure depends, is characterized by a high percentage of lost or damaged plants [1].

The losses of regenerated plants at the adaptation stage are associated with their anatomical and physiological characteristics when cultivated under sterile conditions. When transitioning from sterile to non-sterile conditions, plants need to quickly rebuild all their basic vital systems. Features of plants in *in vitro* culture: low photosynthetic activity, low content of cuticular wax, underdeveloped chlorenchyma, weak activity of the stomatal apparatus. In addition, in many regenerating plants, during rhizogenesis *in vitro*, the formation of second-order roots and root hairs does not occur, which complicates the adaptation of roots to substrates and the supply of nutrients from them. To solve these issues, solutions of various organic acids are used to spray regenerated plants, and conditions of high humidity are created in the first weeks of adaptation [1, 2].

When moving from *in vitro* to *ex vitro* conditions, plants encounter new stress conditions. Abiotic stresses include prolonged illumination, high temperature (26-36°C) and light intensity (6-12 thousand lux), which causes rapid evaporation of water and plant wilting, limited supply of minerals and deficiency of CO2 necessary for photosynthesis. In addition, the new growing conditions are septic, which creates biotic stresses including pathogens such as bacteria, fungi and nematodes. In order to reduce the pathogenic background, substrates for adaptation are sterilized at a temperature of 121°C, 1.1 atm [2].

To ensure a high level of survival and intensive growth of plants in non-sterile conditions, special attention is paid to the selection of a substrate for adaptation, which should be characterized by good water and air permeability, initial sterility or the possibility of sterilization without compromising other properties of the substrate, and a high level of mineral nutrition. In addition, it must have high water-holding and absorption capacity, which create favorable conditions for plant survival. Due to their multifunctionality, such adaptation substrates are usually two- or three-component mixtures that use such starting materials as peat, sand, perlite, vermiculite, coconut fiber, ion-exchange substrates, vermicompost, and water-retaining preparations [1, 2].

At the adaptation stage, plants must quickly adapt to new conditions and begin to actively develop. The use of artificial substrates (ion exchange substrates: BIONA, TRIONA) and various additives (zeolites) helps to obtain standard seedlings in short periods of time. These substrates are characterized by the ability to retain nutrients in soils, improving the slow release of elements for absorption by crops, and have positive effects on soil properties, such as increasing moisture, improving hydraulic conductivity [3].

Thus, the process of plant adaptation to non-sterile conditions is a critical stage of clonal micropropagation, at which most plants may die. Therefore, the selection of optimal factors for plant adaptation will lead to improved adaptation processes. The selection of substrates for adaptation, providing optimal physical and nutritional properties, is an important condition for increasing the survival rate and growth of plants in non-sterile conditions.

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THE EFFECT OF GRASSHOPPER MEAL AND TRADITIONAL FEED ON WEIGHT GAIN AND FEED CONSUMPTION IN BROILER CHICKENS

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In recent years, in the process of searching for stable and high-quality feed sources in poultry farming, particular attention has been given to protein sources derived from insects, especially the nutritional value of *Locusta migratoria* (migratory locust) and *Dociostaurus maroccanus* meals. Feeding experiments conducted on broiler chickens showed that replacing 10–15% of soybean meal in the diet with grasshopper meal significantly increased daily weight gain and improved feed conversion efficiency. At the same time, feed intake in chickens fed with grasshopper meal remained within normal limits, and no negative effects on growth performance were observed. These results indicate that grasshopper meal has a high digestibility rate and considerable energy value. In addition, the unsaturated fatty acids (omega-3 and omega-6) present in grasshopper meal improve lipid metabolism, strengthen cell membranes, and activate energy production processes in the growing organism. Therefore, the role of grasshopper meal is important in stabilizing the energy balance and enhancing the growth rate of broiler chickens.

Keywords: Grasshopper meal, *Locusta migratoria*, broiler growth, feed efficiency, protein source, bioactive peptides, digestive system.

Introduction

Edible insects, including the migratory locust (*Locusta migratoria*), are rich in high-quality proteins, beneficial fats, vitamins, and minerals. They represent a sustainable source of protein for animal feed. Microbiological analyses have shown that grasshopper meal and dried grasshoppers contain a low number of bacteria, with no presence of *Salmonella* or *Listeria* detected. Therefore, when properly processed, they are also considered microbiologically safe [4]. *Locusta migratoria* is distinguished by its high biological value, being rich in proteins, lipids, and amino acids. Consequently, research on utilizing locusts as a nutritional source for chicks to improve their quantitative and qualitative growth indicators is considered one of the most relevant topics today. Grasshoppers are known worldwide as plant-feeding insects that cause significant damage to agriculture. In Morocco, these insects – including the Moroccan locust (*Dociostaurus maroccanus*) – are widespread and regarded as a serious threat. Their digestive system has the ability to break down large amounts of plant tissue. This study aims to explain this process by examining their intestinal microorganisms (microbiota) using biochemical and molecular methods.

Objective. Grasshopper meal is a high-protein and safe feed source containing bioactive peptides and transmitters that enhance digestion and stimulate appetite. The glycoprotein proteins found in grasshoppers can serve as a basis for improving weight gain and feed efficiency in broiler chickens.

Main Part

In recent years, as part of the search for sustainable protein sources in animal husbandry, studying the nutritional and biological value of insect-derived products – particularly meal obtained from the migratory locust (*Locusta migratoria*) – has become an important area of research. The chemical composition of grasshopper meal has a high biological value, and its inclusion in poultry feed has been found to enhance the growth rate of chicks and improve feed utilization efficiency [5].

Chemical composition analyses show that the body of *Locusta migratoria* contains 64–70% crude protein, 8–10% fat, and significant amounts of calcium, iron, and phosphorus. Among its amino acids, lysine, methionine, and valine are present in high amounts, comparable to soybean meal. Therefore, grasshopper meal has been proven suitable for partially replacing soybean protein in poultry feed [1].

Feeding experiments conducted on chicks demonstrated that replacing 10–15% of soybean meal in the diet with grasshopper meal increases daily weight gain and improves feed conversion efficiency. No negative effects on feed intake or survival were observed. These results are explained by the high digestibility and energy value of grasshopper meal [2].

The high content of biologically active compounds in grasshopper protein also enhances its effectiveness. Angiotensin-converting enzyme (ACE) and ACE-like peptides identified in *Locusta migratoria* stimulate digestive system activity, increase intestinal motility, and improve nutrient absorption. This, in turn, enhances growth rate and energy balance. Changes in body protein and fat content have been observed in grasshoppers fed diets with varying protein-to-carbohydrate ratios. This indicates that, for *Locusta migratoria*, the nutritional balance of the feed and feeding schedule are important factors determining growth efficiency and body composition [3,6].

In addition, grasshopper meal contains micronutrients such as phosphorus, zinc, magnesium, and iron, which stimulate metabolic processes and accelerate muscle growth. These characteristics make grasshopper meal a promising and environmentally safe protein source for use in poultry feed.

Results and Analysis

A total of 84 broiler chickens (Ross 308) were used in the experiment. They were randomly selected and divided into four groups, each consisting of six chicks. All birds were kept under identical environmental and thermal conditions throughout the study.

1. **Control group (6 chicks):** These birds were fed a standard grain mixture composed of 50% corn, 20% wheat, 10% rice groats, 5% millet, 7% mung beans, 5% cracked corn, 1% vitamin premix, 1.5% limestone, and 0.5% salt for 45 days. Their body weight and growth performance were recorded regularly.
2. **Experimental group I (6 chicks):** The diet of these broilers consisted of 15% locust **(*Dociostaurus maroccanus*)** meal and 85% of the standard grain mixture for 45 days. Changes in body mass and growth indicators were monitored throughout the feeding period.
3. **Experimental group II (6 chicks):** These birds received a diet containing 25% locust (***Dociostaurus maroccanus***) meal and 75% of the standard grain mixture for 45 days. Body weight and growth data were systematically collected.
4. **Experimental group III (6 chicks):** The diet included 15% **Dericorys albidula** (Saxaul bush locust) meal and 85% of the standard grain mixture, administered for 45 days. Their growth rate and body weight were recorded during the experimental period.

This article was prepared within the framework of the applied research project No. AL-9524115100 titled **“Development of technology for obtaining unconventional protein and nutrients from locusts in Uzbekistan”**, conducted at the Faculty of Biology and Ecology, National University of Uzbekistan.

Conclusion

The above analyses indicate that grasshopper meal (*Locusta migratoria*) is of significant scientific importance as a highly effective and environmentally safe protein source for poultry feed. Its composition includes 64–70% protein, 8–10% fat, and biologically active minerals such as iron, zinc, calcium, and phosphorus, confirming it as a complete protein source. The amino acid profile of grasshopper meal – particularly its high levels of lysine, methionine, valine, threonine, and isoleucine – promotes the formation of muscle tissue and accelerates growth processes in chicks. These amino acids, especially lysine and methionine, are recognized as key components that activate protein synthesis in growing chicks. Therefore, incorporating grasshopper meal into feed enhances muscle mass gain and overall growth rate. Additionally, grasshopper meal has a high digestibility coefficient, allowing its proteins and lipids to be easily absorbed by the chicks’ gastrointestinal system. The angiotensin-converting enzyme (ACE) and FMRFamide-type peptides present in grasshopper meal stimulate the secretion of digestive enzymes and accelerate the breakdown of nutrients. As a result, the efficiency of energy derived from feed increases, which reduces feed consumption while providing more energy for growth. Thus, based on scientific experiments and biochemical analyses, it can be concluded that adding 10–15%

grasshopper meal to chick feed yields optimal results, accelerating weight gain, reducing feed intake, and improving overall poultry production efficiency.

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STRUCTURAL DETERMINANTS OF OXIDATIVE TOXICITY OF MODIFIED NUCLEOSIDES AND THE PROTECTIVE ROLE OF QUERCETIN

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The study assesses the oxidative stress induced by modified nucleoside derivatives in a rat model of LPS-induced inflammation. We investigated the protective effects of quercetin against the toxicity of various nucleoside analogues, including halogenated, phosphorylated, and acetylated compounds. The results demonstrate that quercetin significantly mitigates oxidative damage by restoring antioxidant enzyme activity and reducing lipid peroxidation. The efficacy of this correction was found to be highly dependent on the structural features of the nucleoside, such as charge and lipophilicity, highlighting a structure-dependent cytoprotective mechanism.

Keywords: oxidative stress, modified nucleosides, LPS-endotoxicosis, quercetin, antioxidant correction.

Modified nucleoside/nucleotide antibiotics represent promising antimicrobial agents, but their clinical application is limited by systemic toxicity, particularly through oxidative stress mechanisms. This study evaluated the oxidative stress profile induced by structurally diverse nucleoside analogues in LPS-endotoxicosis model and assessed quercetin's antioxidant potential for toxicity mitigation.

Male Wistar rats (n=90) were divided into groups receiving LPS (10 mg/kg) alone or combined with test compounds: fludarabine, fludarabine-5'-monophosphate, 2-NH_2-6-Cl-araPur, ara-CMP, TTU, ara-C, and cCMP, with or without quercetin (50 mg/kg). Oxidative stress markers included TBARS, SOD, CAT, GPx activities, GSH and H_2O_2 levels.

LPS treatment significantly increased TBARS (116.7% above control, $p<0.05$) and decreased antioxidant enzyme activities: SOD (-19.2%), CAT (-25.9%), GPx (-30.0%). Test compounds further exacerbated oxidative stress, with ara-C and cCMP showing maximal toxicity (TBARS increase >250%, GPx decrease >50%). Structural analysis revealed that halogenated compounds (fludarabine with fluorine) generated higher ROS levels compared to chlorinated analogues. Phosphorylated derivatives (ara-CMP, cCMP) demonstrated prolonged oxidative stress due to extended systemic circulation. The "rescue index" calculation showed quercetin's correction efficiency ranged from 30-65% across different parameters.

Quercetin supplementation significantly ameliorated oxidative damage in all treatment groups. Most pronounced effects were observed with neutral or moderately lipophilic compounds, where TBARS levels decreased by 44-76% and antioxidant enzyme activities were restored to near-control values. For highly charged phosphate derivatives, quercetin's

protective effect was less complete (CAT and GPx recovery remained 15-20% below control), indicating limitations in antioxidant correction for compounds with prolonged systemic exposure.

The study demonstrates that structural modifications significantly influence oxidative toxicity patterns: fluorine substitution > cyclic phosphates > chlorine substitution > triazole groups in decreasing order of ROS generation. Acetylation of sugar moieties (2-NH_2-6-Cl-araPur, TTU) reduced systemic toxicity through improved tissue sequestration. Quercetin proved highly effective (rescue index >45%) for neutral/lipophilic compounds but showed limited capacity for highly charged molecules with sustained circulation.

These findings support a structure-based approach to nucleoside drug design, emphasizing the importance of minimizing electrophilic substituents and optimizing lipophilicity. The differential efficacy of quercetin correction suggests that antioxidant co-therapy should be tailored to specific structural features of nucleoside antibiotics for optimal therapeutic outcomes in infectious disease management.

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EPIDEMIOLOGICAL ASSESSMENT OF LOWER LIMB VENOUS THROMBOSIS IN BOBRUISK AND THE BOBRUISK DISTRICT

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This paper examines the dynamics of lower extremity venous thrombosis (LEVT) incidence in the city of Babruisk and the Babruisk district from 2018 to 2023. It is shown that the incidence of LEVT fluctuated, with the peak incidence occurring in 2019. The data revealed that women were more likely to be affected than men. The incidence among rural residents is lower than among urban residents.

Keywords: LEVT, incidence, condition, incidence dynamics, population, growth rate.

LEVT is an acute condition, one of the main health problems, and the most common circulatory disorder. This pathological condition is widespread: 10-20% of the global population has experienced it at least once, and in 50% of cases, it is a serious complication of varicose veins. Thrombosis is easy to develop: a sedentary lifestyle, excessive alcohol consumption, smoking, or excessive exercise are all you need to know. While there are certainly factors beyond your control, most are self-inflicted.

Thrombosis is the formation of dense blood clots, also known as thrombi, within blood vessels. This phenomenon slows or stops normal blood flow. It's important to understand that thrombus formation is a normal protective response of the body. When the vascular wall is damaged, these blood clots obstruct the flow of blood to prevent significant blood loss. If all body systems are in proper, healthy balance, the clots dissolve harmlessly. However, various disorders can worsen the condition, leading to phlebothrombosis, which often affects the lower extremities.

The study demonstrated that the incidence of lower extremity venous thrombosis in Babruisk fluctuated from 2018 to 2023. The peak incidence occurred in 2019, with 23.1 cases per 100,000 population. In 2023, the incidence was also high, with 15.8 cases. From 2020 to 2022, the incidence of lower extremity venous thrombosis was relatively low, with 9.6-8.1 cases per 100,000 population. The average annual growth rate of lower extremity venous thrombosis in Babruisk from 2018 to 2023 was 23.18%. In 2023, the incidence of lower extremity venous thrombosis among females in Babruisk was 1.55 times higher than among males. The age group most susceptible to lower extremity venous thrombosis is 61

to 80 years old, accounting for 36.36% of all patients. In 2023, the incidence of lower extremity venous thrombosis among the urban population of Bobruisk was 6.58 times higher than among the rural population.

Over the study period from 2018 to 2023, the incidence of lower extremity venous thrombosis in the Bobruisk district also fluctuated. The peak incidence was in 2019, at 29.5 cases per 100,000 population. From 2020 to 2022, a decrease in incidence was observed – 11.5-8.5 cases per 100,000 population. However, in 2023, the incidence of lower extremity venous thrombosis increased to 15.8 cases per 100,000 population. The average annual increase in the incidence of lower extremity venous thrombosis in the Bobruisk district was 10.27%. In the Bobruisk district, women are 1.36 times more likely to develop lower extremity venous thrombosis than men. 36.84% of patients are aged 61 to 80 years.

Thus, based on all the data presented in the study, it is shown that the incidence rate depends on many factors and has a wave-like nature.

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EFFECT OF EXPERIMENTAL HYPOTHYROIDISM ON PLATELET COUNT IN RATS

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This study examined changes in platelet count in rats with experimental hypothyroidism induced by methimazole. The model was developed according to Kozlov's method. The results demonstrated an increase in platelet count under hypothyroid conditions, which may be associated with compensatory activation of thrombopoiesis in response to thyroid hormone deficiency.

Keywords: hypothyroidism, PLT, methimazole.

An experimental model of hypothyroidism was established in healthy adult male rats weighing 180–220 g. The animals were kept under vivarium conditions at a temperature of 22 ± 2 °C and 55–60 % relative humidity. Three to four rats were housed per cage, with food and water provided ad libitum. The hypothyroid state was induced following Kozlov's method by oral administration of methimazole (5 mg per 200 g body weight) for 30 days [1]. All experiments were carried out in accordance with international ethical standards for the use of laboratory animals.

Hematological analysis of blood samples using an automated analyzer showed that the platelet count (PLT, $\times 10^9$/L) in healthy rats averaged 324 ± 14.8, whereas in hypothyroid rats it increased to 344 ± 16.0. This change may be related to compensatory activation of thrombopoiesis or a decrease in platelet destruction rate.

Previous studies have reported that hypothyroidism leads to a reduction in platelet count due to suppression of bone marrow metabolism [2]. However, in some cases – particularly in the early or mild stages of the disorder – a slight increase in platelet number has also been observed [3]. The present results suggest that the degree and duration of thyroid hormone deficiency may differentially influence thrombopoiesis and platelet homeostasis. The observed rise in platelet count may represent an adaptive response of the hematopoietic system to reduced thyroid activity.

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DEVELOPMENT OF A DEVICE FOR EXPERIMENTAL ASSESSMENT OF THE FIXATION CHARACTERISTICS OF AUXILIARY DEVICES FOR SIMULATION OF RADIATION MAMMARY GLAND

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A comparative study of auxiliary devices for bolus fixation and bolus attachment to an experimental setup using a tissue-equivalent breast phantom was conducted for two methods of fixing the compensating bolus to the delivered surface dose during radiation therapy.

Keywords: breast cancer, radiation therapy, anthropomorphic phantom, bolus, fixation device.

Breast cancer is a socially significant disease and is frequently diagnosed in women of reproductive and working age. Estimating the dose of ionizing radiation delivered to a patient's skin during breast cancer radiation therapy using bolus-based delivery is a pressing issue in medical physics.

A key factor in ensuring the effectiveness of radiation therapy is the optimal distribution of the absorbed dose within the target volume. One effective method for modifying dose distribution is the use of boluses. Placing a bolus on the patient's body surface allows for a shift in the depth of maximum dose, which reduces the likelihood of adverse skin reactions when irradiating tumors located close to the skin. However, boluses alter the initial dose distribution. Incorrect placement of boluses can result in both over-irradiation of healthy tissue and under-irradiation of a malignant tumor.

There is also a significant discrepancy between the virtual bolus model used for planning and the actual physical contact of the bolus with the patient's body, due to anatomical differences. The most significant problem is the formation of air gaps between the bolus and the skin, which leads to significant distortions in dose distribution due to differences in the density of the contacting materials and, consequently, can cause clinical complications. The solution lies in the development of a tissue-equivalent breast phantom, which allows for the optimization of the bolus fixation system for accurate dose delivery during radiation therapy [1].

In the study, eight materials with different mechanical, optical, and chemical properties were selected for phantom fabrication: gelatin mixture, modeling paste, silicone, medical breast implant, dental wax, xanthan gum, guar gum, and latex. Based on the analysis, modeling paste was selected as the material that met the physicochemical properties required for the phantom. To verify the calculated data of the Eclipse radiation therapy planning system, an experimental study of a clinical situation involving breast irradiation using a bolus was conducted. The experimental model used was an Alderson anthropomorphic phantom, supplemented by a breast phantom made of modeling paste and wrapped in PVC film. Two fixation methods were compared: compression garments and a thermoplastic mask. Both methods, firstly, minimize air gaps between the skin and the bolus, and secondly, ensure a stable position of the structure relative to the isocenter of the linear accelerator.

A 6 MeV photon beam irradiation plan was generated using the Eclipse radiation therapy planning system. The calculated dose at the measurement point, obtained in the radiation therapy planning system, was 1.92 Gy. When fixed with a thermoplastic mask, the average measured dose was 1.83 Gy, corresponding to a deviation from the calculated value of 0.060 ± 0.039 Gy. When using compression garments, the measured dose was 1.18 Gy, and the deviation from the calculated value reached 0.740 ± 0.051 Gy. The obtained results demonstrate that the thermoplastic mask has a statistically insignificant effect on the surface dose and ensures high reproducibility of the results. The use of

compression garments leads to a significant and statistically significant underestimation of the measured dose compared to the calculated data, making it clinically inappropriate for precision dosimetry tasks. The findings highlight the critical importance of considering the type of fixation device when planning radiotherapy to ensure accurate dose distribution.

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AMPHYBIA DEATHS HIPPED BY VEHICLES IN THE OUTSKIRTS OF MINSK

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Amphibians are among the most vulnerable vertebrate species worldwide. The most direct negative impact of road traffic on animal populations is the fatal collision with vehicles, that is, the death of animals under the wheels of cars. Available data on amphibian fatalities under the wheels of vehicles in Europe and our country are insufficient and often incomparable due to the unique responses of individual species [3]. The aim of our study was to investigate amphibian fatalities under the wheels of vehicles on third-level roads.

Keywords: amphibians, amphibians, batrachofauna, mortality, anthropogenic impact.

One of the reasons for the decline in amphibian populations due to their deaths under the wheels of vehicles is the impact of roads. However, quantitative data from different authors characterizing the intensity of animal mortality varies, indicating that the impact of road networks on amphibian populations varies depending on the specific location, time of year, and habitat [2].

Amphibian mortality studies on highways were recorded in the Minsk region in 2023 and 2024 (Shhomyslitsy village, Minsk region) during various seasons: spring (April–May), summer (June–August), and autumn (September). The mortality of amphibians on highways was recorded using the route method [1]. A section of the road was traversed, counting all dead animals, which were then removed after identification and counting. The species composition of amphibians was determined using standard diagnostic features [2].

The research results showed that despite the relatively low traffic volume in this locality, the highest number of amphibian deaths occurred in the spring – during the amphibian migration to spawning grounds. During this time of year, we recorded 692.4 ±67.1 amphibian deaths per 1 km of the third-level road route. In most cases, roadside deaths were located near fire ponds and oak groves.

It has been established that the death of amphibians under the wheels of vehicles affects different taxonomic groups differently. In our case (in the spring), we recorded 91.3% of anurans (*Anura*) and 8.7% of - tailed (*Caudata*) . Amphibians (toads, frogs, spadefoot toads, newts) are most often died under the wheels of cars when they crossed roads during migration between breeding and wintering grounds.

Mortality is also greatly influenced by the behavior of amphibians when a vehicle approaches, as during this period of danger they stop moving and freeze.

The most common species in the population structure of the dead animals were the common frog (*R. temporaria*), the moor frog (*R. arvalis), and the sulphur toad (B. bufo*) – 71.7%, 16.3%, and 4.5%, respectively. The share of the remaining species – the green toad (4.2%), the common spadefoot (2.1%), and the common newt (1.2%) – was 7.5%.

During the summer period, the majority of amphibians that died on roads were young-of-the-year frogs and toads (94.4%: 82.9 and 11.5%, respectively), while adult animals accounted for only 5.6% of all dead amphibians.

A seasonal analysis of the mortality of amphibians on roads shows that the lowest mortality of amphibians under the wheels of vehicles was in the autumn period – 35.0 ±6.2 per 1 km of the route.

Thus, our findings confirm previous results showing that amphibians are particularly vulnerable to roadkill near their habitats. Moreover, the species composition of the fatalities and the mortality rate of amphibians depend on the

study area, the abundance of individual species in the study area, the availability of suitable habitats in the surrounding area, and the mortality rate of amphibians depends on the time of year, as spring is characterized by mass migrations of these animals, as noted by other authors [3]. We are confident that the results of this study could be used to reduce the impact of road traffic on amphibians through the implementation of temporary or permanent mitigation measures. Recommendations include the creation of special tunnels for amphibians to pass through during their migrations, the installation of warning signs, and the involvement of the public in conservation efforts.

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THE USE OF NOBLE METALS IN MEDICINE

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This article examines the properties of noble metals, demonstrating their role and unique applications in medicine.

Keywords: precious metals, properties of precious metals, use of precious metals in medicine.

Noble metals are a group of elements that generally have high chemical resistance. They include gold, silver, platinum, and platinum group metals such as ruthenium, rhodium, palladium, osmium, and iridium. They were initially used in jewelry. However, due to their unique physical and chemical properties, they have found widespread application in medicine.

Gold is known as highly wear-resistant, hypoallergenic, and non-toxic. Therefore, it is unrivaled in dentistry for the production of dental crowns and dentures. Its alloys with platinum, palladium, and copper have proven effective. In the pharmaceutical industry, gold salts are used to treat rheumatoid arthritis. It should be pointed out that its effect on immune cell function is currently being studied. Besides, it is worth mentioning that gold nanoparticles are used to precisely detect tumors and destroy cancer cells without damaging healthy tissue.

It is also important to emphasize the fact that of all known metals, silver has the most powerful antimicrobial properties. Its ions damage the DNA of microorganisms, causing their death. Microbes develop tolerance to silver ions much more slowly than to antibiotics. Therefore, in the medical industry, catheters, stands, breathing tubes, and surgical instruments are coated with silver nanoparticles or a thin layer. Dressings impregnated with silver ions promote rapid healing of burns and surgical wounds. Silver coatings are also used in the manufacture of bone and joint implants.

Platinum has high biocompatibility with living cells, conducts electrical current well, but is also friendly to the body. Platinum and its alloys with iridium are used in the medical industry to manufacture electrodes, pacemakers, neurostimulators, and stents. The properties of noble metals are given in Table 1 [1], and the main advantages of their use in medicine are presented in Figure 1.

Table 1

Properties of noble metals

Metal	Density, g/cm^3	Temperature of melting, ^oC	Hardness (acc. Mosh scale)	Content in the Earth's crust, % by mass
Gold (Au)	19,32	1064,18	2,5	$4{,}3 \cdot 10^{-7}$
Silver (Ag)	10,49	961,78	2,5	$7 \cdot 10^{-6}$
Platinum (Pt)	21,45	1768,30	4,5	$5 \cdot 10^{-7}$
Palladium (Pd)	12,02	1554,90	4,75	10^{-6}

Ruthenium (Ru)	12,41	2334,00	6,5	$5 \cdot 10^{-7}$
Rhodium (Rh)	12,41	1963,00	6,0	10^{-7}
Osmium (Os)	22,59	3033,00	7,0	$5 \cdot 10^{-6}$
Iridium (Ir)	22,65	2466,00	6,5	10^{-7}

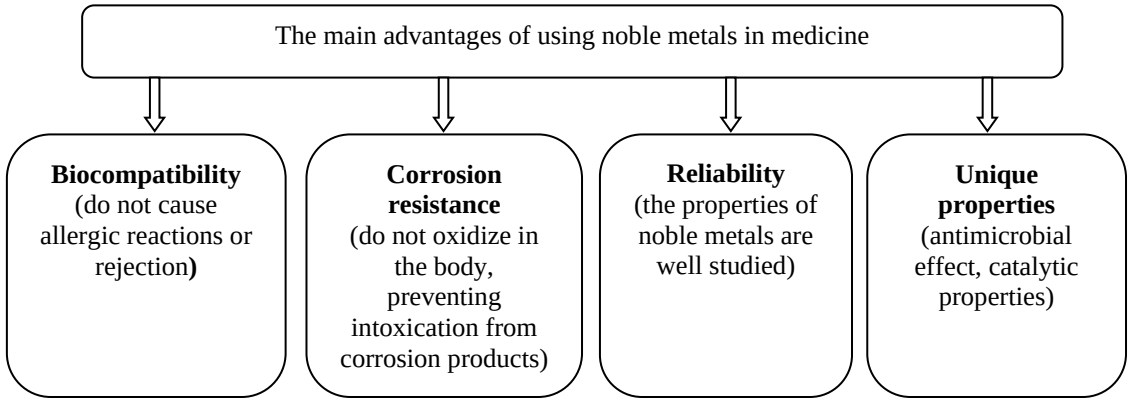

Fig. 1 - Advantages of using noble metals in medicine

However, there are also disadvantages of using noble metals in this direction. First and foremost, their high cost limits their widespread adoption. Of special importance is the fact that some platinum compounds have side effects. It must be specially underlined that noble metals are limited resources, are difficult to process, and require specialized technologies.

Scientific research of the future is aimed at finding new compounds of noble metals for the benefit of humans.

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INFLUENCE OF ENVIRONMENTAL FACTORS ON THE DEVELOPMENT OF ANEMIA

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Anemia is one of the most common pathological conditions in the population, especially among children, adolescents, and women of reproductive age [1]. Anemia is a clinical-hematological syndrome characterized by a decrease in hemoglobin concentration in the blood, often accompanied by a reduction in the number of erythrocytes per unit volume of blood [1, p. 45]. According to the World Health Organization, approximately 30% of the planet's inhabitants suffer from various forms of anemia [3]. Alongside nutritional, hereditary, and infectious factors, environmental causes related to pollution are gaining increasing significance [5]. The impact of environmental factors on public health is becoming increasingly relevant, especially in the context of urbanization and industrial development [5, p. 80].

Keywords: anemia, environmental medicine, pollution, heavy metals, radionuclides, preventive measures.

Air, water, and soil pollution with heavy metals (such as lead, cadmium, and mercury), radioactive elements, pesticides, industrial waste, and combustion products have a pronounced toxic effect on the hematopoietic system. These substances can inhibit the activity of enzymes involved in hemoglobin synthesis, cause damage to erythroid cells in the bone marrow, and disrupt iron metabolism [2]. Inhibition of enzyme activity under the influence of toxic substances can lead to impaired normal hemoglobin synthesis and the development of anemic conditions [2, p. 210]. As a result,

secondary hypochromic anemia develops, often accompanied by a decrease in the number of leukocytes and platelets in the blood.

Prolonged exposure to lead is one of the most studied causes of lead anemia. Lead blocks enzymes involved in porphyrin metabolism, leading to the accumulation of intermediate metabolic products and a decrease in hemoglobin synthesis. Cadmium and mercury have a similar effect, damaging mitochondria and red blood cell membranes. Radioactive isotopes of strontium and cesium, upon entering the body, tend to accumulate in the bone marrow, causing disruptions in cell differentiation and suppressing erythropoiesis. Radioactive substances, accumulating in the bone marrow, can negatively affect hematopoietic processes, leading to various hematological disorders [5, p. 155].

In industrial areas, an increase in the incidence of iron-deficiency anemia has been observed among children and women under 40 years of age. This is attributed not only to exposure to toxic substances but also to a deficiency in micronutrients (zinc, copper, selenium), which play a crucial role in iron metabolism. Furthermore, environmental pollution negatively affects the absorption of nutrients and B vitamins, which are essential for normal hematopoiesis. Special attention should be paid to the influence of socio-environmental factors: unbalanced nutrition, stress, chronic infections, poor drinking water quality, and insufficient sanitary culture exacerbate the effects of harmful substances and increase the risk of anemia development.

Preventive measures include monitoring the environmental state, controlling the quality of food products and drinking water, reducing industrial waste emissions, using sorbents in cases of chronic intoxication, and implementing population-based programs aimed at ensuring adequate intake of iron and vitamins into the body. Thus, anemia should be considered not only a medical but also an environmental problem requiring a comprehensive interdepartmental approach involving specialists in medicine, ecology, toxicology, and environmental hygiene. A comprehensive approach to solving environmental problems related to anemia requires the interaction of medical professionals, ecologists, and representatives of government authorities [5, p. 370].

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THE SIGNIFICANCE OF LOCUST MEAL AS AN ALTERNATIVE PROTEIN SOURCE AND ITS EFFECTS ON THE ORGANISM

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In recent years, the increasing global population has led to a growing demand for food, which in turn has intensified the shortage of feed resources and aggravated environmental problems in the livestock sector. These challenges have prompted the search for new and sustainable protein sources. **Entomophagy** – the use of insects as food or feed – represents a promising approach to address these issues. In particular, locusts (Locusta migratoria) are rich in high-quality proteins, lipids, and essential amino acids, making them a valuable nutritional resource. Therefore, studying the use of locusts as a potential feed ingredient for agricultural animals is an important step toward improving their growth, health, and productivity indicators, while promoting sustainable livestock farming.

*Keywords***:** locusts; Locusta migratoria; insect meal; alternative protein; livestock feed; sustainable agriculture; nutritional composition; amino acids; immune response; environmental impact

Introduction

The search for affordable, protein-rich, and environmentally safe feed sources for animals remains a major challenge in modern agriculture. From this perspective, locusts (order Orthoptera) are gaining increasing attention as an alternative feed ingredient with high biological value. The use of locusts as a food and feed source dates back to ancient times. Throughout human history, locusts have been consumed both directly as food and as a supplementary feed for livestock. To date, at least 10 locust species are known to have been used for human consumption and animal feeding in more than 65 countries[12].

Several scientific arguments support the utilization of locusts as a feed source. Locusts possess a highly efficient digestive system regulated by a complex biological mechanism, allowing them to maximize nutrient absorption from their diet[7]. The peptides in their midgut, which regulate digestive enzyme activity and intestinal motility, decrease in activity during food scarcity but are rapidly reactivated upon feeding[8]. This adaptive control of digestive processes enables locusts to maintain digestive efficiency under varying nutritional conditions.

Moreover, locusts exhibit dietary flexibility by consuming various plant species, which helps maintain a balance of proteins, fats, and carbohydrates in their bodies[9]. Their stable internal regulation system, or homeostasis, ensures high biological adaptability, particularly under mass-rearing conditions[7,10]. This adaptability, along with effective energy utilization and environmental resilience, makes locusts one of the most efficient biological sources of protein in the food chain. Therefore, the use of locusts as animal feed is both economically and ecologically justified. Ultrasonic analyses of locust oils have revealed high physicochemical stability, a balanced omega-6 to omega-3 ratio, and a rich content of linoleic and oleic acids, which contribute to improved animal growth and health[2]. Microbiological assessments have shown that locusts possess a stable and safe microbiome dominated by beneficial bacteria, including lactic acid bacteria, Bacillus, and Enterococcus species. The low prevalence of pathogenic microorganisms indicates that properly processed locust products can be microbiologically safe for feed use [3]. Other studies have demonstrated that the nutritional composition of locusts varies depending on the plants they consume, suggesting that by controlling their diet, it is possible to enhance their nutrient profile and increase their value as sustainable livestock feed [5].

Investigations of desert locusts collected in Kenya showed that their dry matter contains 62–65% protein and 13–15% lipids, with a protein digestibility of up to 89% [11]. Furthermore, glycopeptides derived from vitellin protein in locust eggs have been shown to exhibit strong antioxidant and antibacterial properties, highlighting the potential of locust proteins as functional additives in feed and food formulations [4].

Results and Discussion

Recent empirical evidence underscores the promising effects of using locust-derived meal as an alternative protein source in poultry nutrition. For instance, a study involving dietary supplementation with Schistocerca gregaria in broiler diets revealed that moderate inclusion (2 %) led to significant improvements in body weight and indicators of kidney function by week 5 of the trial while carcass and organ weights remained unaffected. Furthermore, antibody titers against Newcastle disease were notably higher in the group receiving 3 % locust meal, indicating enhanced immune responsiveness. Overall, the evidence suggests that with appropriate inclusion levels, processing technologies, and formulation strategies, locust-based meals hold tangible potential to enhance growth, improve immune status, and contribute to more sustainable livestock feeding systems. Future research must focus on standardizing processing methods, defining optimal inclusion thresholds for different species, and exploring long-term health and productivity impacts under commercial production conditions.

Recent experimental findings further substantiate the potential of locust-based protein meals as a viable alternative feed component in livestock and poultry nutrition. In our present study, two locust species – the Moroccan locust (Dociostaurus maroccanus) and Dericorys albidula – were utilized at inclusion levels of 15% and 25% in formulated diets for broiler chickens and laboratory rats. The experimental design demonstrated that both species contributed to positive physiological responses; however, the 25% inclusion level exhibited more pronounced effects compared to 15%. Specifically, the groups receiving 25% locust meal showed enhanced growth performance, improved immune responsiveness, and better overall health indicators throughout the experimental period. Broiler chickens exhibited increased body weight gain and feed efficiency without adverse effects on carcass composition, while hematological assessments in rats indicated improved protein metabolism and immune activity. These results suggest that locust-based meal can promote not only growth and productivity but also the metabolic and immunological stability of animals.

Overall, our findings align with earlier studies demonstrating the nutritional and immunostimulatory properties of insect-derived protein. The observed improvements at the 25% inclusion level indicate that both *Dociostaurus maroccanus* and *Dericorys albidula* possess significant potential as sustainable feed ingredients for animal production systems.

Conclusion

The outcomes of this research provide compelling evidence that locusts can be regarded as a sustainable and nutritionally valuable source of protein for use in animal feed. Both experimental results and scientific analyses indicate that locust meal - especially that derived from *Dociostaurus maroccanus* and *Dericorys albidula* - contains balanced amino acids, beneficial fatty acids, and essential micronutrients that collectively enhance growth, immunity, and physiological performance in animals.

In the present study, diets containing 25% locust meal produced more notable improvements than those with 15% inclusion. Animals receiving the higher inclusion rate exhibited increased growth rates, enhanced immune responses, and more stable metabolic indicators, demonstrating that locust-based feed can effectively promote both productivity and overall health. Importantly, these results align with international findings that insect-derived proteins are safe and efficient alternatives to conventional protein sources in livestock and poultry nutrition. Beyond its nutritional benefits, the use of locusts in feed formulation holds clear ecological advantages. Converting a widespread agricultural pest into a high-quality protein ingredient not only reduces environmental impact but also contributes to a more circular and resource-efficient production system.

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ANTIBACTERIAL ACTIVITY OF COMMON CARAWAY

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This study examined the antibacterial activity of various extracts (ethanol, hexane, and aqueous) of common caraway (Carum carvi) seeds of Belarusian, Russian, and Finnish origin against the gram-positive bacterium

Staphylococcus aureus and the gram-negative bacterium Escherichia coli using disk diffusion analysis. Antibacterial activity was assessed based on the diameter of growth inhibition zones around the disks. The data showed that activity depends on the solvent and the region of seed origin.

Keywords: caraway, antibacterial activity, disk diffusion method, extracts, ethanol.

Caraway (Carum carvi) is a pharmacopoeial plant rich in biologically active compounds. It contains essential oil (3-7%), the key components of which are carvone and limonene, as well as flavonoids (quercetin, kaempferol), coumarins (umbelliferone, scopoletin), and phenols (carvacrol), which are characterized by their antimicrobial, antioxidant, and anti-inflammatory properties. The aim of this study is to comparatively evaluate the antibacterial activity of caraway extracts grown in different regions [1–2].

Study subjects: Caraway seed powder produced in Belarus, Russia, and Finland.

Extract preparation: Ethanol, hexane, and aqueous extracts were prepared from the seed powder. A 5 g sample was dissolved in 50 ml of solvent (ethanol, hexane, distilled water), followed by homogenization with a magnetic stirrer for 4 hours at 50°C and infusion (14 days for ethanol and hexane, 30 days for water). Extracts were obtained after two filtrations.

Clinically relevant cultures were used: gram-positive Staphylococcus aureus and gram-negative Escherichia coli. Antibacterial activity was assessed using the disk diffusion method on a solid nutrient medium, Mueller Hinton Agar. Sterile paper disks were soaked with 15 µl of extract and applied to the surface of the agar inoculated with a bacterial lawn. Antibiotic disks (penicillin, meropenem, cefepime) and empty disks were used as controls. The dishes were incubated at 37°C for 24 hours. The results were assessed by measuring the diameter of the inhibition zone around the discs [3].

Disc diffusion analysis showed that the ethanol extracts exhibited moderate antibacterial activity against both bacterial strains. The inhibition zone diameters for E. coli were 11 mm (Belarus), 10 mm (Russia), and 12 mm (Finland). For S. aureus, the values were 10 mm (Belarus), 11 mm (Russia), and 12 mm (Finland). Hexane and aqueous extracts showed no antibacterial activity (inhibition zone diameter = 0 mm) against all tested strains, regardless of caraway origin. These results confirm the potential of caraway as a source of natural antibacterial compounds, promising for the development of new agents in medicine and the food industry in the face of growing antibiotic resistance.r lifestyle. By combining the correct use of technology with healthy habits, we can reduce the risks to our health.

The most active was the ethanol extract of Finnish caraway.

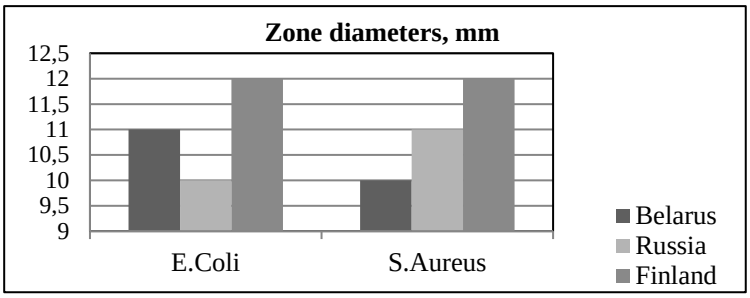

Fig. 1 **–** Antibacterial activity of ethanol extract of common caraway

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FEATURES OF ONCOGENESIS AND LIMITATIONS OF ANTITUMOR THERAPY IN CHILDREN WITH LOUIS-BAR SYNDROME

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Louis-Bar syndrome (ataxia-telangiectasia) is a rare autosomal recessive disorder caused by mutations in the ATM gene, leading to defective DNA repair and genomic instability. Patients with this condition exhibit a significantly increased risk of developing malignancies, predominantly lymphoproliferative disorders, as well as extreme radiosensitivity and heightened toxicity to conventional chemotherapy, necessitating the development of individualized therapeutic approaches.

Keywords: Louis-Bar syndrome, ataxia-telangiectasia, ATM gene, oncogenesis, antitumor therapy, radiosensitivity.

Louis-Bar syndrome (LBS), also known as ataxia-telangiectasia, is a complex multisystem inherited disorder caused by biallelic mutations in the ATM (ataxia-telangiectasia mutated) gene located on chromosome 11q22-23. This gene encodes a key kinase that plays a central role in the cellular response to DNA double-strand breaks. Loss of ATM protein function results in genomic instability, which underlies both the neurodegenerative manifestations and the markedly elevated oncogenic risk in these patients. The ATM defect disrupts cell cycle checkpoints, particularly at the G1/S and G2/M transitions, allowing cells with damaged DNA to proliferate. Developing lymphocytes are especially vulnerable, as V(D)J recombination physiologically generates DNA double-strand breaks. The inability to properly repair these breaks leads to chromosomal translocations – such as t (14;18) or t (7;14) – that are characteristic of lymphomas in LBS patients.

Antitumor therapy in children with LBS is associated with significant challenges and limitations. The primary issue is extreme radiosensitivity of healthy tissues. Even standard diagnostic doses of ionizing radiation (e.g., during computed tomography) can lead to severe, potentially fatal complications such as tissue necrosis and secondary malignancies. Similarly, many cytotoxic agents that act by damaging DNA – such as alkylating agents and anthracyclines – cause exceptionally severe toxicity in these patients, including profound myelosuppression, mucositis, and damage to internal organs.

Therefore, standard oncological treatment protocols are not applicable to this patient group. Management strategies require radical modification: complete avoidance of radiotherapy and the use of reduced, adapted chemotherapy doses with careful monitoring of toxicity. This creates a therapeutic dilemma, as reducing treatment intensity may compromise oncological outcomes. An essential aspect of managing LBS patients is the avoidance of imaging modalities based on ionizing radiation. Even a single CT scan can trigger localized soft tissue necrosis or accelerate the development of secondary tumors. Magnetic resonance imaging (MRI) and ultrasound are recommended alternatives for monitoring suspicious lesions or lymphoma staging. Currently, research is ongoing to identify alternative, less toxic therapeutic strategies.

Thus, Louis-Bar syndrome represents a striking example of a cancer predisposition syndrome in which the underlying pathogenesis directly dictates the approach to antitumor treatment. Understanding the molecular mechanisms of the disease is key to developing safe and effective therapies for malignant neoplasms in this vulnerable pediatric population. Managing oncological conditions in children with Louis-Bar syndrome requires not merely modifying standard protocols but adopting a fundamentally different approach grounded in the molecular pathophysiology of the disorder. The future of therapy lies in the development of non-toxic, targeted strategies, as well as early tumor detection and prevention within the framework of personalized medicine.

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ANALYSIS OF CLINICAL DATA AND EGFR/HER-2/NEU EXPRESSION LEVELS IN PATIENTS WITH BRAIN-DEAD STATUS FOLLOWING GASTRIC CANCER

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This study presents an analysis of tissue antigen expression levels (EGFR, Her-2/neu) and clinical characteristics of patients with pancreatic head cancer. The research evaluated clinical data from 56 confirmed cases of pancreatic head cancer, including tumor morphology, disease severity, differentiation grade, tumor localization, as well as patient demographics such as age and gender. The results showed that in this patient cohort, EGFR and Her-2/neu expression was predominantly absent.

Keywords: pancreatic cancer, adenocarcinoma, expression, immunohistochemistry, EGFR, Her-2/neu

Doctors refer to pancreatic cancer (PC) as the "king of cancers" due to its stealthy onset, high malignancy rate, rapid progression, and the fact that about 80% of patients are already in advanced stages when diagnosed, making surgical treatment impossible. Depending on the tumor's location in the pancreas, it is classified as pancreatic head cancer, pancreatic body cancer, or pancreatic tail cancer. Head of pancreas cancer accounts for nearly 90% of all cases of pancreatic cancer [1, 2].

EGFR is overexpressed or mutated in many tumors, leading to uncontrolled growth of cancer cells and increased malignancy. The EGFR expression does not show significant correlation with pathological factors such as gender, patient age, tumor size, or location. However, it is associated with vascular invasion, lymph node metastasis, and tumor stage according to the TNM system [3]. The expression level of the Her-2/neu gene in pancreatic cancer is significantly higher than in normal pancreatic tissue and benign tumors, indicating a close association between Her-2/neu hyperexpression and pancreatic cancer development. Its positive expression level decreases markedly with progression of cancer stages according to the TNM system, suggesting that Her-2/neu may play a role in pancreatic cancer before metastasis occurs [4].

The study analyzed clinical data and tumor tissue from 56 patients with pancreatic cancer who received treatment at the N. N. Alexandrov National Cancer Centre of Belarus.

The expression of tissue antigens (EGFR, Her-2/neu) in patients with thyroid carcinoma was determined using immunohistochemical methods with antibodies from DAKO (Denmark). Histological specimens were reviewed and immunohistochemical staining evaluations were performed by a single pathologist.

Clinical data analysis revealed a median age of 62 years [49; 70], with 31 cases in males and 25 in females. Localization analysis showed 75% of patients had tumors in the pancreatic head, 16.1% in both head and body, and 8.9% exhibited total tumor involvement. The predominant tumor grade was moderately differentiated (76.8%), followed by high-grade (12.5%), low-grade (8.9%), and undifferentiated (1.8%) cases. The analysis of tumor prevalence showed that stage IA was diagnosed in 1.8%, stage IB in 1.8%, stage IIA in 19.6%, stage IIB in 26.8%, stage III in 3.6%, and stage IV in 46.4%. Based on tumor morphology, patients were categorized as follows: 35 cases (62.5%) had ductal adenocarcinoma, 8 cases (14.3%) mucinous adenocarcinoma, 5 cases (8.9%) metastatic adenocarcinoma, 2 cases (3.6%) neuroendocrine carcinoma, 3 cases (5.3%) mixed ductal-endocrine carcinoma, 1 case (1.8%) intestinal-type adenocarcinoma, 1 case (1.8%) clear cell adenocarcinoma, and 1 case (1.8%) undifferentiated carcinoma.

In our study, we analyzed the expression levels of the epidermal growth factor receptor type 1 (EGFR). Results showed that 40 patients (71.4%) had no EGFR expression, 9 patients (16.1%) exhibited low expression, 2 patients (3.6%) showed moderate levels, and 5 patients (8.9%) demonstrated high expression.

In the study, HER-2/neu hyperexpression was observed in 10.7% of patients, moderate expression in 7.1%, hypoexpression in 5.4%, and no expression in 76.8%.

In pancreatic cancer patients with affected head of pancreas, expression was detected in 28.6% of cases, while Her-2/neu was present in 23.2%. These findings may indicate tumor hyperplasia progression and tumor spread, suggesting a poorer disease prognosis.

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MOLECULAR ASSESSMENT OF MICRORNA EXPRESSION IN CUTANEOUS MELANOMA

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Cutaneous melanoma (CM) is a neoplasm that develops as a result of malignant transformation of melanocytes and melanoblasts [1].

Currently, the incidence of this disease has increased significantly worldwide, including in Belarus, and continues to grow steadily. The average annual growth rate of CM in the world is about 5%, which is one of the highest among all malignant tumors, except for lung cancer. Cutaneous melanoma is one of the most aggressive neoplasms. The tumor is located mainly in the skin, less often in the mucous membranes and the retina.

Keywords: cutaneous melanoma, profiling, microRNA, melanocytic nevi, polymerase chain reaction.

Improving the effectiveness of antitumor therapy for CM is directly related to advances in molecular and cell biology and genetics, as well as related fields, which allows for the development of new methods for treating oncological diseases on a rational basis. The "molecular portrait" of a tumor, i.e., the totality of its characteristic molecular changes, allows for the diagnosis of oncological diseases, assessment of its sensitivity to the therapy, and determination of prognosis. Currently, there is data suggesting that microRNAs can be considered as biomarkers of tumor cells: the expression level of microRNAs is specific for different cancer cell lines; their detection in biological fluids, including blood, can be diagnosed using molecular genetic technologies [2, 3].

The research material was tumor tissue from patients with cutaneous melanoma who received special treatment at the "N.N. Alexandrov National Research Center for Oncology and Medical Radiology". Of the total number of patients, 40.6% had stage I, 59.4% had stage II, and melanocytic nevi were diagnosed in 10%. The average age of patients with cutaneous melanoma was 59 ±13.09 years. In the study group, cutaneous melanoma was detected on the trunk in 28% of cases, on the lower extremities in 44%, on the upper extremities in 19%, and on the head and neck in 9%. Superficial spreading melanoma was diagnosed in 44% of patients, the nodular form in 44% of cases, and lentigo melanoma in 12%. In the analyzed patient group, pigmented melanoma was observed in 68%, weakly pigmented melanoma in 20%, and non-pigmented melanoma in 12%.

To determine the molecular expression profile of the studied microRNAs, tissue from cutaneous melanoma and benign melanocytic nevi embedded in paraffin blocks was used as material. RNA isolation was performed using reagent kits from "Qiagen", Germany, according to the manufacturer's instructions. The isolated mRNA was converted into cDNA. Amplification was carried out in a BioRad (USA) amplifier. For real-time amplification of cDNA fragments, a BioRad (USA) amplifier was used.

According to preliminary data, the expression of microRNA mir-21 in patients with CM varied from 19.5 to 32.8 rel. units (26.5±0.13 rel. units) compared to the values in patients with melanocytic nevi 29.8±0.15 rel. units (expression level from 27.5 to 32.2 rel. units) (p (Mann-Whitney) <0.05).

The development of CM is associated with an increase in the expression of mir-181 to 32.3±0.16 rel. units compared to the parameter value in nevi of 29.9±0.12 rel. units (p (Mann-Whitney) <0.21).

The research continues.

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IDENTIFICATION OF THE PHYTASE ENZYME GENE IN BACTERIA OF THE *BACILLUS SUBTILIS* SPECIES ISOLATED FROM SOILS EXPOSED TO PROLONGED EXPOSURE TO IONIZING RADIATION USING REAL-TIME PCR

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Chronic exposure to ionizing radiation is a powerful environmental stress factor that can affect the genetic structure of soil microbiological communities. The purpose of this study was to compare the frequency of occurrence of the phytase enzyme gene in soil strains of *Bacillus subtilis* isolated from territories with different levels of radiation contamination.

Keywords: ionizing radiation, Bacillus subtilis, phytase, PCR, soil microorganisms.

Enzymes are highly specific biological catalysts involved in the metabolic processes of microorganisms. They are vital, and without them, no catabolic or anabolic reaction could occur. The functionality of enzymes depends on various physico-chemical factors, and they are sensitive to any changes in the surrounding internal environment. Therefore, finding deterministic models of the dependence of their catalytic activity on these factors is extremely important [1]. For example, how ionizing radiation affects the activity of various enzymes and how this can be controlled is a key issue for microbiology, biochemistry, medicine, technology, etc., since it is both fundamental, given some evolutionary aspects, and purely applied, especially in cases where certain bacterial enzymes are used in for industrial or domestic purposes.

In this study, Real-time quantitative PCR was used to identify the phytase enzyme gene in bacteria of the species *Bacillus subtilis* isolated from soil samples from the territory of the Polessky State Radiation and Ecological Reserve (PGREZ) and the territory of the Berezinsky Biosphere Reserve (natural background level of ionizing radiation) (BBZ). The presence of the enzyme gene was studied in two bacterial fractions and compared with each other in order to study the effect of ionizing radiation on physiological and biochemical processes.

A commercial FastDNA SPIN KIT (MP Biomedicals, USA) was used to isolate total DNA from selected soil samples. The resulting precipitate was dissolved in sterile water, and the concentration was determined spectrophotometrically (A260/A280 ratio). The obtained samples were subjected to quantitative PCR analysis using the ZUBR Green-1 intercalating dye (Primtech, Republic of Belarus) and the primer sequences [2] listed in Table 1, according to the following protocol: 95 °C for 2 minutes, then 40 cycles of 95 °C for 10 seconds, 59 °C during 15 °C and 67 °C during 15 °C. The results were interpreted by the Ct value (threshold cycle) in the range of 18-40.

Table1

Sequences of primers and their concentrations for detecting the phytase enzyme gene

Name	Sequence	Concentration
Fit-f	GACCGTGCGACAGGAGATCA	50 мкМ

Fit-r	GCCAAGTCCGAAACCGAGAA	50 мкМ

The results of the study show a significant difference in the prevalence of the phytase enzyme gene among soil strains of *Bacillus subtilis*. For soil isolates of the BBZ territory, the frequency was 47%, whereas for isolates of the PGREZ territory it was only 20%. The fact that the gene is found 2 times more often in an area not exposed to chronic ionizing radiation is consistent with the hypothesis that radiation affects the genomic stability of soil bacteria.

The practical significance of the results lies in the identification of a potential genetic marker of adaptation of microorganisms to radiation stress, which is important for assessing the state of microbial communities in conditions of anthropogenic pollution.

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DETECTION OF THE GENE OF THE NITROGENASE ENZYME IN BACTERIA OF THE BACILLUS SUBTILIS SPECIES ISOLATED FROM SOILS EXPOSED TO PROLONGED EXPOSURE TO IONIZING RADIATION BY REAL-TIME PCR

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The effect of chronic radiation pollution on the functional potential of soil microbiocenoses remains poorly understood. In this work, using the example of a model object, the bacterium Bacillus subtilis, it is shown how ionizing radiation affects the prevalence of the gene for the enzyme nitrogenase, a key enzyme that performs biological nitrogen fixation.

Keywords: Bacillus subtilis, PCR, chronic radiation exposure, nitrogenase, soil.

Microorganisms are widespread in the soil environment and are important components of its ecosystem. They play many important roles in the soil, including decomposing organic matter, promoting nutrient cycling, and influencing soil structure and fertility. By analyzing how ecological processes occur in externally exposed soils and in *intact*-soils, we can clearly trace the influence of biotic and abiotic (physico-chemical) factors on the performance of its ecological functions by the soil.

For example, ionizing radiation is a classic stress factor that makes it possible to clearly trace the contribution of abiotic components to the functioning of the soil ecosystem [1]. This is especially evident in the example of enzymatic activity. In intact soils, the enzymatic activity is quite high, while in soils exposed to radiation, there is a complex dynamics of its changes.

In the framework of this study, a comparative study of the genetic potential of *Bacillus subtilis* bacteria associated with the synthesis of the enzyme nitrogenase was carried out. For the practical part, soil samples were taken from two territories contrasting in radiation conditions: the zone of chronic radiation exposure (Polessky State Radiation and Ecological Reserve, PGREZ); the territory with the background radiation level (Berezinsky Biosphere Reserve, BBZ).

The quantitative real-time PCR (qPCR) method was used to detect the expression of the nitrogenase enzyme gene in isolated *Bacillus subtilis* strains. Genomic DNA was isolated using the FastDNA SPIN KIT for Soil (MP Biomedicals, USA). The quality and quantity of the isolated DNA were monitored spectrophotometrically by the ratio of optical density values of 260/280 nm. PCR amplification was performed in a 25 µl reaction mixture using the ZUBR Green-1 intercalating dye (Primtech, Republic of Belarus) and the primer sequence shown in Table 1 [2].

Table1

Sequences of primers and their concentrations for detecting the gene of the enzyme nitrogenase

Name	Sequence	Concentration
Nit-f	AACAGCCTGCTTCGGGTCTG	50 мкМ
Nit-r	GCTCGGCAGCTTTCCACATC	50 мкМ

A comparative analysis revealed a twofold decrease in the prevalence of the nitrogenase enzyme gene among *Bacillus subtilis* in radioactively contaminated soils of the PHREZ (22%) compared with pure soils of the BBZ (42%). This observation confirms the hypothesis about the negative impact of chronic exposure to ionizing radiation on the genomic stability of soil microorganisms.

The practical value of the work lies in the fact that it offers a new approach for assessing the long-term damage caused to the soil ecosystem by radiation pollution.

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RESVERATROL INHIBITS OSTEOBLAST FERROPTOSIS IN THE TREATMENT OF OSTEOPOROSIS

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Osteoporosis correction issues arise with the development of oxidative stress, which results from ferroptosis, which occurs when iron metabolism in the body is disrupted [1]. Osteoporotic fractures, also known as fragility fractures, are primarily caused by low-energy falls and most commonly occur in areas such as the vertebral body, distal forearm, femur, proximal humerus, and pelvis [1]. Osteoporotic hip fractures are particularly serious, with a mortality rate of 5%.

Study Objective: To investigate the effect of Resveratrol on osteoblast ferroptosis induced by TBHP, a well-known inducer of cytotoxic and oxidative stress.

Methods: A ferroptosis model was established in U2OS osteoblast-like cells using TBHP (tert-butyl hydroperoxide). Cells were divided into a control group, a TBHP model group, and an intervention group (TBHP +Re) [2]. Cell viability was measured using a CCK-8 assay, and cell morphology was observed under an optical microscope. The GSH/GSSG ratio was determined by ELISA, while the expression levels of ferroptosis-related proteins SLC7A11 and GPX4 were analyzed by Western blot. Mitochondrial morphology in cells was examined using scanning electron microscopy. Results: TBHP treatment significantly reduced cell viability and induced abnormal cell morphology, significantly downregulated the protein expression of SLC7A11 and GPX4, increased GSH consumption, and induced mitochondrial shrinkage along with a decrease in cristae density, confirming the successful establishment of a ferroptosis model. Resveratrol treatment significantly improved cell viability and partially restored normal cell morphology, markedly upregulated SLC7A11 and GPX4 expression, attenuated GSH depletion, and partially restored mitochondrial morphology, demonstrating a protective effect against ferroptosis [3]. Conclusion: Resveratrol at a concentration of 20 μM effectively blocks TBHP-induced ferroptosis in osteoblasts, providing new experimental data and mechanistic insights into its potential use as an adjuvant therapy for osteoporosis; however, the protection was not clearly dose-dependent.

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COMBINED EFFECT OF THE POLYPHENOL G-11 AND MG^{2+} ON CALCIUM TRANSPORT IN RAT BRAIN SYNAPTOSOMES

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Keywords: Synaptosomes, polyphenols.

Abstract. Calcium transport in the brain plays a key role in maintaining neuronal excitability, neurotransmitter release, and the formation of synaptic plasticity. Imbalance of calcium homeostasis underlies many neurodegenerative processes. Polyphenols, possessing antioxidant and modulatory properties, are considered promising compounds capable of affecting calcium channels and thus exerting neuroprotective effects [1].

Mg^{2+} plays a crucial role in regulating NMDA receptors by blocking their pores at resting membrane potential. This block is relieved during depolarization, ensuring calcium selectivity and preventing excessive Ca^{2+} influx. Therefore, Mg^{2+} controls neurotransmitter release and maintains synaptic plasticity. The use of Mg^{2+} ions makes it possible to clarify the mechanism of calcium transport through NMDA receptors and to relate it to the influence of the studied polyphenol [2,3].

Materials and Methods. Synaptosomes were isolated from rat brain tissue using differential centrifugation. Calcium concentration was assessed using the fluorescent calcium-sensitive probe HTC, and fluorescence changes were recorded fluorimetrically.

Results and Discussion. The fluorescence level obtained in control synaptosome suspensions was taken as 100%. In the presence of Mg^{2+} (50 μM), this value increased by 54%, indicating a marked rise in membrane-bound Ca^{2+} associated with the inhibitory properties of Mg^{2+} on calcium influx. This result suggests that magnesium ions stabilize the synaptic membrane and limit Ca^{2+} permeability, thereby increasing the proportion of calcium bound to membrane components rather than remaining in the cytosolic fraction.

When polyphenol G-11 (75 μM) was applied in combination with Mg^{2+} (50 μM), a further significant increase in the fluorescence signal was observed – by 72% compared to control. This synergistic effect indicates that polyphenol G-11 enhances the ability of Mg^{2+} to inhibit calcium entry into synaptosomes. The data imply that G-11 may act through an allosteric modulation of calcium-permeable channels, possibly NMDA receptors, by altering their sensitivity to Mg^{2+}-dependent blockade.

In contrast, in the presence of classical calcium channel blockers such as nifedipine and argiolobatin, the increase in membrane-bound calcium was considerably lower. This suggests that the mechanism of action of polyphenol G-11 differs from that of traditional L-type calcium channel inhibitors and may involve specific interactions with glutamate receptor-associated pathways.

The observed effects collectively indicate that G-11 not only potentiates the inhibitory influence of Mg^{2+} on Ca^{2+} transport but may also exert additional stabilizing effects on synaptic membranes. Such a combined modulation of calcium dynamics could contribute to reduced excitotoxicity under pathological conditions and highlight polyphenol G-11 as a potential co-modulator of NMDA receptor activity.

Conclusions. Polyphenol G-11 enhances the calcium-blocking effect of Mg^{2+}, suggesting that it may act as a co-modulator of calcium entry through NMDA receptors. This mechanism may represent a potential therapeutic target for the development of new neuroprotective agents.

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ASSESSMENT OF THE IMPACT OF ATMOSPHERIC POLLUTION ON THE SPREAD OF RESPIRATORY DISEASES

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This article reveals the problem of the influence of atmospheric pollution on the spread of lung diseases.

Keywords: lungs, atmosphere, pollution.

Pollutants of atmospheric air are substances (gases, particles and biological molecules) present in the air and capable of causing various harm to human health. Such substances can enter the air from natural sources such as volcanic eruptions and forest fires. But industrial emissions, coal and oil combustion, as well as emissions from vehicles account for a large amount of pollution.

A large number of atmospheric pollutants enters the body through the lungs. The ingress of pollutants in this way is the most dangerous, since they can continuously enter the human body. Polluted air can not only cause various diseases of the respiratory system, but also exacerbate other human diseases.

The assessment of the effects of atmospheric pollution depends on the type of pollutant, but almost all substances can cause irritation and damage to the mucous membranes of the respiratory tract. When inhaling various gases together with air, small particles enter the mucous membrane of the respiratory tract and dissolve in it, thereby causing various negative consequences.

Sulfur dioxide (so_2), formed during the combustion of coal and petroleum products, also poses a serious threat to the respiratory system. This gas causes bronchospasm, increases the secretion of mucus in the respiratory tract, which is especially dangerous for people suffering from asthma and chronic bronchitis. Prolonged exposure to sulfur dioxide leads to a decrease in the immune defense of the lungs and increases susceptibility to respiratory infections [1].

Solid particles (PM2.5 and PM10) are particularly dangerous because of their ability to penetrate deep into the lung tissue. Particles smaller than 2.5 micrometers can reach the alveoli and even enter the bloodstream, causing systemic inflammation. Exposure to particulate matter is associated with an increased incidence of lung cancer, chronic obstructive pulmonary disease (COPD), and increased mortality from cardiovascular and respiratory diseases [2].

Carbon monoxide (CO), formed during incomplete combustion of fuel, reduces the ability of the blood to carry oxygen, which leads to tissue hypoxia. Although carbon monoxide predominantly affects the cardiovascular system, its effects worsen the course of respiratory diseases, especially in people with chronic respiratory failure [3].

Thus, the greatest danger to public health is posed by solid particles PM2.5 and PM10, which can penetrate into the deep parts of the lungs, as well as gaseous pollutants such as nitrogen dioxide, sulfur dioxide and ozone, which irritate the mucous membranes and exacerbate chronic respiratory diseases. Critical risk groups are children, the elderly, and patients with chronic lung diseases, in whom the negative effects of pollution are most pronounced.

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ANALYSIS OF MICROELEMENTS, CLINICAL AND MOLECULAR MARKERS IN OSTEOARTHRITIS PATIENTS WITH METABOLIC SYNDROME

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This study investigates the interplay between trace element imbalances, inflammatory markers, and microRNA expression in osteoarthritis (OA) patients with and without metabolic syndrome (MS). Results reveal significant correlations between synovial glucose and lipid levels and concentrations of iron, manganese, zinc, and other trace elements in OA patients with MS. Elevated IL-6 and IL-17A levels correlate with microelement imbalances and microRNA expression, indicating their role in inflammation. The findings suggest that combined analysis of biochemical, inflammatory, and molecular-genetic markers improves OA diagnosis and prognosis. This integrative approach supports personalized treatment strategies in rheumatology and orthopedics.

Keywords: trace elements, inflammatory marker, microRNA, synovial fluid, osteoarthritis, metabolic syndrome.

Osteoarthritis (OA) remains the most prevalent rheumatic disease worldwide, characterized by diverse clinical phenotypes reflecting heterogeneous disease mechanisms. Besides age, the main risk factors for OA development are obesity and chronic systemic diseases associated with microelementosis. Understanding molecular pathways involving microRNAs and trace element imbalances in OA patients with and without metabolic syndrome (MS) is critical for identifying biomarkers and improving early diagnosis and treatment strategies.

The aim was to identify the relationship between microelement imbalances, biochemical, inflammatory, and molecular-genetic markers in osteoarthritis associated with metabolic syndrome.

A patient group (n=40) was divided into three subgroups: isolated OA (n=26), metabolic disorders without joint deforming changes (n=6), osteoarthritis patients with MS (n=8). The control comparison group consisted of patients without signs of changes in metabolism and joints (n=8). Synovial fluid samples were collected during surgery on knee or hip joints. The concentration of trace elements was determined by inductively coupled plasma atomic emission spectroscopy. Expression levels of hsa-miR-34a-5p and hsa-miR-146a-5p were assessed via PCR using the $2^{-\Delta\Delta CT}$ method. Biochemical analyses and ELISA were used to examine metabolic and inflammation markers. Statistical analysis of the obtained results was carried out with nonparametric methods using the Statistica 8.0 program.

Patients with OA and metabolic syndrome showed a statistically significant inverse correlation between synovial fluid glucose levels and concentrations of iron, manganese, magnesium, zinc, chromium, copper, and molybdenum ($Rs < -0,7$; $p < 0,05$). In osteoarthritis patients with metabolic syndrome, lipid metabolism disturbances were observed, with triglycerides, cholesterol, LDL, and HDL concentrations inversely strongly correlated with synovial manganese ($Rs < -0,8$; $p < 0,05$). Serum interleukin-17A concentration was elevated in OA patients with or without metabolic syndrome ($p < 0,05$), correlating with increased peripheral blood iron concentration ($Rs = 0,8$; $p < 0,05$). Elevated interleukin-6 inversely correlated with manganese, magnesium, zinc, chromium, copper, and molybdenum in synovial fluid in OA ($Rs = [-0,6; -0,9]$, $p < 0,05$). Levels of IL-6, IL-17, CRP, and MMP-13 in synovial fluid correlated with miR-146a-5p and miR-34a-5p expression and depended on metabolic syndrome presence, reflecting joint inflammation status ($p < 0,05$). Inflammatory processes modulated by microRNAs, which regulate gene expression post-transcriptionally, are increasingly recognized as key factors in OA pathology and its interplay with MS.

Thus, the results indicate a significant relationship between micronutrient imbalances, molecular-genetic factors, and biochemical clinical markers in osteoarthritis, both with and without metabolic syndrome. The study of trace element imbalances and cytoplasmic post-transcriptional regulation of cytokine synthesis via microRNAs, together with biochemical and inflammatory markers, can be applied in practical medicine (rheumatology and orthopedics) for comprehensive diagnosis of patients with musculoskeletal disorders. This approach allows assessment of inflammation severity, prognosis of disease progression, and nutritional correction in osteoarthritis patients under anthropogenic environmental influences.

CHRONIC INFLAMMATORY DEMYELINATING POLYNEUROPATHY (CIDP): CHARACTERISTICS OF AUTOANTIGENS AND GROWTH FACTORS

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Chronic Inflammatory Demyelinating Polyneuropathy (CIDP) is a rare autoimmune disorder of the peripheral nervous system characterized by the destruction of the myelin sheath and axonal damage resulting from a pathological immune response. This paper discusses the key immunopathogenetic mechanisms of CIDP, focusing on the role of autoantigens and growth factors.

*Keywords***:** CIDP, autoantigens, growth factors, myelin, autoimmune inflammation.

Chronic inflammatory demyelinating polyneuropathy (CIDP) is a rare autoimmune disease of the peripheral nervous system in which an abnormal immune response leads to the destruction of the myelin sheath of nerve fibers and axonal injury. The relevance of the study is determined by the limited understanding of the disease's etiology and mechanisms, which hinders early diagnosis and the development of effective therapeutic strategies. The aim of this work is to investigate the immunopathogenetic mechanisms of CIDP with an emphasis on the role of autoantigens and growth factors. The study examines the characteristics of the cellular and humoral immune responses, as well as the involvement of B lymphocytes and cytokines in the development of the inflammatory process.

It has been shown that in CIDP, both cellular and humoral components of the immune system are affected. Inflammatory infiltrates consisting of $CD4^+$ and $CD8^+$ T cells and macrophages form within nerve fibers, accompanied by elevated levels of cytokines (IL-1, IL-6, TNF-α). In the serum of patients, antibodies to myelin proteins – neurofascin (NF155, NF186), contactin-1 (CNTN1), and Caspr1 – have been detected; these are associated with severe disease course and reduced responsiveness to glucocorticoid therapy. The B-cell activating factor (BAFF/BLyS), which regulates the survival and maturation of B lymphocytes, plays a significant role in maintaining autoimmune inflammation. Disruption of the blood–nerve barrier facilitates the infiltration of autoreactive cells into nervous tissue, initiating demyelination and subsequent axonal injury.

Understanding the mechanisms by which autoantigens and growth factors contribute to the pathogenesis of CIDP is crucial for improving diagnostics and developing novel therapeutic strategies aimed at modulating the immune response. CIDP should be regarded as an organ-specific autoimmune disorder involving complex interactions between cellular and humoral factors. Despite substantial progress in studying the disease, the precise nature of the autoantigens remains unclear, underscoring the need for further research in this area.

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EPIDEMIOLOGICAL SITUATION OF TUBERCULOSIS IN THE WORLD AND BELARUS IN 2023

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Tuberculosis remains a significant public health problem worldwide. This article presents an analysis of the epidemiological situation of tuberculosis in the Republic of Belarus and other countries based on official statistical data for 2023. In Belarus, the incidence of tuberculosis in 2023 was 13.9 cases per 100,000 population, with 49.5% of cases occurring in people aged 35 to 54 years, and 75.6% of cases diagnosed in men.

Keywords: tuberculosis, epidemiology, morbidity, World Health Organization, Republic of Belarus.

Tuberculosis is one of the deadliest infectious diseases in the world, caused by a microorganism called *Mycobacterium tuberculosis* [1]. More than 10 million people continue to fall ill with TB every year. Mortality from tuberculosis without treatment exceeds 50%. Globally, tuberculosis incidence declined by 2% per year between 2010 and 2020. However, is estimated to increase by 4.6% between 2020 and 2023. Today, all Member States of the United Nations and the World Health Organization aims to achieve an incidence rate of less than 1 case per million of the global population and eliminate tuberculosis as a public health problem by 2030.

The aim of this study was to analyze materials from the World Health Organization on various aspects of the fight against tuberculosis in the world [2], as well as data from the National Statistical Committee of the Republic of Belarus [3] for 2023 and to compare incidence rates in Belarus with global ones.

Geographically, most people with tuberculosis in 2023 were in Asia (45%), Africa (24%) and the Western Pacific (17%), with smaller proportions in the Eastern Mediterranean (8.6%), the Americas (3.2%) and Europe (2.1%). The highest number of tuberculosis cases in 2023 were registered in India (26% of the global total), Indonesia (10%), China (6.8%), the Philippines (6.8%), and Pakistan (6.3%). Anyone can become infected with tuberculosis, regardless of age or gender. According to the World Health Organization, in 2023, approximately 55% of all cases were in men over 15 years of age. Women who developed tuberculosis during the same period accounted for 33% of all cases. The number of children and adolescents aged from 0 to 14 years infected with tuberculosis amounted to 12% of the total number.

The global incidence rate of tuberculosis in 2023 was 134 new cases per 100,000 population, a very slight increase (0.2%) compared to 2022. Among those infected with tuberculosis, 55% were men, 33% were women, and 12% were children and adolescents. Tuberculosis caused 1.25 million deaths in 2023.

In Belarus, the incidence of tuberculosis in 2023 was 13.9 cases per 100,000 population. 75.6% of cases were among men, and 24.4% were among women (including children). Compared to 2022, the incidence rate decreased by 7.3%. Middle-aged individuals between 35 and 54 years of age predominated among those infected (49.5% of all cases). Among children under 17, the incidence rate was 1.2 cases per 100,000 population, accounting for only 1.7% of all tuberculosis cases Tuberculosis incidence in neighboring countries was higher or comparable. In Russia and Lithuania, approximately 30 cases of tuberculosis per 100 000 population were registered in 2023, while in Latvia and Estonia, the rates were 18.4 and 11.2 cases per 100 000 population, respectively.

There has been a significant improvement in the epidemiological situation regarding tuberculosis in Belarus. The main measures for tuberculosis prevention in Belarus are aimed at strengthening the regulatory, organizational, methodological, and informational framework of healthcare organizations providing anti-tuberculosis care to the population, as well as the introduction of modern, effective, and cost-effective prevention and treatment measures into practice. Thanks to the measures taken in the republic, the trend towards a decrease in the incidence and mortality from tuberculosis continues. The main problems of tuberculosis both in the world and in Belarus are associated with the

development of multiple drug resistance in some patients (15%), the presence of HIV-associated tuberculosis, as well as significant financial costs for the prevention and treatment of this disease.

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THE EFFECT OF SUSPENDED PARTICLES ON TYPE 2 DIABETES

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This article reviews current scientific understanding of the association between ambient air pollution by fine particulate matter and the prevalence of diabetes mellitus, particularly type 2 diabetes. In recent years, an increasing number of studies have indicated that air pollutants can exert significant adverse effects on human health, contributing to the development of various diseases – among which diabetes mellitus occupies a leading position. In this context, particular attention is paid to the role of fine particulate matter in the pathogenesis of this disease, with emphasis placed on how the effects depend on particle size, origin, chemical composition, and atmospheric concentration [1].

Keywords: particulate matter, diabetes mellitus, air pollution.

Research has shown that particulate matter generated by road traffic and containing transition-valence metals poses the greatest threat to human health. Long-term exposure to high concentrations of fine ($PM_{2.5}$) and ultrafine particles is associated with an increased risk of developing type 2 diabetes mellitus and higher mortality rates from this condition.

Even short-term exposure to particulate matter has detrimental consequences. It can induce vascular insulin resistance and inflammatory responses initiated through oxidative stress in the lungs. This oxidative stress triggers the release of pro-inflammatory cytokines from cells, leading to systemic inflammation throughout the body. Exposure to particles of 2.5 μm in diameter ($PM_{2.5}$) results in significantly upregulated expression of inflammation-related genes and activation of corresponding signaling pathways, further supporting their role in the pathogenesis of type 2 diabetes [2].

Experimental studies using animal models demonstrate that particulate matter disrupts glucose homeostasis and promotes inflammatory processes in adipose tissue, the liver, and the central nervous system. Nevertheless, despite accumulating evidence, the precise role of airborne fine particles in the pathogenesis of type 2 diabetes – particularly at the molecular and cellular levels – remains incompletely understood. Further research is needed to formalize the mechanisms by which particulate matter affects the human body. Such studies would enhance our understanding of how air pollution contributes to the development of various diseases, including type 2 diabetes mellitus [3].

Understanding these mechanisms is crucial for developing more effective treatment and prevention strategies. Ultimately, investigating the health impacts of air pollution may lead to novel public health approaches aimed at reducing diabetes incidence and improving the quality of life for individuals living with this disease.

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POTENTIAL OF THE PRECEPITATION METHOD FOR DETECTION OF CIRCULATIN IMMUNE COMPLEXES OF DIFFERENT SIZES

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The functional activity of circulating immune complexes is one of the mechanisms of humoral immunity. Promising directions include improving research methods and deepening knowledge in the field of immune complex nature. Qualitative analysis of circulating immune complexes involves the simultaneous determination of their concentration and size using polyethylene glycol of varying concentrations [1].

Keywords: immune complexes, serum, precipitation, polyethylene glycol

Circulating immune complexes (CIC) are characterized by heterogeneity in composition and size. They include soluble antigens, antibodies of various classes, and associated components of the complement system C1q, C3, and C4. The formation of immune complexes is a natural immune response of the body aimed at removing endogenous and exogenous antigens. Increased CIC concentrations are observed in a wide range of pathologies: autoimmune diseases, allergic processes, and bacterial and viral infections.

Assessment of the size of immune complexes, reflecting their pathogenic properties, is of significant importance. Large (high molecular weight) complexes are actively captured by phagocytes and cleared from the bloodstream. Small (low molecular weight) complexes are characterized by prolonged circulation and a tendency to deposit in organs and tissues. Polyethylene glycol (PEG) is used to determine the concentration and size of CIC[2].

Objective: To quantitatively characterize immune complexes of various sizes in serum from donors using a precipitation method.

Methods: The determination of circulating immune complexes was carried out in the blood serum of 20 healthy individuals with no history of acute and chronic inflammatory processes of any etiology, autoimmune, allergic, and oncological pathologies. For the assessment of the total concentration of CIC, a modified method by Grinevich and Alferova (1981) was used, based on the selective precipitation of complexes with a 3.75% solution of polyethylene glycol with a molecular weight of 6000 Daltons (PEG 6000) [3]. To determine the size of CIC, polyethylene glycol of varying concentrations was used. High molecular weight and low molecular weight CIC were precipitated in 3% and 6% solutions of PEG 6000, respectively. The results were recorded photometrically at wavelengths of 450-620 nm. Excel spreadsheets and the Statistica 8.0 application software package were used for statistical analysis.

Results: The CIC concentration in the group of healthy donors was 64 (50÷98) arbitrary units (AU). The reference interval, including the values of the 5th and 95th percentiles, ranged from 50 to 98 AU. Low molecular weight CICs were prevalent in the donors, with a concentration of 76 (65÷86) AU. The content of large-sized CICs in the serum of donors corresponded to 22 (16÷30) AU. The reference values for low molecular weight and high molecular weight CICs were 61-92 AU and 14-33 AU, respectively. To characterize the biological activity of immune complexes, the pathogenicity coefficient, which represents the ratio of the concentration of low molecular weight CICs to the amount of high molecular weight CICs, was calculated. The pathogenicity coefficient was 3.7 (2.3÷5.5) AU, and the reference values ranged from 2.5 to 5.8.

Thus, the precipitation method using various concentrations of polyethylene glycol with a molecular weight of 6000 Daltons allows for the effective determination of the total concentration of CICs and the identification of their sizes. It was established that low molecular weight immune complexes normally prevail in peripheral blood, with levels ranging from 61 AU to 92 AU. The content of high molecular weight CICs in circulation is low, amounting to 14-33 AU, which is due to their increased affinity for phagocyte receptors and effective elimination from the body.

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CYTOKINES DETECTION BY FLOW CYTOMETRY

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This article describes in detail the steps involved in cell staining to determine intracellular cytokine production levels using flow cytometry. Both the advantages and disadvantages of intracellular cytokine detection are presented, as well as the areas of application of this method in scientific research and clinical practice.

Keywords: intracellular cytokines, flow cytometry, fixation, permeabilization, stimulation.

Cytokines are biologically active substances of peptide nature that regulate a wide range of processes. Measurement of cytokine concentrations is a powerful and essential approach to the study of immune response in health and pathology. Methods for cytokine detection include immunoassays like enzyme-linked immunosorbent assay (ELISA) and multiplex bead-based assays (Luminex), which measure the proteins directly, as well as quantitative polymerase chain reaction (PCR) for measuring the expression of cytokine genes at the RNA level [1]. Flow cytometry is a highly effective technique that detects intracellular cytokines using specific fluorescence-labeled antibodies. This assay has its advantages and disadvantages. Its main features are its high analysis speed, simultaneous measurement of multiple parameters, and multiparametric characterization of cytokine production at the individual cell level without the need for long-term cultivation.

The steps of cytokines detection of flow cytometry include cell isolation, fixation, permeabilization, blocking, intracellular staining and analysis. Commonly used cells for this assay include peripheral blood mononuclear cells, other leukocytes or specific cell lines. These cells are often stimulated with mitogens (phytohemagglutinin etc) or specific antigens to induce cytokine production. The most potent stimulator of cytokine production is a combination of phorbol 12-myristate 13-acetate (PMA) and ionomycin. PMA activates protein kinase C, which leads to phosphorylation of intracellular proteins, activation of transcription factors such as NF-κB. Ionomycin acts as a calcium ionophore, increasing intracellular calcium (Ca^{2+}) levels and activating calcium-dependent enzymes and transcription factors such as NFAT. The combination of PMA and ionomycin triggers signaling pathways of many cytokines, such as interferon γ, tumor necrosis factor-α (TNFα), interleukin-1 (IL-1), and others. Following antigen/mitogenic stimulation of cells, it is necessary to block intracellular cytokine secretion to accumulate them inside the cell. Protein transport inhibitors, such as brefeldin A or monensin, are used for this purpose. Brefeldin A inhibits transport between the endoplasmic reticulum and the Golgi apparatus. It is preferred for long-term incubations because it does not significantly reduce cell viability. Monensin inhibits protein transport through the Golgi apparatus, particularly the trans-Golgi. It is more toxic than brefeldin A and has a greater impact on cell viability. In addition, when used as a stimulator of PMA/ionomycin to block cytokine synthesis, brefeldin A is more effective than monensin [2].

The next step involves staining the cells with fluorophore-conjugated antibodies specific to cell surface markers (e.g., CD3, CD4, CD8, CD19). This will subsequently allow the identification of specific cell populations and analysis of their intracellular cytokine production levels. To stabilize intracellular proteins, prevent protein degradation and maintains structure, cell fixation with paraformaldehyde is necessary.

Cell permeabilization is a process by which the cell membrane becomes permeable to a number of substances, including antibodies to intracellular antigens. For permeabilization, non-ionic detergents such as Triton X-100, saponin, Nonidet P-40 (NP-40) and Tween-20 are used. The most commonly used permeabilizer is saponin, which selectively binds to cholesterol in the cell membrane. Lower concentrations of saponin are used to act on the plasma membrane, whereas other membrane structures (e.g., endoplasmic reticulum) can only be permeabilized by high concentrations of this detergent [1-3].

The final step of intracellular staining involves incubating fixed and permeabilized cells with fluorophore-conjugated antibodies specific to cytokines and analyzing the stained cells on a flow cytometer. The study of intracellular cytokine production by flow cytometry allows us to evaluate the functional activity of cells in normal conditions and in a number of pathologies, including the response of cells to various stimuli.

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EXPERIMENTAL MODELING OF COMPETITIVE BINDING OF BIOTINYLATED FULL-LENGTH ANTIBODY CONJUGATES WITH FERRITIN ON POLYSTYRENE USING FLUORESCENT DETECTION

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Quantitative determination of such a diagnostically significant protein as ferritin is a pressing issue in modern medical biotechnology and is associated with a new approach to the diagnosis of pathological conditions such as anemia, cancer, myocardial infarction, infectious and inflammatory diseases, and post-COVID syndrome.

At the experimental modeling stage, the parameters of the competitive interaction of soluble and immobilized forms of ferritin were determined under the conditions of a standard solid-phase immunoassay carried out in intact wells of polystyrene plates and wells coated with polycationic polyelectrolyte poly-L-lysine without the use of silver nanofilms. [1].

Keywords: silver nanofilms, immunofluorescence analysis, polyelectrolyte, poly-L-lysine, monoclonal antibodies, conjugates of monoclonal antibodies with biotin, ferritin

The aim of this work was the experimental design of a laboratory test system for quantitative assessment of ferritin using a fluorescence detection method.

To quantify the formed immune complexes, either direct determination of the concentration of the formed immune complexes (type 1) or quantitative assessment of the remaining free specific binding sites on the antigen or antibody (type 2) are possible.

The second common stage of any immunochemical assay is the formation of a bond between the labeled compound and the immune complex or free binding sites on the antibody or antigen. The third mandatory process in immunochemical assay is the conversion of the label into a corresponding signal, measurable by some physicochemical method (spectrophotometric, fluorometric, luminescent, etc.).

Ferritin was immobilized by non-covalent sorption in the wells of a high-sorption capacity polystyrene plate without a polyelectrolyte layer coating and with a poly L lysine layer coating at a concentration of C1.

To create conditions for competition between binding sites on immobilized and soluble ferritin for binding sites on antibodies, a range of soluble antigen concentrations ranging from 12 to 500 ng/ml was chosen. This corresponds to diagnostically detectable ferritin concentrations in various biological fluids and tissue homogenates.

The experiments revealed that, within the chosen range of soluble antigen concentrations, active complex formation occurs between the anti-ferritin MAB-biotin conjugate and the soluble antigen, leading to a decrease in the number of antigen-antibody complexes formed with immobilized ferritin.

Active competition between the two forms of unlabeled antigen is already detected at a soluble competitor concentration of 12 ng/ml.

It should be noted that when ferritin is immobilized on a layer of polycationic polyelectrolyte poly-L-lysine, the intensity of competition between soluble and immobilized antigen increases.

The half-maximal inhibition concentration (C) of the 50% soluble form of antigen in a system where ferritin is immobilized on intact polystyrene is 50 ng/ml, while the half-maximal inhibition concentration (C) of the 50% soluble form of antigen in a system where ferritin is immobilized on a layer of polycationic polyelectrolyte poly-L-lysine is 25 ng/ml.

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MODERN METHODS OF DIAGNOSIS AND TREATMENT OF CEREBRAL INFARCTION

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This paper examines modern methods for diagnosing and treating cerebral infarction. It describes the most important stages of patient examination, from computed tomography and magnetic resonance imaging (MRI) to vascular ultrasound and laboratory tests. It then explains the essence of key treatment approaches, such as thrombolytic therapy, anticoagulant therapy, and blood pressure monitoring. The importance of rehabilitation and preventive measures is emphasized.

Keywords: cerebral infarction, computed tomography, doppler ultrasound, magnetic resonance imaging, electroencephalogram.

Cerebral infarction (CI) is one of the most common forms of cerebrovascular accident, leading to serious consequences for the health and quality of life of patients. Modern diagnostics and treatment significantly increase the chances of a successful recovery and minimize the negative consequences of the disease [1].

Stroke diagnosis begins with an assessment of the patient's neurological status and identification of symptoms characteristic of acute cerebrovascular accident. The most informative methods are:

Computed tomography (CT) allows for rapid detection of cerebral hemorrhage, ruling out hemorrhagic stroke, and assessing the extent of tissue damage. This method is especially important in the first hours after the onset of an attack, as speed in deciding on thrombolytic therapy is critical [3].

Magnetic resonance imaging (MRI) provides highly accurate visualization of soft brain tissue, allowing for the detection of even the smallest lesions, including early changes invisible on CT scans. This helps physicians more accurately plan treatment and rehabilitation strategies [3].

Ultrasound examination allows us to evaluate blood flow in the vessels, identifying stenosis, blockages and vascular structure anomalies that could lead to the development of a stroke [3].

Electroencephalogram is used to assess the functional state of the brain and exclude concomitant diseases of the nervous system, such as epilepsy [3].

Blood tests help identify risk factors for cardiovascular diseases, such as high cholesterol, sugar, inflammation, anemia, etc., which influence the development of stroke [2].

Modern treatment of stroke includes a set of measures aimed at restoring normal blood circulation, protecting nerve cells and preventing repeated episodes of the disease [4].

Thrombolytic therapy involves the administration of drugs that dissolve the clot and restore arterial patency. This method is most effective within the first few hours after the onset of symptoms [4].

Anticoagulant therapy the administration of anticoagulants reduces the risk of new blood clots and prevents recurrence of strokes [2].

Antihypertensive therapy to control blood pressure reduces the load on blood vessels and reduces the risk of recurrent stroke [3].

Rehabilitation measures, a complex of physical exercises, physiotherapy, and speech therapy sessions, help restore lost functions and improve the general well-being of patients [2].

Operations are performed for large arterial occlusions, carotid stenosis and aneurysms of cerebral vessels [2].

Thus, effective diagnosis and timely treatment play a key role in the outcome of a heart attack. The use of modern methods can significantly reduce the incidence of severe cases and fatalities, improving patients' quality of life and reducing medical costs. Therefore, it is important to raise public awareness of stroke signs and prevention methods, as well as develop a system for early detection and treatment of this disease.

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ASSESSMENT OF THE DYNAMICS OF THE LEVEL OF ENDOGENOUS INTOXICATION IN PATIENTS WITHCEREBRARY INFARCTIONDURING COMBINATION THERAPY

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The study was based on clinical data and peripheral blood samples from 40 patients with stroke before and after completion of specialized therapy. We found that, during treatment, patients experienced a statistically significant decrease ($p \leq 0.05$) in the lymphocyte-to-eosinophil ratio and an increase in the lymphocyte-to-monocyte ratio.

Keywords: cerebral infarction, levels of integral indices of endogenous intoxication, therapy.

Cerebral infarction (CI) is one of the most common and dangerous types of stroke, representing an acute cerebrovascular accident due to the blockage of an artery by a thrombus or embolus. This condition is characterized by a sudden cessation of blood supply to a specific area of the brain, leading to the death of nerve cells and impairment of functions controlled by the affected area. The incidence of cerebral infarction is steadily increasing, especially among the elderly, but risk factors are also observed in young patients [1]. The main causes of cerebral infarction are atherosclerosis of the cerebral vessels, arterial hypertension, diabetes mellitus, heart rhythm disturbances, smoking, and alcohol abuse. Early diagnosis and timely initiation of treatment play a key role in minimizing the consequences of the disease and restoring lost functions. Modern diagnostic methods, including computed tomography (CT) and magnetic resonance imaging (MRI), make it possible to quickly determine the location and extent of brain damage, which significantly influences the choice of therapeutic strategy [2].

The object of the study was the clinical data of the peripheral blood of 40 patients suffering from IHM. The subject of the study was the dynamics of the level of integral indices of endogenous intoxication during the course of the combined therapy: lymphocyte-to-monocyte ratio index (LMR), lymphocyte-to-eosinophil ratio index (LER), lymphocyte-to-erythrocyte sedimentation rate ratio index (LSR). Hematological examination was performed using the Hemacomp 10 analyzer (Italy). The study group included patients with an average age of 72 years [36; 88]. Gender distribution was: men - 19 people; women - 21 people.

In the course of the study, the reactivity of the body of patients with IGM to therapy was assessed using integrated indices of endogenous intoxication. After analyzing the clinical data of patients with IGM, the level of ILESR before treatment was 1.48 relative units [CI 0.71; 2.33] and was below the limit of the reference values of the parameter (1.87±0.24 relative units), which indicates a non-specific defense of the body in response to intoxication associated with the autoimmune process. After the therapy, this indicator statistically insignificantly ($p_{(Wilcoxon)} = 0.539203$) increased by 1.013 times and was 1.5 relative units [0.63; 2.61]. The level of ILESR allows us to judge the ratio of the components of the phagocytic system, as well as the severity of inflammatory manifestations and the effectiveness of the therapy. In the group of patients with IHM, the studied parameter before the start of treatment was 2.4 relative units [1.69; 3.69], which is lower than the reference values (5.78±0.73 relative units). After therapy, the parameters statistically significantly decreased by 1.06 times ($p_{(Wilcoxon)}= 0.048064$) and amounted to 3.31 relative units [2; 4.78]. It follows that the conducted therapy is effective and contributed to the reduction of the inflammatory process. The level of ISLE in the group of patients reflects the ratio of immediate and delayed hypersensitivity processes; before the start of treatment, the parameter was 14 relative units [CI 8.25; 24], which did not exceed the normal value (8.73±1.26 relative units). After treatment, a decrease in the index by 1.21 times was observed ($p_{(Wilcoxon)} = 0.018355$) and amounted to 11.5 relative units [CI 6; 16].

Thus, according to our preliminary data, it was established that during therapy in patients with cerebral infarction, a statistically significant ($p\leq0.05$) decrease in ISLE levels by 1.21 times and an increase in ISLM by 1.06 times, as well as an insignificant ($p\geq0.05$) increase in ILESR levels by 1.013 times, were detected. The study is ongoing.

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SHORT TANDEM REPEAT METHOD FOR IDENTIFYING THE GENETIC PROFILE OF AN INDIVIDUAL

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Short tandem repeat analysis is a recognized international standard for establishing the authenticity and genetic stability of cell lines. Promising directions are the search for new STR markers and the identification of their new alleles. The article presents an analysis of the frequency of occurrence of STR marker alleles among residents of the Republic of Belarus.

Keywords: short tandem repeat, allelic variant, the polymerase chain reaction.

The development of modern molecular genetic technologies has significantly expanded the possibilities for studying biological objects in many areas of science, including molecular diagnostics. Autosomal DNA markers, particularly short tandem repeat (STR) loci, are most frequently used in genetic identification due to their versatility and low racial and ethnic variability. The aim of this work was to study the frequency of occurrence of allelic variants of STR markers in the population of the Republic of Belarus.

Materials and methods. The object of the study were samples of buccal epithelium from 20 donors. DNA extraction was performed using Chelex® 100 ion exchange resin according to the standard method. Then, using the polymerase chain reaction (PCR), 22 independently inherited DNA loci were identified, each of which is represented in the human genome by regions with STR of nucleotides. Multiplex PCR was performed using the Microreader^{TM} 28A ID System reagent kit (China) on an automatic programmable T20 PCR Thermal Cycler («LongGene», China). The obtained results were analyzed using GeneMapper software.

Table

Loci	Alleles (frequency, %)
D3S1358	14 (7.5%), 15 (2.5%), 16 (25%), 17 (17.5%), 18 (22.5%), 19 (2.5%)
D7S820	8 (15%), 9 (47.5%), 10 (2.5%), 11 (7.5%), 12 (2.5%), 13 (20%)
D5S818	10 (15%), 11 (47.5%), 11.3 (2.5%), 12 (7.5%), 13 (2.5%), 14 (20%), 15 (5%)
D2S441	8 (35%), 9 (5%), 10 (2.5%), 11 (20%), 12 (27.5%), 13 (7.5%), 14 (2.5%)
D13S317	8 (52.5%), 9 (12.5%), 10 (2.5%), 11 (22.5%), 12 (10%)
TPOX	6 (22.5%), 7 (15%), 8 (5%), 9 (27.5%), 9.3 (27.5%), 10 (2.5%)
TH01	11 (15%), 12 (2.5%), 14 (10%), 15 (35%), 16 (30%), 17 (7.5%)
D22S1045	14 (12.5%), 15 (22.5%), 16 (17.5%), 17 (22.5%), 18 (15%), 19 (10%)
vWA	18/2.5%, 19/12.5%, 20/7.5%, 21/20%, 22/22.5%, 23/7.5%, 23.3/2.5%, 24/10%, 25/10%, 26/5%
FGA	15 (2.5%), 16 (2.5%), 17 (10%), 18 (20%), 19 (10%), 19.3 (2.5%), 20 (12.5%), 21 (7.5%), 22 (15%), 23 (7.5%), 24 (5%), 25 (2.5%), 26 (2.5%)
D12S391	12 (15%), 13 (17.5%), 14 (15%), 15 (15%), 16 (7.5%), 17 (15%), 18 (10%), 20 (2.5%), 22 (2.5%)
D18S51	9 (2.5%), 11 (42.5%), 12 (35%), 13 (12.5%), 14 (7.5%)
D16S539	8 (2.5%), 10 (10%), 11 (7.5%), 12 (20%), 13 (27.5%), 14 (25%), 15 (7.5%)
D8S1179	10 (42.5%), 11 (22.5%), 12 (27.5%),13 (7.5%)
CSF1PO	16/10%) 17/17.5%, 18/7.5%, 19/5%, 20/10%, 21/2.5%, 22/5%, 23/15%, 24/7.5%, 25/17.5%, 26/2.5%
D2S1338	11 (25%), 12 (22.5%), 13 (10%), 14 (5%), 16 (2.5%), 17 (10%), 18 (12.5%), 19 (7.5%), 20 (5%)
D6S1043	12 (10%), 13 (20%), 14 (22.5%), 15 (30%), 16 (17.5%)
D10S1248	13 (2.5%), 15 (5%), 16 (10%), 17 (20%), 18 (2.5%), 19 (2.5%), 20 (2.5%), 20.2 (2.5%), 21.2 (2.5%), 23.2 (10%), 24.2 (12.5%), 26.2 (2.5%), 27.2 (7.5%), 29.2 (5%), 30.2 (5%), 31.2 (5%), 32.2 (2.5%)
SE33	11/15%, 12/12.5%, 13/2.5%, 14/7.5%, 15/15%, 15.3/5%, 16/15%, 16.3/10%, 17/7.5%, 17.3 /2.5%, 18.3/7.5%
D1S1656	28 (12.5%), 29 (30%), 30 (35%), 30.2 (5%), 31 (2.5%), 31.2 (2.5%), 32 (5%), 32.2 (5%), 33.2 (2.5%)
D21S11	10 (15%), 11 (47.5%), 11.3 (2.5%), 12 (7.5%), 13 (2.5%), 14 (20%), 15 (5%)
D19S433	12 (10%), 13 (17.5%), 13.2 (2.5%), 14 (45%), 15 (17.5%), 15.2 (2.5%), 16 (2.5%), 16.2 (2.5%)

Results. The studied allelic composition of loci and their frequency in the population of the Republic of Belarus are presented in the table. Between 4 and 17 allelic variants were detected in the studied loci. Alleles frequencies ranged from 2.5% to 52.5%. The algorithm for further research included determining the frequency of alleles for homozygous and heterozygous profiles and determining the total probability of a random match in all 22 studied loci with the characteristics of a randomly selected individual. It has been established that the highest probability of a random coincidence of genetic traits in the determining allelic loci is 1 in 4632x1030 people, which confirms the uniqueness of the genotype of each person.

EFFECTS OF VAPING ON THE HUMAN BODY

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In recent years, there has been a rapid growth in the popularity of electronic cigarettes (vapes, electronic aerosols), especially among the younger generation. This phenomenon is becoming epidemic, competing with traditional smoking. While the adverse effects of smoking ordinary cigarettes containing nicotine, resin and carbon monoxide have been studied in detail and widely known, the effects of vaping and its components on the human body are still the subject of intensive research. Particularly worrisome is the increase in the number of cases of lung injuries related to the use of electronic cigarettes, leading to the development of a new pathology - EVALI (lung injury associated with the use of electronic cigarettes or vaping products).

Keywords: vapes, nicotine, smoking, electronic cigarettes, Вейper disease, EVALI.

In the early 2000s, Chinese pharmacist Hong Leek developed an electronic cigarette as a device that generates nicotine vapour without burning and smoke [1]. The principle of action is based on heating or spraying a special liquid containing nicotine and stored in the tank. Today, millions of people around the world, mostly young people, use electronic cigarettes.

The basis of the vaping liquid is glycerin and propylene glycol, which determine the vapor density. In addition, the composition includes nicotine, distilled water, food flavourings and dyes. There are also non-nicotine options. It is important to note that even during the extraction process, additional chemical compounds can get into the liquid. There are currently no strict standards and regulations governing the composition of these mixtures. Although veiling releases significantly less harmful substances than smoking tobacco (about 4,000 compounds, including resins, acetone, ammonia, arsenic), the heating and interaction of liquid components produces about 30 different chemicals. When inhaled, even natural flavourings and dyes can be hazardous to health.

Nicotine affects almost all systems of the body, but the effect is most pronounced on the central nervous, cardiovascular and endocrine systems. It stimulates the release of adrenaline, causing narrowing of blood vessels, increased arterial pressure, heart rhythm and increased load on the heart, which leads to premature wear of the heart muscle and promotes atherosclerosis [2].

At the initial stages of nicotine use, it has a stimulating effect on the central nervous system: increased excitability, improved short-term memory and attention, reduced reaction time, decreased anxiety and appetite, general relaxation. However, in the future there is a phase of oppression, disruption of the work of parts of the brain responsible for learning and self-control, impaired memory, slowed thinking, decreased attention, irritability, sleep problems, emotional disorders and depression.

Chronic exposure of nicotine to the endocrine system leads to a hormonal imbalance affecting the sex hormones and thyroid hormones, as well as the gradual development of insulin resistance. This can be manifested in the form of early menopause, reproductive disorders, erectile dysfunction, irregular menstruation, overweight, osteoporosis and other pathological conditions.

Among other things, nicotine inhalation has a negative effect on the respiratory system, increasing the formation of moisture, causing dry cough, allergic reactions, chronic diseases and significantly increasing the risk of developing malignant neoplasms.

EVALI (E-cigarette or Vaping product use-Associated Lung Injury), or "Viper's disease", is an acute lung injury associated with the use of electronic cigarettes and vapes. In 2020, more than 2,600 EVALI cases were recorded in the US, resulting in approximately 70 deaths. The first EVALI case in Europe was recorded in 2021. The disease is manifested by respiratory symptoms (cough, chest pain, difficulty breathing), common symptoms (fever, fatigue, weight loss) and gastrointestinal disorders (nausea, vomiting, diarrhea). In rare cases, there is bleeding, shortness of breath, dizziness and chest pain occurring immediately after the use of electronic cigarettes [3].

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IMPACT OF ARSENIC WATER POLLUTION ON HUMAN HEALTH

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The article focuses on studying the impact of chronic arsenic intoxication through drinking water on human health: a comprehensive analysis of pathogenesis, clinical manifestations and prevention.

Keywords: inorganic arsenic, drinking water, chronic intoxication, arsenicism, oxidative stress, carcinogenesis, polyneuropathy, palmoplantar keratosis, biomonitoring, water hygiene.

Relevance of the topic: Drinking water contamination with inorganic arsenic (As) is recognized by the World Health Organization (WHO) as one of the most significant threats to global public health. Chronic exposure to this toxicant, which has pronounced cumulative properties, leads to the development of a specific pathological condition – chronic arsenicism. This review examines in detail the multi-layered mechanisms of arsenic toxicity, the polymorphic clinical presentation of intoxication with an emphasis on target organs, modern diagnostic methods, and prevention and treatment strategies at the individual and population levels[1].

The problem of drinking water contamination with inorganic arsenic is global, affecting, according to various estimates, up to 200 million people in more than 70 countries. The situation is most severe in Bangladesh, West Bengal (India), Vietnam, Argentina, and Chile, where As concentrations in groundwater are many times higher than the WHO threshold of 10 μg/L. The source of this toxicant is typically natural geological formations, from which arsenic leaches into aquifers. Long-term consumption of such water leads to its accumulation in the body, resulting in systemic toxicity.

Arsenic toxicity is multifaceted and occurs through a cascade of interconnected pathological processes.

Trivalent arsenic (As^{3+}) exhibits a high affinity for the thiol (-SH) groups of proteins. By binding to lipoic acid, it inhibits key enzymes of the Krebs cycle (pyruvate dehydrogenase, α-ketoglutarate dehydrogenase) and oxidative phosphorylation, blocking ATP synthesis. Under conditions of energy deficiency and the generation of reactive oxygen species (ROS), massive oxidative stress develops, leading to: lipid peroxidation of cell membranes and organelles, protein denaturation and enzyme dysfunction, and damage to mitochondrial and nuclear DNA. Arsenic is a combined carcinogen, capable of both initiating and promoting tumor growth[2].

Disruption of cell signaling and proliferation: Activation of growth factors (e.g., TGF-α) and proinflammatory pathways (NF-κB) stimulates uncontrolled cell division.

Arsenic induces endothelial cell apoptosis, suppresses nitric oxide (NO) synthesis, and stimulates endothelin-1 production, leading to vasoconstriction, smooth muscle cell proliferation, and the onset of atherosclerosis.

Skin manifestations of arsenic exposure in water may include diffuse or patchy grayish-brown pigmentation on the trunk, neck, and armpits. A characteristic symptom is the "raindrops on a dusty road" – multiple small hyperpigmented spots on a background of generalized hyperpigmentation. Hyperkeratosis and appendage lesions are also possible. Arsenic is a known Group 1 carcinogen according to the IARC classification. It increases the risk of developing squamous cell skin cancer (often associated with hyperkeratotic lesions), basal cell carcinoma, and bladder and kidney cancer [3].

Neurological impairments may occur, such as peripheral sensorimotor polyneuropathy: this begins in the distal lower extremities (called "sock syndrome"), manifesting as paresthesia (numbness, tingling, burning), hypoesthesia, and muscle weakness. The process later affects the upper extremities (called "glove syndrome"). Achilles reflexes are reduced or absent. Memory impairment, difficulty concentrating, headaches, and emotional instability are also observed. Long-term exposure to arsenic-containing water can lead to type 2 diabetes: arsenic interferes with insulin signaling, causing insulin resistance. For pregnant women, this can lead to miscarriage and low birth weight babies[4].

Chronic arsenic intoxication through drinking water is a complex, multisystemic condition with a high potential for disability and mortality. Its solution cannot be achieved by the healthcare system alone and requires the concerted efforts of hydrogeologists, ecologists, process engineers, and sociologists. Priority tasks include implementing affordable water treatment technologies, organizing effective water quality monitoring, and establishing early detection systems for arsenicism, which will reduce the burden of arsenic-related diseases globally.

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INFLUENCE OF STRESS ON THE HUMAN ORGANISM

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Stress is currently an urgent problem for the entire global population. Over the past decade, the number of people suffering from stress and its consequences has increased. This paper presents an analysis of a social survey of the population on the effects of stress on their body.

Keywords: stress, stressor, diseases.

Stress is a combination of nonspecific adaptive reactions of the body to the impact of various unfavorable factors - stressors (physical or psychological). Upon contact with a stressor, the central nervous system activates alarm. The body's reaction is controlled by the autonomic nervous system, mobilizing vital organs for survival. Breathing and heart rate increase, blood pressure rises, adrenaline and norepinephrine are released. Dry mouth, dilated pupils, and increased muscle tone are felt. The body tries to adapt to new conditions, which can lead to a lack of oxygen in less active organs. Possible consequences of stress include stomach ulcers, hypertension, asthma, migraines, and tumors.

We conducted a survey among the residents of Belarus, in which 71 people took part, the majority of whom are aged 18 to 35 and are women. 39 people answered that they often experience stress, 9 - constantly, 22 - rarely. Mostly, the population of Belarus experiences moderate (40 people) or mild stress (25 people), but also 6 people answered that they suffer from severe stress. To the question "How often do you experience sleep disorders, migraines, fatigue, and other consequences of stress?", 39 people answered sometimes, 22 - often, 6 - constantly, and 4 people answered that they have never experienced them.

Conclusion. Stress is always present in a person's life, whether you want it or not. Stress negatively affects many systems of the body, causing chronic diseases or complete exhaustion of the nervous system. As the survey showed, a large part of the population of Belarus experiences both mild and severe stress, and also experiences various consequences of stress.

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EVALUATION OF THE EFFICIENCY OF LOW-INTENSITY LASER IRRADIATION TO STIMULATE THE GERMINATION OF WINTER WHEAT SEEDS

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The article studies the effect of low-intensity laser radiation on winter wheat seeds. The experiment included irradiation of winter wheat seeds with low-intensity laser radiation (wavelength 620–700 nm, frequency 12500 Hz) with doses from 0.9 J to 3.6 J on the fifth and tenth days of germination. It was found that irradiation affects the chlorophyll concentration: on the fifth day, the decrease was from 1.9% to 10.1% (depending on the dose), on the tenth day - from 4.4% to 14.3%. The best indicators of germination energy (75%) and germination (89%) were achieved at a dose of 0.9 J. The maximum length of seedlings (37.2 mm, exceeding the control by 116.3%) was also noted at a dose of 0.9 J; at a dose of 3.6 J, the effect was reduced (25.3 mm, exceeding the control by 47.1%). The results demonstrate that low doses

of laser radiation stimulate germination and improve seed quality, while increasing the dose reduces the effectiveness of the effect.

Keywords: laser radiation, winter wheat, germination, germination energy.

Maintaining and improving the seed quality of economically important crops is a pressing scientific challenge. This is driven by two main factors: first, the need for seed reserves due to irregular sowing, with long-term storage negatively impacting germination. Second, some crops are inherently characterized by low seed quality, with germination rates reaching barely 50%, meaning a loss of half the harvest even in good seasons.

The use of laser radiation stimulates phytochrome, an enzyme presents in the cells of photosynthetic organisms, and mimics the effect of natural sunlight on seeds. The effectiveness of laser irradiation, like the effect of sunlight, depends on the duration, wavelength, and type of seeds irradiated. A properly selected dose can achieve an effect similar to the use of artificial growth stimulants. However, in this case, the plant itself acts as the stimulant (phytohormone), which improves seed quality, accelerates germination, and increases resistance to adverse environmental conditions. A low-intensity laser was used for irradiation. The seeds were placed in an aluminum container (S = 4 cm2) and exposed to pulse-modulated infrared radiation with a frequency of 12,500 Hz, a wavelength in the red range (620-700 nm), and doses ranging from 0.9 J to 3.6 J.

Figure 1 shows the germination energy and final germination rates of seeds in the control and experimental groups.

As the table shows, the group irradiated with 0.9 J demonstrated the best results, with 75% germination energy and 89% germination, respectively.

Figure 1. Germination energy and viability indicators in the studied groups

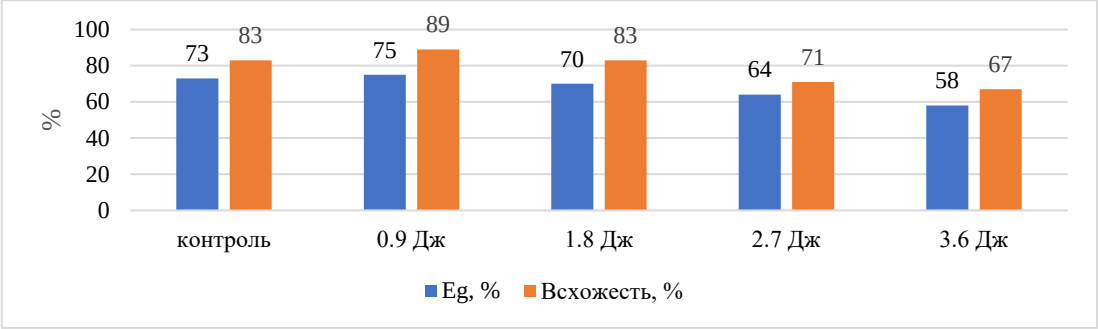

Fig. 1. Germination energy and viability indicators in the studied groups

Figure 2 shows that the maximum result is achieved at a dose of 0.9 J (37.2 mm), which is 116.3% higher than the control value of 17.2 mm, while the minimum value is observed at a dose of 3.6 J (25.3 mm), which is 47.1% higher than the control; these data indicate that the greatest effect is achieved at lower doses, and an increase in dose leads to a decrease in efficiency, although the result remains above the control level (Figure 2).

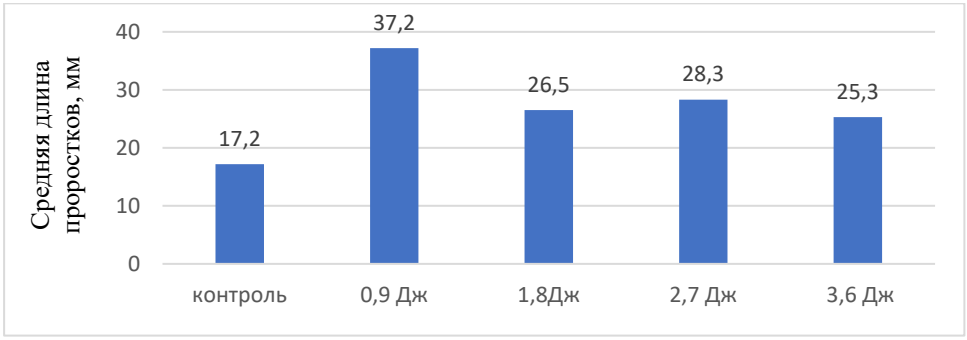

Fig. 2. Average length of the studied winter wheat seedlings

To statistically test the total lengths in the experimental groups, the Kruskal-Wallis test, a nonparametric analogue of anova, was used. Based on the test results, the hypothesis of statistically significant differences in large samples was accepted at $p \leq 0.01$.

Thus, during the study, the best results were achieved with a dose of 0.9 J, which provided 75% of the germination energy and 89% of the germination rate, and the maximum seedling growth (37.2 mm) was 116.3% higher than the control value (17.2 mm). Increasing the dose to 3.6 J reduced the effectiveness, but the results remained higher than the

control, indicating that lower doses of laser irradiation more effectively stimulate the growth and development of winter wheat seeds.

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ISOLATION OF FRUIT-ROTTING MICROORGANISMS AND IDENTIFICATION OF THEIR ANTAGONISTS

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In recent years, microbial spoilage occurring during the storage of fruit products has posed not only significant economic losses but also serious threats to food safety. In this study, fruit-rotting fungi including *Aspergillus niger*, *Penicillium expansum* and *Rhizopus stolonifer* were isolated from decayed apples, grapes, pomegranates and oranges. Natural antoganists – *Bacillus subtilis* and *Pseudomonas fluorecens* - were found to strongly inhibit their growth.

Keywords: fruit-rotting microorganisms, antagonist bacteria, biological preparation, fruit microflora, ecological safety, biocontrol.

Introduction:

Fruits are rich in vitamins, minerals, and organic acids essential for human health. However, they are perishable food products prone to microbial spoilage during storage, transportation, and marketing. This spoilage is mainly caused by microscopic fungi and bacteria. The most common fungal genera responsible for fruit decay are Aspergillus, Penicillium, Rhizopus, Alternaria, and Botrytis. Traditionally, chemical fungicides are used to control such diseases, but their excessive use can harm human health and lead to toxic residues in fruits. Therefore, biological control – the use of beneficial microorganisms to suppress pathogenic flora – has become a relevant alternative. This research focused on isolating fruit-rotting microorganisms, identifying their natural antagonists, and developing an environmentally friendly biological preparation.

Materials and Methods:

Partially decayed fruits, including apples (Malus domestica), grapes (Vitis vinifera), pomegranates (Punica granatum), and oranges (Citrus sinensis), were collected from local markets in Tashkent. A 1 g sample from each fruit was aseptically taken and suspended in physiological saline. The microorganisms were cultured on Potato Dextrose Agar (PDA), Nutrient Agar (NA), and Peptone Agar media. Isolates were identified morphologically using Gram staining and microscopic examination. The dual culture assay was used to determine antagonistic activity, where pathogenic and antagonistic strains were co-cultivated, and inhibition zones were measured. Each experiment was performed in triplicate, and statistical analysis was carried out using GraphPad Prism 9.0, expressing results as mean ± SE.

Results and Discussion:

A total of 24 isolates were obtained from the decayed fruits: 15 fungal and 9 bacterial species. Morphological and biochemical analyses identified Aspergillus niger, Penicillium expansum, Rhizopus stolonifer, and Alternaria alternata as the primary pathogens responsible for rot. These fungi degrade cell wall components such as pectin and cellulose, accelerating decay. Among the antagonistic microorganisms, Bacillus subtilis, Pseudomonas fluorescens, and Lactobacillus plantarum exhibited strong antibacterial and antifungal activity. Lipopeptide compounds (iturin, surfactin, fengycin) secreted by Bacillus subtilis inhibited fungal growth by 65–72%. When a liquid suspension of Bacillus subtilis was sprayed onto fruit surfaces, the degree of decay was three times lower than in control samples.

These findings demonstrated the practical potential of biological preparations in fruit preservation.

Conclusion:

This study revealed that Aspergillus and Penicillium species are the dominant causes of fruit rot. However, their growth can be effectively suppressed by natural antagonists, particularly Bacillus subtilis and Pseudomonas fluorescens. The developed biological preparation is non-toxic, environmentally safe, and highly applicable for fruit storage. This approach contributes to improving fruit preservation methods under natural and pesticide-free conditions in Uzbekistan.

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THE IMPACT OF SLEEP DISTURBANCES ON METABOLISM

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The article examines the influence of sleep disturbances on metabolism, identifying a connection with hormonal changes, weight gain, insulin resistance, and the risks of metabolic diseases.

Keywords: sleep, metabolism, insulin resistance, leptin, ghrelin, thermoregulation.

Sleep is an essential component of human health and plays a key role in regulating metabolism. Sleep disturbances, such as chronic insomnia, sleep apnea, and irregular sleep patterns, can significantly affect the body's metabolic processes [1].

Sleep disorders affect metabolism through hormonal changes: the level of leptin, which is responsible for the feeling of satiety, decreases, while the level of ghrelin, which stimulates appetite, increases. This leads to an increased sense of hunger and higher calorie consumption, especially from high-calorie foods, which can contribute to weight gain and the

development of obesity. Additionally, sleep disorders worsen lipid metabolism by raising levels of triglycerides and "bad" cholesterol, increasing the likelihood of atherosclerosis and cardiovascular diseases.

Sleep disorders can also lead to insulin resistance – a condition in which cells become less sensitive to insulin. As a result, the pancreas has to produce more insulin to maintain normal blood glucose levels. This can cause an increase in blood glucose levels and lead to prediabetes, raising the risk of developing type 2 diabetes. Even a short-term reduction in sleep duration can significantly impair carbohydrate metabolism.

Chronic sleep deprivation is associated with the accumulation of visceral fat, which accumulates around internal organs. Visceral fat has high metabolic activity and is associated with the risk of cardiovascular diseases, metabolic syndrome, and other disorders.

Sleep also plays a key role in thermogenesis – the process by which the body generates heat and burns calories. Lack of sleep can reduce thermogenesis, leading to a decrease in the number of calories burned at rest. This makes it more difficult to maintain a healthy weight.

When sleep is insufficient, energy distribution becomes impaired. The basal metabolic rate – the number of calories the body burns at rest – decreases. Weight loss often occurs at the expense of muscle mass rather than fat tissue. Since muscles are active consumers of energy, their loss leads to an even greater decrease in basal metabolism and exacerbates metabolic disorders [2].

Furthermore, sleep disorders are often accompanied by psychological issues such as increased anxiety and depression. These conditions can lead to elevated cortisol levels and other hormonal changes that negatively affect metabolism and contribute to weight gain.

Thus, sleep disturbances have a significant negative impact on metabolism, increasing the risks of metabolic diseases.

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THE EFFECT OF SLEEP DISORDER ON THE HUMAN BODY. INSOMNIA

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Keywords: insomnia, sleep, disorder, infection.

In the first years of life, a person begins to form a sleep regime and structure. The circadian rhythm, or cyclic fluctuations of various biological processes associated with the alternation of day and night, begin to form 10-12 weeks after birth. This process is absent in newborns, so they need more total sleep time. As children get older, their sleep duration decreases.

A significant role in understanding and evaluating sleep duration is played by the cultural environment, the environment, as well as the psychological state of a person.

Daytime sleep can be divided into three main stages:

1) Stage of light sleep (10-60 minutes);
2) Deeper sleep stage (20-40 minutes);
3) The REM sleep stage (10-60 minutes).

In modern society, the prevalence of sleep problems is high and continues to increase. Sleep disorders in the adult population account for about 30%, and women and the elderly are more susceptible to this disease. People often ignore the first symptoms, which is why the disorders continue to progress, leading to exhaustion of the nervous, immune and other body systems. Therefore, it is important to understand what sleep disorder is and what its manifestations are. [1]

Insomnia is one of the most common and clinically significant sleep disorders. This is a recurring disorder of falling asleep and maintaining sleep, with symptoms such as difficulty falling asleep, frequent nighttime awakenings, waking up too early without feeling fully rested after sleep, feeling tired, irritable, and tired during the day.

Insomnia significantly increases the risk of developing psychiatric disorders such as anxiety disorders, major depressive disorder, bipolar disorder, and post-traumatic stress disorder. With insomnia, both male and female populations are equally at risk of depressive disorder.

During sleep, the immune system produces proteins called cytokines. Some of them help a person fall asleep. With inflammation, infection, or stress, a person needs more specific types of cytokines.

As mentioned earlier, insomnia can adversely affect the human immune system. Studies show that people who suffer from insomnia are more likely to become ill after exposure to the virus. Insomnia also has a significant impact on the rate of recovery in case of illness. This disorder significantly reduces the production of special cytokines, as well as reduces the level of antibodies and infection-fighting cells. [2]

To avoid this pathological condition of the body, it is necessary to adhere to the following recommendations:

1. It is advisable to go to bed no later than 23:00;
2. It is recommended to avoid using your phone or TV 2-3 hours before bedtime.;
3. Do not consume excessive amounts of food or beverages such as tea or coffee before going to bed.;
4. Set the sleep mode so that the wake-up time is the same.;
5. Increase physical activity.

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INFLUENCE OF ECOTOXICOLOGICAL SUBSTANCES ON REPRODUCTIVE AND MOLECULAR-PHYSIOLOGICAL PROCESSES IN THE TRANSGENERATIONAL STATE

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This paper examines the mechanisms of the influence of ecotoxicological substances on reproductive and molecular-physiological processes in the transgenerational state. It is shown that toxicants can cause epigenetic modifications transmitted through germ cells, affecting the development and health of subsequent generations. The study analyzes current data on the impact of heavy metals, pesticides, and microplastics on epigenetic regulation, as well as possible methods for preventing and monitoring these effects.

Modern ecotoxicology studies not only the direct effects of pollutants on organisms but also their long-term effects that manifest in subsequent generations. Transgenerational effects arise due to epigenetic changes induced by toxicant exposure to germ cells, leading to heritable disruptions in gene expression and physiological processes.

The most common ecotoxicants include heavy metals (cadmium, lead, mercury), pesticides, pharmaceutical wastes, and microplastics. Their exposure results in decreased fertility, impaired gametogenesis, hormonal imbalance, and DNA damage. Studies have shown that the offspring of individuals exposed to toxic agents exhibit DNA methylation changes, dysregulation of microRNAs and proteins responsible for embryonic development and the endocrine system.

Special attention is given to the role of epigenetic mechanisms – cytosine methylation, histone modification, and non-coding RNAs – as mediators between environmental exposure and heritable physiological changes. These processes may persist across several generations even in the absence of continued contact with the toxicant.

Thus, the study of the transgenerational effects of ecotoxicological substances is crucial for understanding the long-term ecological and biomedical consequences of anthropogenic environmental pollution.

Conclusion

Ecotoxicological substances exert a negative impact on the reproductive and molecular-physiological processes of living organisms. Their influence can induce epigenetic changes transmitted to subsequent generations, forming transgenerational effects. These changes disrupt hormonal balance, gametogenesis, and embryonic development. Studying such effects is essential to prevent the long-term consequences of environmental pollution and to preserve the health of future generations.

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PROSPECTS OF LOCUST PROTEIN AS A SUSTAINABLE AND FUNCTIONAL SOURCE

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This research examines the locust species as a sustainable protein alternative. Its high protein content, balanced amino acids, and mineral richness indicate potential for food and feed applications. The species also offers ecological benefits, requiring less water and land and emitting fewer greenhouse gases than traditional livestock. Furthermore, its use could transform an agricultural pest into a valuable bioresource.

Keywords: edible insects, sustainable protein, food security.

Introduction Locusts are a rich source of protein, with content ranging from 15% to 70%, accompanied by 11–35% fat and essential minerals such as iron (0.008–0.015%), nutrients [2, 3]. Due to their complete profile of amino acids and high biological value, locust-derived proteins offer a promising alternative to traditional animal protein sources [1, 2]. The Food and Agriculture Organization (FAO) identifies edible insects as promising sources of protein for both human and animal diets [4].

Methods. Locust specimens were collected during the early morning (07:00–10:00) and evening (17:00–20:00) hours, when lower air temperatures reduced insect activity and facilitated safe and efficient capture. Sampling sites included natural grasslands, pastures, and partially cultivated fields – representing stable ecological habitats of natural locust populations.Collections were performed using an entomological sweep net along 10–20 m transects. After each sweep series, locusts were transferred into labeled plastic containers indicating the collection site, date, time, and collector's name.Prior to drying, locusts were subjected to a hot–cold water treatment instead of freezing. They were immersed in boiling water for 1–2 minutes to remove impurities and destroy microorganisms, followed by immediate rinsing in cold water to halt the heat effect and preserve structural integrity, color, and nutritional properties.Two drying methods were applied: sun drying and thermostatic drying. In sun drying, locusts were spread in a single layer on clean metal trays, covered with a fine mesh, and dried for 2–3 days with periodic turning. In thermostatic drying, samples were placed in a laboratory oven at 60–65°C for 24–48 hours, with weight monitored every 4–6 hours until constant mass was reached.

Table 1

The proximate composition of Moroccan locust (Dociostaurus maroccanus) and white-spotted sand grasshopper (Dericorys albidula) flours is presented below.

№	Parameter	Dociostaurus maroccanus (%)	Dericorys albidula (%)

	Moisture	3.72 ± 0.14	4,73±0.12
	Protein	58.72 ± 2.41	43.17±2.12
	Fat	1.07 ± 0.35	1,34±0.45
	Fibre	6.29 ± 0.19	6.72±0.54
	Ash	27.45 ± 5.97	26.81±3.71
	Ca	5.22 ± 2.14	5.25±1,17
	P	3.76 ± 1.54	3.45±1.34

Comment: The analysis shows that *Dociostaurus maroccanus* flour contains a significantly higher protein level (58.72%) than *Dericorys albidula* (43.17%), highlighting its greater nutritional potential as a protein source. Both species have low fat content (~1%), favorable for formulating low-lipid food or feed products. The relatively high ash content (26–27%) indicates a rich mineral composition, predominantly calcium and phosphorus. Fibre levels (6.29–6.72%) suggest possible benefits for digestive health. Overall, the results confirm that these locust species – especially *D. Maroccanus* – represent sustainable and nutrient-rich alternative protein sources for modern food and feed applications (Uzbek Fisheries Research Institute, UzFRI).

This article was prepared within the framework of the applied research project No. AL-9524115100 titled **"Development of technology for obtaining unconventional protein and nutrients from locusts in Uzbekistan"**, conducted at the Faculty of Biology and Ecology, National University of Uzbekistan.

Conclusion. Controlled rearing of locust species represents an eco-efficient strategy for protein production, demanding minimal water and land resources and generating substantially lower greenhouse gas emissions compared to conventional livestock. This approach aligns with principles of circular bioeconomy and sustainable development.

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EFFECT OF MOROCCAN LOCUST MEAL SUPPLEMENTATION ON FISH GROWTH AND FEED EFFICIENCY

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The growing global demand for sustainable and high-quality feed sources in aquaculture has increased interest in insect-based feed ingredients. The Moroccan locust (Dociostaurus maroccanus), due to its high protein content, valuable amino acid profile, and richness in bioactive compounds, is considered a promising alternative feed source. Studies have shown that supplementing 10–25% locust meal in fish feed improves growth performance, enhances feed conversion efficiency, and increases muscle protein accumulation. Additionally, the presence of chitin and trace minerals strengthens the immune system and positively affects the overall health of fish. Beyond its nutritional benefits, locust-based feed supports ecological sustainability by reducing dependency on marine resources and minimizing environmental impact. Therefore, Moroccan locust meal is evaluated as an environmentally responsible and promising component in future aquaculture feed formulations.

Keywords: Moroccan locust, insect meal, aquaculture nutrition, alternative protein sources, fish growth, sustainability.

The rapid development of aquaculture has intensified the need for sustainable and high-nutritional-value protein sources for fish feed. Among insect-derived ingredients, the Moroccan locust (Dociostaurus maroccanus) stands out due to its high protein content, balanced amino acid composition, and natural abundance in certain regions. Processing these locusts into meal form allows the production of feed raw materials rich in essential fatty acids, minerals, vitamins, and bioactive compounds. Moreover, this process contributes to agricultural pest control by reducing locust populations that otherwise damage crops. Many scientific studies have evaluated the efficiency of Moroccan locust meal in feeding various fish species, analyzing digestibility, growth rates, feed utilization efficiency, immune response, and product quality. Therefore, it is important to assess the significance and practical benefits of Moroccan locust meal in aquaculture feed formulations. This article summarizes existing data based on scientific literature and outlines future research directions.

Locust collection was carried out during the cool hours of the day – early morning and late evening – when the insects are less active, making it easier to capture them and preserve sample quality. Sampling areas included natural grasslands, semi-deserts, and partially cultivated fields, which represent the locusts' natural habitats. An entomological net was used as the main collection tool. The net was swung several times over a 10–20 meter distance to capture locusts of different developmental stages. After each collection, locusts were carefully placed in plastic containers to avoid mechanical damage. Each sample container was labeled with information about location, date, time, and collector's name to ensure traceability and reliability in laboratory analyses. In the laboratory, the nutritional composition of the collected samples was analyzed, including protein, fat, vitamin, and mineral contents, to evaluate their potential as a sustainable feed source. The analyses showed that Moroccan locust (Dociostaurus maroccanus) meal is a promising feed ingredient for fish nutrition. Research results indicated that locust meal contains 55–70% crude protein, essential amino acids such as lysine and methionine, and lipids rich in polyunsaturated fatty acids (PUFA). Experimental trials demonstrated that fish fed with insect-based diets exhibited increased growth rates, improved feed conversion ratios, and higher survival rates. Furthermore, bioactive compounds like chitin stimulated immune responses and enhanced disease resistance. From ecological and economic perspectives, the use of Moroccan locust meal is also beneficial. Since locust swarms often cause severe damage to agriculture, processing them into feed offers an environmentally friendly pest management strategy. At the same time, this approach reduces reliance on expensive and limited marine resources.

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COMPARATIVE EVALUATION OF THE IN VIVO ACTIVITY OF POLYPHENOL COMPOUNDS IN A PARACETAMOL-INDUCED HEPATITIS MODEL

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To evaluate the hepatoprotective activity of the polyphenol compound at a dose of 200 mg/kg in vivo in a model of acute toxic hepatitis induced by paracetamol, and to compare it with the reference drug Phosphogliv at a dose of 55 mg/kg in order to determine the effective dose.

*Keywords***:** paracetamol, mitochondria, phosphogliv, polyphenol.

Under the conditions of CCl_4-induced hepatitis, the generation of reactive oxygen species intensifies, resulting in increased lipid peroxidation and protein oxidative modification. These processes disrupt the ion-selective permeability of mitochondrial membranes [3]. As demonstrated in the studies by Ahmedova S. and colleagues, polyphenolic compounds derived from *Helichrysum maracandicum* contribute to the restoration of oxidative phosphorylation in hepatic mitochondria, suppress lipid peroxidation, and stimulate the activity of key antioxidant enzymes, including superoxide dismutase, catalase, and glutathione peroxidase [4,5,6].

It is well established that hepatotoxic doses of paracetamol induce acute hepatitis, making it a widely recognized experimental model of hepatocellular injury. Excessive administration of paracetamol leads to cellular disturbances due to glutathione (GSH) depletion and the accumulation of the toxic metabolite N-acetyl-p-benzoquinone imine (NAPQI). During the early phase (0–3 hours), this metabolite binds to various proteins, including mitochondrial proteins, initiating the first stage of hepatocellular damage (2–6 hours), which subsequently results in apoptosis or necrosis. The administration of the polyphenol compound at a dose of 200 mg/kg showed a corrective effect. In paracetamol-treated rats, hyperenzymemia was observed, evidenced by increased plasma levels of ALT and AST, indicating disruption of hepatocyte membrane integrity and leakage of intracellular enzymes into the bloodstream. Experimental data revealed that toxic doses of paracetamol significantly elevated ALT activity from 39.4 ± 4.7 to 62.8 ± 13.8 U/L ($P < 0.05$) and AST from 33.0 ± 4.1 to 53.4 ± 13.5 U/L ($P < 0.05$). Treatment with the polyphenol compound (200 mg/kg) and phosphogliv restored plasma urea concentration to near-normal values, differing significantly from the untreated group ($P < 0.05$). Urea, one of the final products of protein and nitrogen metabolism, is synthesized in the liver and excreted by the kidneys. Since its production and elimination are continuous, a constant level of urea is normally maintained in the blood. A decrease in urea concentration is often associated with impaired hepatic function. The study showed that in the context of paracetamol-induced acute hepatitis, blood urea levels nearly halved compared to physiological values – from 4.4 ± 0.4 mmol/L to 2.2 ± 0.6 mmol/L ($P < 0.05$).

It was found that, among all the evaluated parameters, the polyphenol compound at a dose of 200 mg/kg exhibited the highest overall hepatoprotective activity, comparable to that of the reference drug.

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FEATURES OF THE MANIFESTATION OF THE MAIN SYMPTOMS OF CHRONIC PANCREATITIS

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The study involved a comprehensive diagnostic evaluation of patients with chronic pancreatitis, including a survey, clinical and instrumental examinations, and the identification of gene polymorphisms. Based on the patient survey and medical history, no significant differences were found between the groups in terms of age of onset or disease duration. A relatively young, working-age age was noted for the onset of the disease.

Among the patients, an assessment of the quality of life was carried out using a modern questionnaire specialized on the digestive organs, the GSRS, and a significantly higher quality of life was found in patients who underwent resection intervention on the pancreas, compared with non-operated patients, on all assessment scales, except for diarrhea syndrome, which is due to more active intestinal peristalsis after the formation of pancreatojejunostomy, especially in the first year after surgery.

An analysis of the data obtained from instrumental and laboratory research methods was also conducted: in the general blood and urine analysis, the most representative were patients in group 1B, according to the biochemical analysis, a decrease in the amylase level in group 2 was reliable, an excess of the activity norms of almost all enzymes in group 2 with a tendency for them to decrease over time, which is due to the subsidence of the acute inflammatory process during exacerbation of CP of the AP type.

Keywords: pancreas, chronic pancreatitis, symptoms, surgical treatment, diagnostics.

Patients underwent a comprehensive diagnostic evaluation, including a questionnaire, clinical and instrumental examinations, and the determination of gene polymorphisms. Based on the questionnaire and medical history, no significant differences were found between the groups in terms of age of onset or disease duration. A relatively young, working-age age was noted for the onset of the disease.

Among the patients of the first group, an assessment of the quality of life was carried out using a modern questionnaire specialized on the digestive organs, the GSRS, which revealed a significantly higher quality of life in patients who underwent resection intervention on the pancreas, compared with non-operated patients, on all assessment scales, except for diarrhea syndrome, which is due to more active intestinal peristalsis after the formation of pancreatojejunostomy, especially in the first year after surgery.

An analysis of the data obtained from instrumental and laboratory research methods was also conducted: in the general blood and urine analysis, the most representative were patients in group 1B, according to the biochemical analysis, a decrease in the amylase level in group 2 was reliable, an excess of the activity norms of almost all enzymes in group 2 with a tendency for them to decrease over time, which is due to the subsidence of the acute inflammatory process during exacerbation of CP of the AP type.

Comparison of ultrasound and MRI data for patients in the first group revealed persistent enlargement of the pancreas, uneven echogenicity of its parenchyma, and significant heterogeneous dilation of the ductal system, which is explained by persistent structural changes in the parenchyma, the development of fibrosis, sclerosis, and calcification. In the second group, pancreatic contours are predominantly blurred and indistinct, which more likely indicates inflammatory parenchymal edema.

Timely diagnosis, early detection of chronic pancreatitis, and prognosis of its course will enable radical surgical intervention to be performed within the optimal timeframe in patients without decompensation of concomitant somatic pathology and complications of chronic pancreatitis. Timely identification of genetic polymorphisms, predictors of complicated CP, will facilitate the implementation of adequate and timely surgical interventions, before the development of clinically significant complications that can significantly increase intra- and postoperative risks.

COMPARATIVE ANALYSIS OF THE INCIDENCE OF MALIGNANT NEOPLASMS OF THE PROSTATE IN THE REPUBLIC OF BELARUS

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Prostate cancer is one of the most common malignant neoplasms in men and ranks second in mortality among all oncological diseases in many countries. The study shows that between 2014 and 2023, the incidence of prostate cancer in the Republic of Belarus increased from 87.6 to 155.4 cases per 100,000 population. Among the urban population, the rate rose from 90.5 to 154.9, and among the rural population – from 78.4 to 157.4 cases per 100,000 population.

Keywords: prostate cancer, incidence, prostate-specific antigen

Prostate cancer (PCa) is one of the most frequently diagnosed malignant tumors in men, ranking second among the causes of cancer-related mortality in many countries. The incidence of PCa is largely associated with age, hormonal and hereditary factors, lifestyle, diet, and environmental influences. Among men over 50 years of age, the risk of developing the disease increases several times, especially in the presence of a family predisposition.

In recent years, a marked upward trend in prostate cancer incidence has been observed in the Republic of Belarus. According to the Belarusian Cancer Registry, this pathology holds a leading position in growth rate among all malignant neoplasms in the male population. The increase is due not only to longer life expectancy but also to the active introduction of early diagnostic methods, particularly prostate-specific antigen (PSA) testing and transrectal ultrasonography (TRUS).

The aim of the study was to analyze the dynamics of prostate cancer incidence among the population of the Republic of Belarus from 2014 to 2023. The research was based on statistical data from the Belarusian Cancer Registry and population figures for the specified period, with calculations of relative and average annual incidence rates.

The study showed that between 2014 and 2023, the incidence of prostate cancer in the Republic of Belarus increased from 87.6 to 155.4 cases per 100,000 population. Among the urban population, the rate rose from 90.5 to 154.9, and among the rural population – from 78.4 to 157.4 per 100,000 population. The average annual incidence rate for the total population was 104.7 per 100,000 people.

Among newly diagnosed cases, stages I–II predominate, indicating improved early detection, while the proportion of stages III–IV has decreased. Analysis of the regional structure showed an increase in incidence across all regions: from 57.1 to 124.6 per 100,000 in the Brest Region, from 94 to 139 in the Vitebsk Region, from 67.5 to 163.5 in the Gomel Region, from 67.5 to 129.2 in the Grodno Region, from 78.5 to 143.9 in the Mogilev Region, from 101.3 to 192.3 in the Minsk Region, and from 130.4 to 171 per 100,000 in the city of Minsk. The highest rates were recorded in the Minsk and Gomel regions, which is associated with population density, environmental factors, and better access to medical care. [1]

Analysis of the obtained data revealed an unstable but pronounced upward trend in incidence ($R^2 = 0.34–0.45$). The increased detection of early-stage cases can be attributed to improved screening measures and greater public participation in preventive programs. However, a considerable proportion of patients are still diagnosed with locally advanced and metastatic forms, highlighting the need to strengthen primary prevention and regular medical follow-up.

Over the ten-year period, the Republic of Belarus has experienced a significant increase in prostate cancer incidence, reflecting both a true rise in disease prevalence and improvements in diagnostic practices. Given the demographic aging of the population, a further increase in the number of cases is expected. [2]

To reduce the growing incidence of prostate cancer in the Republic of Belarus, it is necessary to enhance preventive measures, including regular examinations of men over 45 years old, the promotion of a healthy lifestyle, and the reduction of risk factors such as smoking, high-fat diet, and physical inactivity. Improving screening programs and introducing modern diagnostic technologies will make it possible to detect the disease at earlier stages and reduce mortality.

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HEALTHY LIFESTYLE AS AN INVESTMENT IN THE FUTURE

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This article examines the concept of a healthy lifestyle (HLS) as one of the most valuable and dependable long-term investments in one's own future.

Keywords: HLS (healthy lifestyle), health investment, quality of life, healthy habits, immunity.

In today's world, where time is our most precious resource, we are constantly seeking investment opportunities. We invest money in stocks, real estate, and self-education to secure a comfortable future. However, we often overlook the most crucial asset each of us possesses: our own health. A healthy lifestyle (HLS) is not merely a fleeting trend, but the most reliable and long-term investment in our future. It's an investment guaranteed to pay off, yielding dividends in the form of extra years of life and an immeasurably higher quality of it [1].

A classic investment involves allocating resources (money, time) today with the aim of gaining benefits tomorrow. The same principle applies to health. Regular physical activity, a balanced diet, abstaining from harmful habits, and stress management are the "funds" we "deposit" into our "bodily account." Unlike financial markets, there's no risk of a crash here. The returns are guaranteed, manifesting as:

• Increased life expectancy (quantity). Studies by the World Health Organization (WHO) and numerous scientific works demonstrate that even basic healthy habits can add an average of 10-15 years to one's life. Quitting smoking, engaging in 30 minutes of daily activity, and consuming sufficient fruits and vegetables significantly reduce the risk of premature death from cardiovascular diseases, diabetes, and oncology – the leading "killers" of our time.

• Enhanced quality of life (quality of active years). This is the most crucial aspect. It's not just about living longer, but about remaining active, energetic, and independent at any age. By investing in an HLS today, we "buy" ourselves the opportunity to hike at 60, play with grandchildren at 70, and enjoy mental clarity and self-sufficiency at 80. We invest in joint mobility, mental acuity, good eyesight, and a stable mood [2].

Like any savvy investor, it's crucial to diversify your investments. Key assets in your "healthy portfolio":

1. Movement – your primary dividend-yielding asset. Regular physical activity strengthens the heart, blood vessels, muscles, and bones, boosts metabolism, and acts as a powerful antidepressant. You don't need to exhaust yourself at the gym. 150 minutes of moderate aerobic activity (brisk walking, swimming, cycling) per week is already an excellent investment.

2. Nutrition – a fundamental asset. What we eat serves as the building blocks for our body. A balanced diet rich in vegetables, fruits, whole grains, healthy fats, and proteins is the fuel that allows the body to function efficiently and without disruptions. Conversely, limiting processed foods, sugar, and trans fats reduces the risk of chronic inflammation and diseases.

3. Sleep – a strategic asset for recovery. During sleep, the body "repairs" itself, consolidates memory, and regulates hormones. Chronic sleep deprivation is destructive: it increases the risk of obesity, diabetes, depression, and weakens the immune system. An investment in 7-9 hours of quality sleep daily is an investment in productivity and longevity.

4. Mental Health – an asset for resilience. The ability to manage stress through meditation, hobbies, nature walks, or spending time with loved ones protects against burnout, anxiety, and their destructive impact on physical health.

5. Quitting Harmful Habits – closing unprofitable projects. Smoking and excessive alcohol consumption are not assets but liabilities that daily "write off" years and quality from your life. Giving them up is the quickest and most effective financial operation to "rehabilitate" your "portfolio" [3].

Remember: it's never too early and never too late to start investing in your health. The body possesses an amazing capacity for recovery. Every small step – taking the stairs instead of the elevator, choosing a salad over a burger, going to bed an hour earlier – is a deposit into your account. Choose investments that are guaranteed to pay off. Choose a life full of strength and opportunities.

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ANALYSIS OF BIOLOGICALLY ACTIVE SUBSTANCES IN ECHINACEA PURPLE EXTRACTS THAT AFFECT ANTIOXIDANT ACTIVITY DEPENDING ON THE EXTRACTING AGENTS

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This article analyzes the biologically active substances in Echinacea purpurea extracts that influence antioxidant activity depending on the extracting agent.

Keywords: Echinacea purpurea, biologically active substances, chemical composition.

Echinacea purpurea is a perennial plant from the Asteraceae or Compositae family. This plant was previously classified in the genus Rudbeckia. Purple coneflower herb is a popular and promising medicinal plant material, used in the production of medicines and biologically active measures for digestion, enhancing the immune status of the body due to a positive effect on the body under conditions of non-specific immunity [1, 2].

The biologically active substances of purple coneflower can be widely used in the food industry to create specialized food products and biologically active substances in digestion [3]. The plant is used for colds, coughs, bronchitis, upper tract infections, urinary tract infections and some inflammatory conditions [4].

Chemical analysis of plants of the genus Echinacea allows us to name the following compounds that determine the pharmacological activity [5]: polysaccharides, including immunoactive ones; phenolic derivatives (luteolin, kaempferol, rutin, quercetin, etc.); caffeic acid derivatives; glycoproteins, including lectins; alkaloids; Saponins, which have immunostimulating and virus-neutralizing activity; alkamides of unsaturated acids, which give Echinacea preparations a burning taste and have local anesthetic, anti-inflammatory, insecticidal properties; tannins of a pyrocatechol nature (5-11%); extractive substances, the content of which varies in plants of different countries, depends on the species, variety, growing conditions and ranges from 13.4 to 28.8%; organic acids; vitamins; essential oils, the amount of which is variable (0.01-0.6%); macro- and microelements: calcium, potassium, aluminum, magnesium, chlorine, iron, molybdenum, selenium, manganese, silver; phytosterols; cyanidins; resins. Despite the fact that the chemical particles possess high pharmacological activity, the healing properties of combined Echinacea preparations (tinctures, extracts, juices) are much greater.

A review of the literature on biologically active substances revealed that plants of the genus Echinacea purpurea do not contain echinacoside. The active ingredient in Echinacea purpurea is chicoric acid. Thus, Echinacea purpurea can be considered a drug with immunomodulatory action. Preparations based on Echinacea purpurea also show promise for their antibacterial and antiviral effects.

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USE OF PROBIOTIC BACTERIA OF THE GENUS *LACTOBACILLUS* FOR THE TREATMENT OF DERMATOLOGICAL DISEASES

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The article analyzes the use of probiotic bacteria of the genus *Lactobacillus* for the treatment of dermatological diseases.

Keywords: probiotics, dermatitis, allergies.

Human skin is a unique indicator that reflects the condition of all organs and systems, protecting against infection and mechanical and chemical damage. Skin diseases indicate a disruption in the functioning of internal organs, an unhealthy lifestyle and bad habits, poor nutrition, and poor personal hygiene. The diversity of skin diseases is staggering. Many are difficult to treat and recurring. Such ailments include eczema, psoriasis, neurodermatitis, and dermatoses.

The pathogenesis of diseases is multifactorial and is caused by a complex interaction of genetic predisposition, immune dysregulation, and environmental factors. These pathogenic factors lead to a biphasic imbalance of T-helper cells, characterized by an initial predominance of Th2-polarized responses. Excessive production of Th2-associated cytokines, including interleukin-4 (IL-4), interleukin-13 (IL-13), interleukin-25 (IL-25), and thymic stromal lymphopoietin (TSLP), is accompanied by immune cell activation, further enhancing the induction of allergic sensitization.

Development dermatological diseases typically begins in early childhood and may represent the first stage of the so-called "atopic march," a natural history of allergic manifestations characterized by a sequence of atopic diseases that precede the development of other allergic disorders later in life. Dermatitis in infancy is typically followed by allergic rhinitis and/or asthma later in life. Although the etiology of these patologies remains unclear, it is reported that more than half of all children with AD are sensitized to one or more allergens, with food allergens predominating, suggesting their important role in the early activation of the proallergic immune response.

Over the past few decades, there has been a rising trend in the incidence of dermatological diseases and food allergies, particularly in developed countries. This trend is associated with strict hygiene practices, increased use of detergents, low family size, altered dietary habits, frequent antibiotic therapy, low rates of infectious diseases, and a high rate of cesarean sections. The Western lifestyle is believed to influence the composition of the gut microbiota, which may activate pro-allergic mechanisms. Children with these patologies exhibit low gut microbiota diversity, specifically a lack of *Bacteroides* diversity and a high prevalence of *Clostridium difficile* colonization.

Therefore, the use of probiotics may be one of the preventive and therapeutic measures for allergies. Probiotics are defined as live microorganisms that, when administered in the correct dose, exert a beneficial effect on human health. Experts emphasize that the clinical effects of probiotics depend on the strain. The probiotic strain *Lactobacillus rhamnosus GG* (LGG) is one of the few strains that has been studied in children with dermatological diseases at multiple research centers using the same protocol. *Bifidobacterium* is a key probiotic genus, regulating host physiology and pathological processes through microbiota modulation. It is known to suppress pathogenic microorganisms by producing acetate and lactate and secreting bacteriocins. The results of these studies demonstrate that not only the choice of strain but also the target population is important.

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ANTHROPOGENETIC POTENTIAL OF GAME SPORTS ATHLETES (USING YOUNG HOCKEY PLAYERS AS AN EXAMPLE)

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Abstract. The article assessed the prospects of 86 young hockey players, whose average age was 16-18 years, using the General Genetic Point (GGP) method. Analysis of six examined gene profiles - ACE Alu I/D, COMT Val158Met (rs4680), 5HTT L/S, 5HT2A T102C, AGT Thr174Met, BDKRB2 + 9/-9, MTHFR C677T, GPX1 C679T - made it possible to identify athletes with the greatest GGP, therefore, genetically predisposed to the combined manifestation of the qualities of "speed/strength" and "endurance."

Keywords: total genetic score; GGP; young hockey players; polymorphic loci of the human genome; polymorphism; allelic variants.

To date, about 240 genetic markers associated with the development and manifestation of physical qualities are known, therefore, the analysis of allelic representation of marker genes is a potential molecular tool for identifying sports talent [1,2].

The biomaterial was collected by buccal scraping. Molecular genetic diagnosis was carried out using classical polymerase chain reaction (PCR) methods and restriction fragment length polymorphism analysis (PDRP analysis).

After genotyping, the "total genetic point" or GGP was calculated, i.e. the gene profile of the tendency to "endurance" and "speed/strength" was evaluated: each polymorphism profile was assigned a score variant (0, 1, 2) in order to fully assess the contribution of genes to the physical quality of the athlete [1,2].

Example of the calculation of the GGP of a polygenic profile associated with the quality of "endurance":

$GGP_{endurance}$ = (100/2n) x (GP (ACE) + GP (BDKRB2) + GP (AGT) + GP (MTHFR) + GP (5HT2A) + GP (5HTT)),

where n is the number of genes responsible for the endurance characteristic (n = 6).

GP - genetic point on the polymorphism profile.

According to this method, the highest significance (highest point) is assigned to the most "effective" allele of the gene in relation to the development of physical quality, for example, ACE I/D polymorphism: I/I = 2, I/D = 1, D/D = 0; BDKRB2 -9/+ 9 polymorphism: -9/-9 = 2, -9/+ 9 = 1,+9/+ 9 = 0.

The GGP of the polygenic profile associated with the velocity/force quality was calculated using the formula:

$GGP_{speed/force}$ = (100/2n) x (GP (ACE) + GP (5HT2A) + GP (COMT) + GP (MTHFR) + GP (GPX1)),

where n = 5.

In 86 genotyped hockey players, based on the analysis of their polygenic profile, the range of GGP associated with the "speed/strength" quality ranged from 30 to 80 points with an average value of 55, in 13 hockey players (15.12%) it was 70 points. The range of endurance-related GGP ranged from 25 to 75 points with a mean close to 50, and 20 individuals (23.3%) had more than or equal to 60 points.

Thus, the analysis of the six gene profiles of the examined made it possible to identify athletes with the highest GGP and as genetically predisposed to the combined manifestation of the "speed/strength" and "endurance" qualities. This information can be guided by the coach to develop individual training programs.

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STIMULATING EFFECT OF LOW-INTENSITY LASER IRRADIATION ON GROWTH PROCESSES OF SOLANACEAE CROPS UNDER VIRAL INFECTION

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Pre-sowing treatment of seeds with low-intensity laser radiation mitigates the negative effects of tobacco mosaic virus infection in solanaceous crops, promoting the activation of growth processes and reducing visual disease manifestations.

Keywords: laser biostimulation, tobacco mosaic virus, Solanaceae, growth parameters, plant resistance.

The effect of pre-sowing treatment with low-intensity laser radiation on the growth and development of tomato (Minsk early variety) and pepper (Belozerka variety) plants under conditions of infection with tobacco mosaic virus has been studied. It has been shown that laser treatment of seeds before infection contributes to a significant improvement in seed quality and stimulates growth processes.

Tomato and pepper seeds were treated with low-intensity laser radiation (650 nm, 5 MW, 30 s), followed by infection with tobacco mosaic virus. Infected seeds without laser treatment and healthy seeds were used in the control. The results were recorded based on germination rates, morphometric parameters, and visual symptoms of the disease.

Laser pretreatment significantly reduced the negative impact of the viral infection. The germination rate of the treated tomato seeds reached 85.2% versus 62.4% in the infected control. Tomato and pepper plants showed an increase in shoot length by 25-30% compared with the infected control. The severity of mosaic symptoms decreased by 40-50% in the treated plants.

The results indicate the prospects of using low-intensity laser radiation to increase the resistance of nightshade crops to viral infections and reduce the negative effects of tobacco mosaic virus infection.

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MOLECULAR-BIOLOGICAL ASSASSMENT OF NON-SMALL CELL LUNG CANCER AND ITS DIAGNOSTIC SIGNIFICANCE

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Lung cancer is the leading cause of death in most developed countries among men [1]. Lung neoplasms are diagnosed annually in approximately 1.2 million people, and more than 1 million people on the planet die from lung cancer. Lung cancer accounts for 12.8% of all oncological morbidity. 5-year survival rates for lung cancer (LC), even in countries with the highest standard of healthcare, are no more than 15%, and with an average level of medical development, this figure barely reaches 5-7%. Until now, virtually no molecular marker for lung cancer has been used in clinical practice to identify groups of patients with an unfavorable prognosis. One of the reasons is that most studies on prognosticating the course of lung cancer are devoted to the analysis of the relationship between the identification of individual molecular and/or genetic factors (their positive or negative influence) and tumor progression. Currently, the

efforts of molecular biologists and clinicians are aimed at creating algorithms for marker “clusters” that provide more complete and reliable information about the progression of the tumor process [2,3].

Keywords: non-small cell lung cancer, tissue antigens, oncoprotein, immunohistochemistry, profiling.

The study material included tumor tissue of patients suffering from lung cancer who received specialized treatment at the N. N. Alexandrov Republican Scientific and Practical Center for OMR. The age of the patients included in the study ranged from 42 to 76 years. The average age of women was 54.7 ± 7.4 years, and that of men – 58.1 ± 7.4 years. Depending on the morphological form of lung cancer, the patients were distributed as follows: squamous cell carcinoma was verified in 60% of cases, adenocarcinoma was verified in 28.9% of patients, bronchioloalveolar and large cell carcinoma were diagnosed in 4.4% of cases each, and mucoepidermal cancer in 2.2%. When assessing the prevalence of the malignant process, stage 1 of the tumor process was verified in 57.8% of patients, stage II in 15.6% of cases, and stage III in 26.6%.

The study of the expression of molecular biological tissue markers was carried out in all patients after surgical treatment using the immunohistochemical method.

Preliminary data showed that Ki-67 oncoprotein expression was detected in 98.7% of patients. Ki-67 expression levels were less than 20% in 61.6% of patients, and 20% or higher in 38.4%. The pro-apoptotic protein Bax and the anti-apoptotic protein Bcl-2 were measured in patients with NSCLC. Low levels of Bax expression were detected in 30.4% of cases, and Bcl-2 in 15%. High expression of pro-apoptotic Bax was observed in 34.1% of cases, and anti-apoptotic Bcl-2 in 12.9%.

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PSYCHOLOGICAL EFFECTS OF SLEEP ON HUMAN HEALTH

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The article shows how sleep strengthens memory, regulates emotions, and cleanses the brain of toxins. A direct link between sleep quality and mental health, including the risks of depression and anxiety, is considered. It explains why a good night's sleep is the basis for learning and resilience to stress.

Keywords: Sleep, memory, emotions, mental health, brain, stress, neurodegeneration.

Sleep is not just a period of rest, but a complex and vital biological process that has a profound impact on our mental and emotional state. Quality sleep is one of the main factors of a person's psychological well-being. First of all, it plays a key role in memory consolidation and learning processes. During sleep, especially during slow and fast sleep (REM), the brain actively sorts and transfers information from short-term memoryto long-term memory. That is why after a full night's rest, a person copes much better with tasks of memorizing and mastering new skills, while lack of sleep dramatically reduces concentration and the ability to assimilate knowledge.

Sleep is equally important for emotional regulation. The amygdala, the processing center for emotions such as fear and anger, becomes hyperactive when you don't get enough sleep. This leads to increased irritability, anxiety, and emotional instability. A sleep-deprived person reacts more acutely to negative stimuli and loses the ability to adequately assess situations. A good night's sleep helps to "recharge" emotional batteries by reducing stress hormones, which is a powerful prevention of burnout and anxiety disorders [2].

The psychological consequences of poor-quality sleep go beyond individual well-being and affect social interaction. Research in social neuroscience shows that a sleep-deprived person has difficulty recognizing other people's emotions, is prone to conflict, and shows less empathy. This is because a depleted brain saves resources and primarily shuts down the complex social functions needed to build healthy relationships, both in your personal life and in your professional life.

There is also a strong two-way link between sleep and mental health. Chronic insomnia is both a symptom and a risk factor for developing depression and anxiety. It is not uncommon for a vicious cycle to form: a mental disorder disrupts sleep, and poor sleep, in turn, worsens the symptoms of the disorder. Breaking this cycle through improved sleep quality becomes an important part of therapy.

An equally important aspect is the link between sleep quality and physical health. During the deep stages of sleep, the immune system is activated, and the production of cytokines - proteins necessary to fight infections-increases. Chronic sleep deprivation suppresses the immune response, making the body more vulnerable to viral and bacterial diseases. In addition, lack of sleep disrupts the production of appetite-regulating hormones, which can lead to metabolic disorders and weight gain. Thus, full sleep is not only a guarantee of mental well-being, but also a fundamental basis for physical health [1].

Current scientific evidence highlights the key role of sleep in clearing the brain of neurotoxins. The glymphatic system, a unique brain cleaning mechanism that is most active during deep sleep, has been discovered. At this time, the space between brain cells increases, allowing the cerebrospinal fluid to flush out toxic proteins, the accumulation of which is associated with neurodegenerative diseases.

Of particular importance is the relationship of sleep with the circadian rhythms of the body. These internal biological clocks, regulated by the suprachiasmatic nucleus of the brain, synchronize sleep and wake cycles with the natural day. Disruption of circadian rhythms caused by working the night shift, using gadgets before bedtime, or frequently changing time zones leads to desynchronosis. This condition not only causes insomnia and daytime sleepiness, but also negatively affects cognitive functions, emotional background and metabolism, increasing the risk of developing metabolic syndrome and cardiovascular diseases.

Thus, sleep is not a luxury, but a biological necessity. By investing in quality 7-9-hour sleep, we contribute to our mental health, mental clarity, and emotional stability [3].

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THE IMPACT OF LOW-ALCOHOLIC DRINKS ON THE HEALTH OF ATHLETES

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This article examines the impact of low-alcohol consumption on key aspects of athlete health. It analyzes the negative impact of low-dose alcohol on hydration, protein synthesis, sleep quality, and energy metabolism. Particular attention is paid to consequences such as delayed muscle recovery, decreased coordination, and increased risk of injury.

Keywords: low-alcohol drinks, athletes, health, recovery, synthesis.

For someone dedicated to sports, every aspect of life, including nutrition and recovery, is aimed at achieving maximum results. In this context, drinking low-alcohol beverages (such as beer, cider, and low-ABV cocktails) is often perceived as a harmless, relaxing habit. However, even moderate consumption can seriously undermine athletic performance and overall health.

Alcohol, even in small doses, is a diuretic, meaning it increases urine production. This leads to dehydration, which is critical for athletes. Dehydration of just 2% of body weight significantly reduces endurance, strength, and cognitive function (coordination, reaction time). Post-workout recovery, which is directly dependent on hydration, is slowed, increasing the risk of muscle cramps and heatstroke [1].

One of the main goals of training is to stimulate muscle protein synthesis. Alcohol disrupts this process in several ways: 1) by decreasing testosterone levels (the main anabolic hormone), 2) by increasing cortisol levels (the stress hormone that promotes muscle breakdown). As a result, muscle recovery and growth after intense exercise is slowed, negating the efforts made in the gym.

While alcohol can cause drowsiness, it significantly impairs sleep quality. It suppresses rapid eye movement (REM) sleep, which is critical for mental recovery, memory consolidation, and growth hormone production. An athlete who consumed alcohol the night before, even after 8-9 hours of sleep, may wake up feeling groggy and unrefreshed [2].

Low-alcohol drinks, especially various cocktails, often contain large amounts of simple sugars. The body primarily metabolizes alcohol and sugar, not fat. Thus, lipolysis is blocked. Furthermore, alcohol itself is a source of "empty" calories (7 kcal/g), which can easily lead to a calorie surplus and the accumulation of unwanted fat mass. Alcohol, even in small quantities, has a depressant effect on the central nervous system, impairing neuromuscular communication and coordination. This effect can persist the day after consumption, making training not only ineffective but also injury-prone [2–3].

Intense training itself puts stress on the immune system. Alcohol further suppresses the immune system, making athletes more vulnerable to viral and bacterial infections. Missing workouts due to illness directly impacts progress [3].

For an athlete striving for perfection, there is no such thing as a "safe dose" of low-alcohol beverages. Their consumption directly contradicts the key goals of the training process: recovery, muscle growth, maintaining optimal hydration, and energy balance.

Choosing non-alcoholic alternatives (non-alcoholic beer, water, isotonic drinks, natural fruit drinks) is not simply quitting a bad habit, but a conscious investment in your athletic performance and long-term health. The optimal strategy for post-exercise recovery is adequate sleep, balanced nutrition, and adequate hydration, not the mythical "relaxation" with a glass of low-alcohol drink.

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COMPARATIVE ANALYSIS OF ACTIVE SITES OF CYTOCHROME P450 ISOFORMS

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The article presents a comparative analysis of the structural characteristics of the active centers of the key isoforms of cytochrome P450 – CYP3A4 and CYP2D6.

Keywords: cytochrome, active center, CYP3A4, CYP2D6

Cytochrome P450, represented by a variety of isoenzymes, plays a key role in biotransformation processes. Of these, six provide the metabolism of about 90% of all drugs. The greatest contribution to this process is made by CYP3A4 (30-50%) and CYP2D6 (about 20%), while the remaining isoforms are involved to a lesser extent [1].

The three-dimensional structures of two cytochrome P450 isoforms (PDB ID: 6UNG, 4WNV) were obtained from the RCSB PDB database (https://www.rcsb.org /). The online PrankWeb service was used to determine the active binding sites in proteins (https://prankweb.cz /).

Table

Characteristics of active sites in cytochromes P450

Cytochrome	PDB ID	Number of detected sites	Rank of the most probable site	Reliability assessment of the most probable site	Number of amino acid residues forming the site with the highest rank	Coordinates of the most probable site (x, y, z)
CYP3A4	6UNG	4	1	27,30	24	-16,2523; -26,6801; -9,5911
CYP2D6	4WNV	23	1	49,13	32	7,2453;25,4616;4,0948

Four binding sites with their own characteristics are identified in the structure of CYP3A4. The first rank is characterized by a high score of 27.30 and a statistical probability of 0.901, including 24 amino acid (AA) residues. It has a moderate level of conservativeness (average conservation of 1.778), which indicates its fundamental role in the functioning of the enzyme and the preservation of key catalytic properties. The subsequent structural components of the active center demonstrate a gradual decrease in importance. This structural organization assumes that the main catalytic potential of the enzyme is concentrated in the most conservative first rank, while less significant elements can perform auxiliary functions or participate in the regulation of enzyme activity.

The active center of CYP2D6 is characterized by a complex structure with a pronounced hierarchy of elements. The first four structural components show exceptionally high significance scores ranging from 39.86 to 49.13 with a probability above 0.95. These elements include from 30 to 34 AA residues and have a high level of conservativeness (average conservation of 1.683-1,853), which indicates their integral role in the catalytic activity of the enzyme. It is noteworthy that the first four ranks demonstrate almost identical indicators of conservativeness, which indicates their key relationship and importance for enzymatic activity The first rank of them has the best indicators characteristics. Subsequent ranks show a gradual decrease in importance while maintaining a certain order. Ranks 5 to 8 are characterized by moderate assessment and probability indicators, while there is a tendency to increase the average retention. Ranks 9 through 23 show a progressive decrease in all indicators. Such a structural organization presupposes the presence of a main functional zone formed by the first four components, the most likely of which is the first, and a peripheral region with gradually decreasing significance, which may participate in the regulation of enzyme activity or ensure its interaction with additional substrates.

Among the AA found in the active center of CYP3A4: AA 443 cysteine (25.2668), AA 305 alanine (22.1464), AA 309 threonine (21.8886), AA 436 phenylalanine (17.1677), AA 445 glycine (14.7814), AA 444 leucine (10.8495), AA 369 isoleucine (9.9068), AA 435 proline (9.3761) were found with the highest rating. And among the active center of CYP2D6 with the highest rating, AA 305 alanine (9.7483), AA 444 glycine (8.5213), AA 309 threonine (6.8572), AA 435 phenylalanine (6.5174), AA 445 methionine (6.1174), AA 443 isoleucine (4.7939) were found. Based on these data, it can be concluded that these active centers of CYP3A4 and CYP2D6 are conservative.

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THE PROBLEM OF REDUCTIONISM AND HOLISM IN THE STUDY OF ESSENTIAL OIL SYNERGY

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The study of essential oils for antimicrobial therapy poses a unique scientific challenge, arising from a fundamental conflict between pharmacology's dominant reductionist paradigm and the inherently holistic nature of these substances. This article explores this conflict and the methodological synthesis emerging in research on the antibacterial activity of essential oil blends.

The traditional path of drug development is based on the paradigm of reductionism. This approach posits that a complex system can be understood by breaking it down into its constituent parts and studying each in isolation. In the context of pharmacology, this means:

- Isolating the active principle from a natural source (e.g., a plant).
- Identifying and purifying the main active substance (e.g., terpinen-4-ol in tea tree oil).
- Studying the mechanism of action of the substance both in vitro and in vivo.
- Synthesizing analogs and creating a standardized drug based on it.

This method has proven to be immensely effective, yielding most of the world's known antibiotics. Its advantages are simplicity, reproducibility, and the ability to establish a clear cause-and-effect relationship: substance "A" acts on target "B" [2].

Applying a purely reductionist approach to essential oils is ineffective because the purified main component of an oil (e.g., the same terpinen-4-ol) often exhibits lower antibacterial activity than the whole oil. Moreover, it may be less effective than an artificially recreated composition of all major components. This indicates the phenomenon of synergy – the emergence of a new property in a system that is not inherent in any of its individual elements (e.g., potentiation, where one slightly active component enhances the effect of another).

Different components of the oil attack different cellular targets of the bacterium (membrane, proteins, DNA), leading to a combined effect. Inhibition of resistance mechanisms: some components can block the bacterial cell's systems for expelling antibiotics (efflux pumps), thereby "disarming" the bacterium. Thus, the object of study (essential oil) is ontologically holistic, and its key property (synergy) fundamentally cannot be studied by reductionist methods alone. The study of essential oil combinations does not reject reductionism but subsumes it at a new level, creating a methodological synthesis [1].

Reductionist Stage: The research begins with classical methods. Using chromatography (GC-MS), the complex system is reduced to a list of its main components (their identification and quantification). The individual antibacterial activity of each key component is studied.

Holistic Stage: Subsequently, the methodology changes radically. Methods for studying combinations (e.g., the checkerboard method, synergy tests on agar plates with disk diffusion) are used to empirically observe and measure synergy. Quantitative indicators (FIC Index – Fractional Inhibitory Concentration Index) allow for translating the qualitative assertion of synergy into a strict mathematical language.

Explanatory Stage: The attempt to explain the obtained data can again have a reductionist character (studying the effect of the combination on specific targets), but always with an awareness of the system's integrity [3].

In conclusion, the methodology for studying the synergy of essential oils serves as a vivid example of overcoming the rigid dichotomy between reductionism and holism in science. Reductionist methods are used as necessary tools for analyzing composition and obtaining primary data, while the holistic approach serves as the guiding ontological principle, defining the very object and the ultimate goal of the research – not merely to describe the parts, but to understand the logic of their interaction as a whole. This is not eclecticism, but a sophisticated methodological synthesis adequate to the complexity of the systems under study. Such an approach not only confirms the empirical effectiveness of traditional practices but also elevates their study to the level of rigorous evidence-based science.

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CLINICAL, BIOCHEMICAL AND PATHOMORPHOLOGICAL FEATURES OF LIPOPOLYSACCHARIDE-INDUCED ACUTE LUNG INJURY

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The paper analyzes mechanisms, clinical, biochemical and morphological features of lipopolysaccharide-induced acute lung injury in experimental models. LPS exposure activates TLR4 receptors, NF-κB, MAPK cascades, leading to increased IL-6, IL-1β, TNF-α expression and neutrophil infiltration, causing alveolar edema, hypoxemia and epithelial destruction.

Keywords: lipopolysaccharide, acute lung injury, TNF-α, cytokines, NF-κB, inflammation.

Lipopolysaccharide-induced acute lung injury (LPS-ALI) is a reproducible model of inflammatory process accompanied by activation of proinflammatory signaling pathways, cytokine release and structural changes in lung tissue. This study presents comprehensive analysis of clinical, biochemical and pathomorphological manifestations of LPS-induced acute lung injury and evaluation of anti-inflammatory approaches effectiveness aimed at suppressing cytokine cascade.

In vitro experiments demonstrated that LPS causes pronounced activation of proinflammatory NF-κB and MAPK pathways in monocyte and macrophage cultures, increasing secretion of TNF-α, IL-6 and IL-1β, as well as altering expression of non-coding RNAs. Cell cultures showed dose-dependent response with maximal cytokine production at 100 ng/ml LPS concentration after 24-hour incubation.

In vivo studies in rats using intratracheal administration of Salmonella enterica LPS at 20 mg/kg dose revealed systemic inflammatory response characterized by hypothermia (temperature decrease by 2.3±0.4°C), leukocytosis (WBC count 18.4±2.1×10⁹/L), hypoxemia (PaO_2 68±5 mmHg), metabolic acidosis (pH 7.28±0.03), hyperkalemia (K^+ 5.8±0.3 mmol/L), and pulmonary edema with wet/dry lung ratio increase to 6.2±0.4. Histological examination showed alveolar septal thickening, neutrophil infiltration, hyaline membrane formation and epithelial desquamation.

Mouse model experiments demonstrated significant increase in TNF-α (385±42 pg/ml) and IL-6 (520±58 pg/ml) levels in bronchoalveolar lavage fluid compared to control (45±8 and 32±6 pg/ml respectively). Active infiltration of lung tissue with inflammatory cells was confirmed morphologically. Application of PEGylated aptamer against TNF-α (PEG-aptTNF-α) at 2 mg/kg dose significantly reduced cytokine levels by 65% and decreased severity of inflammatory changes, which was confirmed histologically and molecularly through decreased expression of Usp18, Traf1, Tnfaip3 genes by 3.2, 2.8 and 4.1-fold respectively.

The model reliably reproduces clinical, biochemical and morphological features of ALI. LPS-induced acute lung injury is accompanied by systemic inflammatory response with overexpression of proinflammatory cytokines, activation of NF-κB-dependent pathways and structural damage to alveolar epithelium. Use of targeted aptamers against TNF-α demonstrates promise of molecularly targeted therapy for inflammatory lung lesions with potential for clinical translation in acute respiratory distress syndrome treatment.

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STUDY OF THE IMPACT OF INDUSTRIAL EMISSIONS FROM OJSC «BELARUSREZINOTEKHNIKA» ON THE MORBIDITY OF THE POPULATION OF BOBRUISK

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The work shows that the concentrations of most pollutants are within acceptable limits, but there is an excess of maximum permissible concentrations (MPC) for substances: mineral oil, solid particles. Analysis of the dynamics of morbidity of the population of Bobruisk for the period 2013-2022 showed that the following trends are observed: an increase in the overall morbidity of the population: the average annual growth rate was 0.7%, and over 10 years the indicator increased by 14.2%.

Keywords: industrial emissions, diseases, pollution, maximum permissible concentration.

Emissions of harmful substances into the atmosphere caused by industrial activity, transport and other sources have a significant impact on the ecosystem and public health [1].

The purpose of this work is to analyze the impact of industrial emissions of the enterprise OJSC «Belarusrezinotekhnika» on the health of the population of Bobruisk. To analyze industrial emissions, data provided by the enterprise OJSC «Belarusrezinotekhnika» were used. To analyze the impact of emissions on health, data on population morbidity provided by medical institutions and statistical services were used.

According to the conducted study, the primary morbidity rate of the population of Bobruisk for the analyzed period 2013-2022 has a moderate growth trend, the average annual increase is 1.10%, the growth rate over 10 years is 5.0% (Fig. 1).

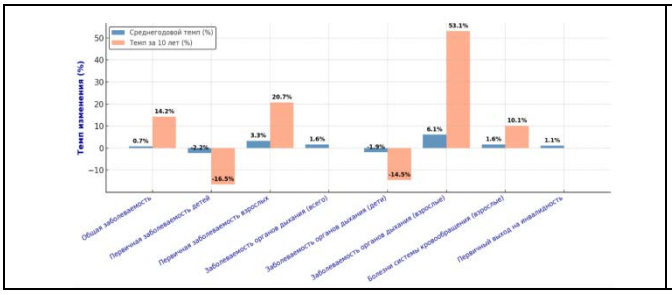

Fig. 1 Dynamics of the growth rate of morbidity in the city of Bobruisk

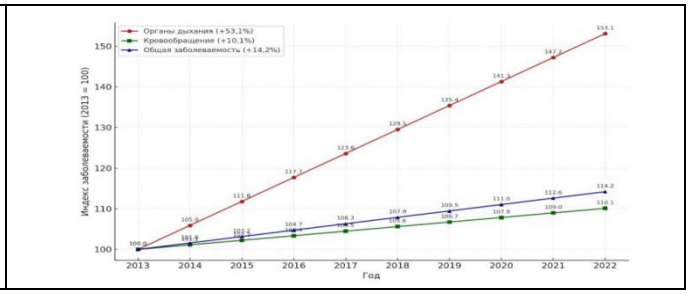

Fig. 2 Dynamics of the growth of morbidity among adults in the city of Bobruisk for 2013-2022.

Analysis of the dynamics of morbidity of the population of Bobruisk for the period 2013-2022 showed the following trends (Fig. 2): growth of general morbidity of the population: the average annual growth rate was 0.7%, and over 10 years the indicator increased by 14.2%. Primary morbidity of adults increased by 3.3% per year, the growth rate over 10 years was 20.7%. Respiratory morbidity among the adult population demonstrates the greatest growth - 6.1% per year, over 10 years the indicator increased by 53.1%. Respiratory morbidity among children, on the contrary, has a moderate downward trend (-1.9% per year), the overall decline over 10 years was (-14.5%). The incidence of circulatory system diseases also demonstrates growth - 1.6% per year, the growth rate compared to the 2013 level is 10.1%. Primary

disability is characterized by a stable trend with a slight increase (+1.1% compared to 2013). The greatest changes were recorded in respiratory diseases in the adult population, which may be associated with regular exposure to pollutant emissions. Mineral oils and solid particles present in the emissions of the enterprise can cause chronic respiratory diseases such as bronchitis, pneumoconiosis, asthmatic reactions, allergic reactions caused by aerosol and gaseous components of emissions, cardiovascular diseases, including hypertension and ischemic heart disease, an increased incidence of cancer associated with exposure to carcinogenic hydrocarbons [1].

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ASSESSMENT OF THE EPIZOOTIC SITUATION ON PARASITIC PATHOLOGY OF THE MUTANT SWAN IN THE MINSK REGION

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The mute swan in Belarus has passed the stage of being considered an endangered species. Their widespread distribution – approximately 1,900 individuals in Belarus – makes them a significant concern in terms of the overall epizootic health of the Belarusian population of these birds, and in particular, in terms of parasitic diseases.

Belarus is a country crossed by numerous migration routes for millions of migratory birds representing a wide range of species. Many of them choose our territory for migration stopovers, resting, and feeding, using Belarus's natural environment and agricultural lands for this purpose.

Practically all migratory bird species are not free of parasites and can be a source of infections and infestations for our farm animals. They also pose an equally significant threat to wild native bird species, including the mute swan, now a common bird species in our waters.

Keywords: Epizootic situation, parasitocenoses, mute swan, parasitological studies, environmental ecology.

A native inhabitant of our waters, the mute swan was completely exterminated by the early 19th century and was virtually absent from our fauna until the 1980s. Swan reintroductions to Belarus came from neighboring regions – Lithuania and Poland.

The epizootic situation and veterinary and sanitary well-being in the country depend on continuous monitoring of processes that may affect them. Systematic monitoring of the health of wild animal and bird populations largely allows for the timely detection of the initial clinical signs of infectious and invasive diseases. Diagnosis and timely preventative measures make it possible to avoid mass cases of illness and animal mortality.

As is well known, various bird species are frequently infected by parasitic agents (nematodes, trematodes, cestodes) or bacterial pathogens. Therefore, parasitological studies of birds of the same family or genus suggest the spread of a particular parasitic organism among other bird species, including farmed poultry [1, 2].

To this end, we conducted parasitological studies of the droppings of white-fronted geese that stopped to feed on agricultural lands in the Molodechno district of the Minsk region during their spring migration. These same agricultural fields are also regularly visited by mute swans, a large population of which remains there for the winter.

Accordingly, there is a real possibility of reinfection with both parasitic representatives of the helminth fauna and bacterial infections [3].

The material was droppings collected from the feeding grounds of a flock of white-fronted geese. The studies were conducted using the Darling method, followed by microscopy at a magnification of x400.

Microscope magnification is determined by multiplying the magnification values of the "10X" eyepiece and "40X" objective. During microcopy, eggs of two species of nematodes were detected: *A. anseris* and *B. anseris*.

Amidostomum anseris (Zeder, 1800) Railliet & Henry, 1909. Nematodes of *A. anseris* belong to the class Chromadorea Inglis, 1983; order Rhabditida Chitwood, 1933; superfamily Strongyloidea Baird, 1853; Amidostomidae Travassos, 1919. In birds, these nematodes are localized under the cuticle of the gizzard.

These scientific studies make it possible to conduct similar laboratory diagnostics based on coprological studies in order to detect representatives of the class of nematodes and other representatives of parasitic fauna in the bodies of swans living in Belarus.

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EFFECT OF ATORVASTATIN AND ROSUVASTATIN ON CHANGES IN THE HEMOSTASIS SYSTEM IN MICE WITH EXPERIMENTAL DIABETES MELLITUS

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Abstract: The article presents data on modeling type 2 diabetes mellitus in white rats using streptozotocin. Changes in the blood coagulation system were studied compared to healthy rats. The effect of atorvastatin and rosuvastatin on the hemostatic system of experimental rats with diabetes was studied.

Keywords: Atorvastatin, Rosuvastatin, type 2 diabetes mellitus (T2DM), platelets, hyperlipidemia, hyperglycemia.

Today, statins are widely used as lipid-lowering drugs, effective in lowering LDL cholesterol levels in the blood and reducing the risk of cardiovascular diseases. However, recent evidence suggests that statins may contribute to the development of diabetes, particularly insulin resistance, and impaired hemostasis. To date, the effects of statins have not been fully studied, and their negative impact on diabetes requires separate study.

The aim of the study was to study the effect of atorvastatin and rosuvastatin on biochemical parameters of experimental rats with diabetes.

Materials and methods. The studies were conducted on 24 white male rats weighing 250–350 g. The diabetes model in rats was modeled by a single subcutaneous injection of streptozotocin (Sigma, USA) (25 mg/kg in 0.1 M citrate buffer, pH 4.5) [1]. Rats with diabetes were administered atorvastatin (Biocom OJSC, Russia) and rosuvastatin (Biopharm Ltd., Poland) at a dose of 10 mg/kg orally through a special tube. The intact group of animals was injected with 0.3 ml of saline solution. Blood was collected dropwise from the conjunctiva of the rat's eye into epidural tubes. The following coagulation parameters were tested: prothrombin time (PT) sek, activated partial thromboplastin time (APTT) sek, thrombin time (TT) sek, using kits from the company (CYANCoag, Belgium) [2,3].

According to the results, diabetes modeling resulted in a 30.2% reduction in thrombin time in blood plasma. Atorvastatin and rosuvastatin had a protective effect on the studied parameters in rats with diabetes mellitus: a decrease in fibrinogen levels was detected, and thrombin time increased under the influence of atorvastatin by 18% and rosuvastatin by 17% compared to the control. In the APTT test, atorvastatin increased prothrombin time by 20%, while rosuvastatin increased it by 10% compared to the control. In diabetic rats, the therapeutic effect of atorvastatin increased prothrombin time by 18%, while rosuvastatin increased it by 32%. The ability of statins to influence both the extrinsic

and intrinsic pathways of blood coagulation is explained by the fact that they inhibit one of the factors XII, XI, IX, VIII of the intrinsic pathway and factors V and II of the extrinsic pathway. In conclusion, it should be noted that the use of atorvastatin and rosuvastatin at a dose of 10 mg/kg in animals with diabetes mellitus reduces the pathological activation of blood coagulation.

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ANTIBIOTIC RESISTANCE OF CUTANEOUS PATHOGENS: RATIONALE FOR EXPLORING ALTERNATIVE STRATEGIES BASED ON ESSENTIAL OILS

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This article examines standard antibiotic resistance in bacteria causing skin diseases and discusses the relevance and feasibility of using essential oils in the treatment of bacterial skin infections.

Bacterial skin infections remain one of the most common reasons for seeking medical care. Traditional therapy is based on the use of antiseptics and antibiotics. However, the widespread and often irrational use of these drugs has led to a rapid increase in antibiotic resistance among key skin pathogens, undermining the efficacy of standard treatments.

Staphylococcus aureus is the leading cause of pyogenic skin infections. Methicillin-resistant strains (MRSA) pose a particular threat. In Russia: According to the multicenter study MARATHON (2019-2020), the proportion of MRSA among *S. aureus* strains isolated from skin and soft tissue infections averages 23.5% [1]. This means that every fourth case of staphylococcal skin infection may be initially resistant to most β-lactam antibiotics (penicillins, cephalosporins). Resistance to macrolides among *S. aureus* in some regions reaches 25-40% [2].

Cutibacterium acnes: causes acne, and although acne is a multifactorial disease, *C. acnes* plays a key role in inflammation. Multicenter studies show that the resistance rate of *C. acnes* to clindamycin reaches 40-50%, and to erythromycin 50-60% in some populations [4]. This directly reduces the effectiveness of widely prescribed topical antibiotics.

This situation has several negative consequences: reduced treatment efficacy: leads to chronic infections, prolonged healing time, and increased risk of systemic complications. The need to use reserve significantly increases the cost of therapy. Disruption of the microbiome: broad-spectrum antibiotics suppress not only pathogenic but also normal skin flora, which can exacerbate dysbiosis and contribute to recurrences.

The search for non-antibacterial agents with novel mechanisms of action is not just relevant but necessary. Plant-derived essential oils offer several advantages: complex multi-component composition. Essential oils contain dozens of biologically active compounds (terpenes, phenols, aldehydes). Such a composition makes it difficult for bacteria to develop resistance, as multiple simultaneous defense mechanisms would be required; broad spectrum of activity. Many essential oils (tea tree, clove, thyme, oregano) demonstrate efficacy against certain opportunistic microorganisms that cause skin diseases (*C. acnes, S. aureus*). Anti-inflammatory and antioxidant properties: beyond direct antimicrobial action, essential oils can modulate the inflammatory response, which is particularly valuable in conditions like acne and infected wounds. Synergy potential: the study of essential oil combinations is a highly promising direction. Enhance the

antimicrobial effect; reduce the working concentration of each component, minimizing potential irritation; broaden the spectrum of antimicrobial activity [3].

In an in vitro study, the efficacy of tea tree (Melaleuca alternifolia), clove (Syzygium aromaticum), and thyme (Thymus vulgaris) essential oils was evaluated against Staphylococcus aureus (including MRSA) and Cutibacterium acnes. Using the disk diffusion method and determination of the minimum inhibitory concentration (MIC), it was found that tea tree oil was active against MRSA at an MIC of 0.5–2%, while a combination of tea tree and clove oils synergistically enhanced the antibacterial effect, reducing the MIC by 30–50%. For C. acnes, thyme oil was the most active, completely suppressing bacterial growth at a concentration of 1%.

Resistance statistics for key skin pathogens indicate that the existing arsenal of antibiotics is losing its effectiveness. This creates a need for the development of new therapeutic and prophylactic agents. Research into the antibacterial activity of essential oil combinations aims to address this very challenge. Such work lays the scientific foundation for creating future drugs that are effective, safe, and capable of overcoming the antibiotic resistance crisis in dermatology.

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DIFFERENTIAL INDUCTION OF CYTOCHROME P450 ENZYMES BY PHENOBARBITAL IN LYMPHOCYTES: IMPLICATIONS FOR IMMUNOTOXICITY AND DRUG METABOLISM

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The study investigates the differential induction of CYP1A1 and CYP1B1 enzymes in lymphocytes exposed to phenobarbital and luminal. Blood samples from 80 epileptic patients were analyzed using qPCR. Results showed phenobarbital induced 3.42-fold increase in CYP1A1 and 2.61-fold in CYP1B1 expression, while luminal caused only 1.25-fold and 1.21-fold increases respectively. A significant negative correlation ($r=-0.85$, $p<0.001$) between CYP450 induction and lymphocyte proliferation suggests potential immunotoxic effects.

Keywords: cytochrome P450, CYP1A1, CYP1B1, phenobarbital, luminal, immunotoxicity, drug metabolism, lymphocytes.

Cytochrome P450 enzymes (CYP450) play a crucial role in xenobiotic metabolism, including drugs and environmental pollutants. CYP1A1 and CYP1B1 primarily perform metabolic activation of carcinogens through the AhR pathway. While phenobarbital's CYP450-inducing properties are well-established, its effects on immune cells remain poorly studied. This study analyzes CYP1A1 and CYP1B1 induction in lymphocytes exposed to phenobarbital and luminal, examining implications for immunotoxicity and drug metabolism.

Blood samples from 80 epileptic patients were divided into phenobarbital-treated and control groups. Lymphocytes were isolated using density gradient centrifugation. Gene expression levels were measured by quantitative real-time PCR using the $\Delta\Delta$Ct method with GAPDH as reference. Phenobarbital (50 μM) and luminal (100 μM) treatments were compared to DMSO controls.

Phenobarbital significantly increased both CYP1A1 and CYP1B1 expression compared to untreated controls. CYP1A1 expression increased 3.42-fold ($p<0.01$) with phenobarbital versus 1.25-fold with luminal. CYP1B1 showed

2.61-fold increase with phenobarbital versus 1.21-fold with luminal ($p<0.01$). These results demonstrate phenobarbital as a more potent inducer of both enzymes in lymphocytes.

CYP450 induction negatively correlated with lymphocyte proliferation ($r=-0.85$, $p<0.001$). Higher enzyme levels were associated with reduced lymphocyte function, likely due to reactive oxygen species production and electrophilic intermediates disrupting cellular homeostasis. Phenobarbital treatment significantly reduced lymphocyte proliferation, indicating potential immunotoxicity from CYP450 induction. Luminal showed smaller CYP450 induction and less impact on proliferation.

The study demonstrates phenobarbital's stronger induction of CYP1A1 and CYP1B1 compared to luminal, with significant implications for drug metabolism. Enzyme elevation produces reactive metabolites causing oxidative stress and reduced immune function. The negative correlation between CYP450 induction and lymphocyte proliferation suggests phenobarbital's immunotoxic potential, complicating administration in immunocompromised patients. Results confirm phenobarbital as a strong AhR pathway agonist, affecting xenobiotic and carcinogen metabolism with broader implications for immune modulation.

Phenobarbital induces significant CYP1A1 and CYP1B1 upregulation in lymphocytes with implications for drug metabolism and immune function. These findings underscore monitoring CYP450 activity in patients receiving phenobarbital therapy, as enzyme induction may produce both beneficial and harmful effects. Future studies should focus on long-term consequences of CYP450 induction in immune cells, particularly in patients requiring continuous drug administration. Clinical monitoring of immune function during phenobarbital therapy is recommended.

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EPIZOOTIC SITUATION OF PARASITOSIS AMONG WATERFOWLING BIRDS LIVING IN THE REPUBLIC OF BELARUS

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Abstract. The abstract presents the results of monitoring parasitic diseases among wild waterfowl living in Belarus. The study involved birds obtained as a result of seasonal hunts in the Molodechno district of the Minsk region. In addition to nesting birds, our research also covered transit species that use the territory of Belarus during seasonal migrations.

To establish the presence of parasites localized in the gastrointestinal tract of game species of waterfowl, classical methods were used to detect eggs and larval forms of parasites.

Keywords: waterfowl, parasitocenoses, epizootic situation, prevention of parasitic diseases.

In the process of evolution, simultaneously with the change in the species diversity of the Earth, the parasite fauna also changed, which chose the organisms of animals, fish, birds, etc. for its habitat. Without their parasitic influence and impact, no living organism exists. Man is no exception.

For centuries, parasitic organisms have used their hosts in various capacities. A host is a person or animal whose body is a permanent or temporary habitat for the parasite and serves as its food source. A distinction is made between

definitive or final hosts, in whose body the parasite is present in a sexually mature form, and intermediate hosts, in whose body the immature stages of the parasite are present. Evolutionarily, parasites have adapted to use several additional or intermediate hosts in order to survive as a species. In this case, the second intermediate host is sometimes called an additional host. Parasites use some as feeders, others as parasitic depots, where the processes of their reproduction and development to sexually mature stages occur.

In each of the listed mechanisms of interaction (parasite - host), this principle was natural and predetermined by the process of evolution. The parasitic organism found all the conditions for its existence, and vice versa, the host organism (temporary or permanent) was always an oppressed object. One of these ideally suited for parasitic creatures was the organism of waterfowl. These animals, due to their biological and physiological characteristics, were optimal for parasitizing many species of nematodes, cestodes, trematodes, protozoa, sarcocysts, as well as a huge number of pathogenic bacteria and viruses [1].

The listed representatives of the parasitic fauna often form parasitocenoses. These communities, as a rule, cause severe consequences for birds. The formation of associations, or parasitocenoses, can also be considered as a manifestation of evolutionary adaptation [2, 3].

The monitoring was conducted from 2019 to 11.05.2025. In this case, 269 individuals representing 8 bird species were subjected to parasitological examination.

The harvested birds belonged to the order Anseriformes: mallard (*Anas platyrhynchos*) – 85 individuals, gadwall (*Anas strepera*) – 24 individuals, teal (*Anas crecca*) – 100 individuals, wigeon (*Anas penelope*) – 19 individuals, shoveler (*Anas clypeata*) – 27 individuals, tufted duck (*Aythya fuligula*) – 6 individuals, greylag goose (*Anser anser*) – 1 individual, white-fronted goose (*Anser albifrons*) – 7 individuals.

As a result, we identified 2 species of parasitic worms represented by nematodes and cestodes. Sarcocysts were often recorded, which affected the pectoral muscles. Of the ectoparasites, mallophages *Menacanthus stramineus* of the Menoponidae family were recorded.

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THE ROLE OF FRESHWATER MOLLUSKS IN MAINTAINING TREMATODOSAL BIOTOPES IN THE REPUBLIC OF BELARUS

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Trematodes and monitoring the natural habitats of these parasitic organisms in Belarus are a topical area of scientific research. Diseases caused by trematodes (flukes) are classified as flatworms (Plathelminthes).

To detect the presence of parasites in the gastrointestinal tract of game birds, we used classical methods to detect eggs and larval forms of the parasites.

Keywords: trematodes and trematodoses, natural biotopes, wild animals and birds, parasitological studies, freshwater mollusks.

Trematodes, like other species of parasitic helminths, have, through a long process of evolution, perfectly shaped their organs and tissues, establishing their ability to become completely parasitic. Such transformations of all vital systems have enabled these parasitic organisms to survive and persist as a species.

Trematodes (or Digenea) are a subclass of flatworms that lead an obligate endoparasitic lifestyle. Trematodes comprise over 2,700 genera and approximately 18,000 species, each of which has developed unique, specific properties. Since trematodes are found on virtually every continent, these species have adapted to parasitize the organisms of animals native to certain regions. Naturally, animals and birds living in different climatic and natural environments have significant biological and physiological differences, and these characteristics have forced parasitic organisms to adapt to the conditions of their hosts.

The Republic of Belarus boasts a climate and natural environment characteristic of these latitudes, providing habitat for a diverse range of wild animals and birds. Nature has created a unique habitat for each of these species, harmoniously blending them with their natural environment.

In addition to wild animals, Belarus is home to a diverse range of domestic and farm animals. The emergence of these species was entirely dependent on humans and their economic needs; however, these animals also developed their own parasitic environment.

Thus, parasitic creatures have had to adapt to virtually all species, genera, and families of wild and domestic animals, and integrate their life cycles into those of their hosts. To preserve parasitic species diversity, trematodes have taken advantage of living biological objects in the external environment, using them as intermediate and additional hosts. This biological maneuver was necessary for their survival during unfavorable periods of their existence and, simultaneously, for the creation of a biological-parasitic insurance fund for the preservation of their species [1, 2].

Trematodes, in particular, have acquired rare parasitic properties, allowing them to survive for centuries and maintain a parasitic lifestyle. One of these properties is the inclusion of freshwater mollusks, which are ubiquitous in Belarus, in their life cycle. Many researchers have shown interest in studying the role of gastropods in Belarus. The large and small pond snails discussed in this paper are among the most common freshwater fauna species in Belarus, belonging to the Lymnaeidae family. These species are an important part of the freshwater ecosystem and malacofauna of Belarus. Being among the most typical and undemanding species of pulmonate mollusks in Belarus, *Lymnaea stagnalis* and *Galba truncatula* actively participate in the purification of water bodies, therefore, they play a role as biological filters. For humans, *Lymnaea stagnalis* and *Galba truncatula* are of interest primarily due to the fact that both of these species are intermediate hosts of a number of parasites, primarily various trematodes, which cause diseases not only in fish, birds and agricultural animals, but also in humans.

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DISEASES ASSOCIATED WITH GROWTH HORMONE DEFICIENCY

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Growth hormone (GH), or somatotropin, is a polypeptide hormone produced in the anterior pituitary gland, exerting anabolic and anticatabolic effects. The hormone is released into the bloodstream cyclically, approximately every 3-5 hours, with the highest concentrations occurring at night. When growth hormone is deficient in children and adolescents, IGF-1 secretion decreases, and growth slows or stops.

Keywords: growth hormone, dwarfism, insulin, pituitary dwarfism, insulin-like growth factor

Pituitary dwarfism (nanosomes) is a group of disorders associated with impaired growth and physiological development due to a deficiency or unresponsiveness to growth hormone. The incidence of this pathology, according to various sources, ranges from 1/3000 to 1/30000 [1].

Typically, patients with pituitary dwarfism begin to experience growth retardation between the ages of 2 and 4 years. Dwarfism is defined as a height below 120 cm for women and 130 cm for men.

Patients have a proportional build. The skin is pale, often with a yellowish tint, and cyanosis (a "marbling" of the skin) is sometimes observed. Developmental abnormalities of the reproductive system are quite common. Thyroid dysfunction can be caused by the ineffective conversion of thyroxine (T4) to triiodothyronine (T3). The electroencephalogram reveals dissociation in the form of instability of the α-rhythm in amplitude and frequency, accompanied by an excess of the δ and θ-rhythms. A similar dissociation is observed in carbohydrate metabolism: with a deficiency of endogenous insulin, an increased response to its exogenous analogue is observed [2].

The classification of hereditary isolated growth hormone deficiency (HIGD) includes four genetically and phenotypically distinct types. The first type, associated with loss of the growth hormone gene, is inherited in an autosomal recessive manner. The second type, caused by a disruption in the hypothalamic regulation of somatotropic function, is also inherited in an autosomal recessive manner. The third type, characterized by a defect in growth hormone synthesis at the pituitary level, is transmitted in an autosomal dominant manner. The fourth type, with an unknown etiology, is inherited in an X-linked manner. In type I HIG, growth hormone levels in the blood are virtually undetectable, while in the other types, they are significantly reduced. Insulin levels are reduced in all types except type III, where they are increased.

Panhypopituitarism, a condition of global pituitary hormone deficiency, is caused by various defects in the hypothalamic-pituitary system. Hereditary forms of the disease are divided into two types: autosomal recessive (type I) and X-linked (type II) [3].

In Laron dwarfism, caused by a genetic defect, liver cells lose the ability to adequately respond to growth hormone. This defect in hepatocyte receptors leads to a sharp decrease in the production of IGF-1 and IGF-2. Inherited in an autosomal recessive manner, it manifests itself as abnormally high levels of growth hormone in the circulating blood. This occurs because the lack of IGF cannot effectively suppress growth hormone secretion. Insulin deficiency is also observed [1–2]. Dwarfism can be observed in hereditary diseases - Hutchinson-Gilford syndrome, Russell-Silver syndrome, Seckel syndrome, Prader-Willi syndrome, Lawrence-Moon-Bardet-Biedl syndrome and some others.

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FLAVONOID-MEDIATED RESTORATION OF THYROID HORMONE HOMEOSTASIS IN AUTOIMMUNE THYROIDITIS

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Autoimmune thyroiditis (AIT) is a chronic immune-inflammatory disorder that causes a marked decline in triiodothyronine (T3) and free triiodothyronine (fT3), leading to metabolic and redox imbalance. This study evaluated the corrective effects of natural flavonoids – quercetin, dihydroquercetin, and luteolin – on thyroid hormone disruption in experimental AIT. Flavonoid administration significantly increased serum T3 and partially restored fT3 levels, reflecting improved deiodinase activity and redox-endocrine coupling. Among tested compounds, luteolin showed the strongest restorative action, indicating its potential as an effective antioxidant and immunomodulatory agent for correcting thyroidal hypofunction.

Keywords: autoimmune thyroiditis, thyroid hormones, T3, fT3 luteolin, quercetin, dihydroquercetin

Autoimmune thyroiditis (AIT) is a chronic autoimmune disorder characterized by lymphocytic infiltration of the thyroid gland and progressive destruction of thyrocytes, leading to suppression of thyroid hormone production and peripheral conversion processes. The most pronounced endocrine manifestation of AIT is a decline in circulating triiodothyronine (T3) and free triiodothyronine (fT3), the biologically active forms of thyroid hormones responsible for regulating basal metabolic rate, thermogenesis, and cellular energy utilization. The deficiency of these hormones results in reduced mitochondrial activity, impaired glucose oxidation, and overall metabolic depression. Moreover, decreased T3 and fT3 levels further intensify oxidative stress by limiting the transcriptional activation of antioxidant genes such as GPX1 and SOD, creating a self-reinforcing cycle of hormonal and redox imbalance.

In the present experiment, induction of autoimmune thyroiditis in rats caused a sharp reduction in serum T3 (–66.5%, $p < 0.001$) and fT3 (–39.5%, $p < 0.01$) compared to healthy controls. These changes reflect both the loss of functional thyroid tissue and the inhibition of peripheral deiodinase enzymes responsible for converting thyroxine (T4) to T3. Under such conditions, the regulation of thyroid hormone metabolism becomes highly dependent on the oxidative and inflammatory status of the organism. Restoration of T3 and fT3 synthesis therefore requires not only endocrine stimulation but also redox and immune modulation.

Administration of natural flavonoids – quercetin, dihydroquercetin, and luteolin – produced significant endocrine improvement. Quercetin increased serum T3 levels by approximately 35% and fT3 by 17% compared to untreated AIT animals, indicating partial reactivation of thyroidal and peripheral conversion mechanisms. Dihydroquercetin demonstrated a moderate improvement (+22% T3, +8% fT3), consistent with its known antioxidant capacity and membrane-stabilizing properties. The most pronounced restorative response was observed with luteolin, which raised T3 by nearly 40% and fT3 by 19%, reaching values close to the physiological range of control rats. Luteolin's superior activity may be attributed to its dual action on Nrf2 activation and suppression of NF-κB and IL-17/IL-23 inflammatory pathways, which together relieve the inhibitory pressure on deiodinase enzymes and support normal thyroid hormone metabolism.

The recovery of T3 and fT3 under flavonoid treatment reflects normalization of the thyroidal–peripheral conversion loop. As deiodinase type I and II activities depend on optimal redox potential, flavonoid-induced antioxidant rebalancing likely contributes directly to enhanced enzymatic function. Furthermore, improved microcirculation and cellular oxygenation following flavonoid therapy may increase thyrocyte responsiveness to TSH and facilitate hormonal secretion. The simultaneous rise of T3 and fT3 indicates that these compounds not only protect thyroid tissue from autoimmune cytotoxicity but also restore the physiological feedback between the hypothalamic–pituitary and thyroidal axes.

Luteolin, in particular, demonstrated nearly complete restoration of serum fT3, signifying its potential as a lead candidate for pharmacological correction of thyroid hormone deficiencies associated with autoimmune diseases. By

preserving deiodinase integrity, reducing oxidative burden, and stabilizing hormonal signaling, luteolin ensures balanced energy metabolism and adaptive thermogenesis[1]. These findings suggest that dietary or pharmacological supplementation with plant-derived flavonoids can represent an effective adjunctive strategy for managing thyroid dysfunction, particularly in conditions where inflammation and oxidative stress impair T3 and fT3 homeostasis.

Collectively, the results emphasize that triiodothyronine and free triiodothyronine are sensitive biomarkers of endocrine–redox interaction, and their restoration by flavonoids demonstrates a promising direction for integrative therapeutic approaches to autoimmune thyroiditis.

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ANALYSIS OF THE INCIDENCE OF CIRCULATORY DISEASES IN THE ADULT POPULATION OF THE GOMEL REGION

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Diseases of the circulatory system (DCS) are among the leading diseases, with a particularly rapid and sustained increase in prevalence among the population. In the Gomel region, both primary and overall incidence of circulatory diseases is observed in the adult population. High blood pressure and coronary heart disease top the list. An increase in the overall incidence of coronary heart disease, diseases characterized by high blood pressure, and cerebrovascular diseases has been observed in the Gomel region's adult population.

Keywords: diseases of the circulatory system, incidence, trends, structure

One of the most pressing issues in scientific medicine and practical healthcare is circulatory diseases. These diseases are the leading cause of death in most economically developed countries. In our country, circulatory diseases are the leading cause of disability and mortality. Disease analysis helps identify and prevent the main causes of morbidity and mortality, and develop preventive programs.

The aim of the work is to analyze the incidence of diseases of the circulatory system in the adult population of the Gomel region in 2015-2022.

In the Gomel region, there is an increase in both primary and overall incidence of circulatory diseases among the adult population. The overall incidence rates of circulatory diseases among the adult population of the Gomel region increased by 14%. The average annual overall incidence rate (A_0) was 29,352.2 per 100,000 adult population. The annual trend indicator A_1 = 756.5 per 100,000 adult population. During the studied period, an increase in the primary incidence of circulatory diseases among the adult population of the Gomel region was also noted (R^2 = 0.8769). The primary incidence rates of the adult population increased from 2,277.3 in 2017 to 3,074.7 in 2022 per 100,000 population. The average annual primary incidence rate (A_0) was 2,682 per 100,000 adult population. Annual trend rate A_1 = 147.9 per 100,000 adult population.

Based on data on the incidence of circulatory diseases in the Gomel region, the overall incidence of circulatory diseases in adults was calculated and the leading ranks were determined. The leading ranks are occupied by diseases characterized by high blood pressure (40-45%), ischemic heart disease (approximately 40%), and cerebrovascular diseases (8-10%).

For the nosologies that occupied the first ranking places, an analysis of the incidence dynamics for 2015-2022 was conducted. The analysis of the overall incidence of diseases characterized by high blood pressure in the adult population of the Gomel region showed a steady increase in incidence throughout the entire studied period (R^2 = 0.9175). The overall incidence rate in 2015 was 10,010.2 cases per 100,000 population, while in 2022 it was already 11,809.8 cases per 100,000 population. The dynamics of the overall incidence of ischemic heart disease in the adult population of the Gomel region in the period from 2015 to 2022 is also characterized by a steady increase (R^2 = 0.7854). The overall incidence rate of cerebrovascular diseases among the adult population of the Gomel region increased by 4% during the study period (3773.9 cases per 100,000 population in 2015 and 4009.6 cases per 100,000 population in 2022).

It can be assumed that the increasing incidence of circulatory diseases in the republic is due to objective and subjective factors: an aging population, increased psycho-emotional stress, urbanization, changes in diet, living and working conditions, the presence of multiple risk factors among a significant portion of the population, primarily the widespread use of smoking, alcohol consumption, a sedentary lifestyle, and excess weight, as well as a lack of motivation among residents to care for their own health and maintain a healthy lifestyle. However, state programs provide for preventive, organizational, methodological, educational, scientific, and therapeutic and diagnostic measures aimed at preventing circulatory diseases and fostering a desire among the population to maintain a healthy lifestyle and care for their own health.

PHARMACEUTICALS AS A POLLUTANT IN THE ACQUATIC ENVIRONMENT

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The pollution of the aquatic environment has become a worldwide problem. The widespread use of pharmaceuticals and the development of the pharmaceutical industry have led to many drugs such as beta-blockers, analgesics, antibiotics, lipid modulators and anti-inflammatory drugs being increasingly detected in groundwater, surface water and wastewater.

Keywords: aquatic environment, pharmaceuticals, content analysis.

In addition to being an integral part of a healthy society, pharmaceuticals are also recognized as environmental pollutants, and many can cause biological disorders. Aquatic pollutants include antibiotics, anti-inflammatory drugs, antidepressants, sex hormones, lipid regulators, and beta-blockers. Currently, there are no strict legal regulations governing the consumption and discharge of pharmaceuticals into water bodies. Furthermore, widely used wastewater treatment methods do not effectively remove pollutants from water [1, 2].

The aim of this study was to analyze the PubMed dataset for 1975–2025 to identify data on pharmaceuticals polluting an aquatic environment.

The PubMed database of the US National Library of Medicine (access point: http://www.ncbi.nlm.nih.gov/PubMed) was examined. Research data were searched using an advanced search system: queries were combined with the "AND" operator, combining the "Pharmaceuticals», «Aquatic Environment" names and the publication type "journal article".

According to the PubMed database, only 81 articles were published between 1975 and 2000 that described drugs as aquatic pollutants. In the first decade of the 21st century (2000-2010), the number of publications increased 10-fold and amounted to 765 articles. From 2010 to 2020, 3,338 articles have already been found in the PubMed database. Moreover, in just 5 years (2020-2025), the number of publications devoted to pharmaceuticals and the aquatic environment amounted to 3866. From 2010 to 2020, the number of publications on pharmaceutical aquatic pollutants increased by an average of 14.7±5.7% (the minimum increase was 4.8%, the maximum – 22.8%). No significant changes were detected in the number of such publications from 2021 to 2025. During this period, the mean of articles on pharmaceutical contaminants in the aquatic environment was 714±52.

The sources of drugs in aquatic environment can be categorized into three groups: human medication, livestock medication, and pharmaceutical factory discharges. The Belarusian pharmaceutical industry is represented by 47 industrial enterprises that annually produce approximately 400 million packages of medicines. Unused and expired medications also enter aquatic ecosystems through household waste or are flushed down the drain. Moreover, some medications are often incompletely metabolized and not absorbed by the human body, further contributing to their release into the environment. Some of the pollution arises from the use of veterinary drugs in livestock and fish farming. The most common substances in the aquatic environment are caffeine, oxytetracycline and erythromycin, fluoxetine, citalopram, sertraline, amitriptyline, venlafaxine, clozapine, carbamazepine, methamphetamine, and oxazepam [3].

The presence of pharmaceuticals in aquatic environments negatively impacts flora and fauna, accumulating in fish and other living creatures, including humans. It has been established that residual traces of antibiotics in wastewater can lead to the development of antibiotic resistance in bacteria. Potential risks associated with the release of pharmaceuticals intended for human use into the environment are becoming an increasingly serious environmental concern.

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TOTAL TRIGLYCERIDE LEVELS IN THE PANCREAS DURING AUTOIMMUNE THYROIDITIS UNDER THE INFLUENCE OF ZINC TRACE ELEMENT

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Annotation. One of the causes of autoimmune thyroiditis (AIT) is the deficiency of trace elements. AIT inevitably affects the gastrointestinal system. The main symptom of this disease is obesity, characterized by a certain increase in the amount of triglycerides. In experimental AIT conditions, when rats were treated with two different doses of the zinc, the total fat content in the pancreas showed significantly positive results. When high-dose zinc correction was carried out for three months, the fat level decreased by up to 60%, approaching the values observed in healthy rats. It was showed that the high dose of zinc had a more beneficial effect compared to the medium dose.

Keywords: Autoimmune thyroiditis (AIT), pancreas, triglycerides, zinc, obesity, fat, thyroid peroxidase (TPO)

Methods. To determine the triglyceride levels in the pancreas, the pancreatic tissue of each rat was diluted up to 20 times according to its mass. Following the dilution, the necessary procedures were performed, and the “Triglyceride” reagent manufactured by Human company was used. A mixture was prepared by combining 1000 µl of the reagent with 10 µl of the diluted homogenate, and the samples were incubated at 37°C for 10 minutes. After incubation, the triglyceride levels were measured using the biochemical analyzer Rayto RT 1904C Semiauto Chemistry.

Table 1

Total pancreatic triglyceride levels in autoimmune thyroiditis under the influence of the trace element zinc (M±m; n=5)

Name of the animal groups	Duration		
	1-month	2-month	3-month
Triglyceride µ/l			
Control group %	11,12 ± 0,6 100	14,098 ± 14 100	32,08 ± 9,1 100
Autoimmune group %	13,09±0,6 17,7	21 ±0,9 48,9	36,8 ±5,7 22

P_1	>0,05	<0,001	>0,2
Medium dose of zinc % P_2	12,78 ± 0,22 -8 >0.001	20,46 ± 1,9 -5 >0,2	34,44 ± 0,9 -6 >0.02
High dose of zinc % P_2	5,18 ± 0,34 -60 <0,001	14,7 ± 0,54 -27 >0,005	31.5 ± 3,8 -15 <0,001

Autoimmune group – (AIT), **Medium dose of zinc** – 0.4 mg/kg, **High dose of zinc** -1.2 mg/kg. **M** – mean value, **m** – standard error, **P** – confidence level (*-P<0.05; **-P<0.01; ***-P<0.001-confidence level relative to the control).

Discussion of results. In the follicular lumen of thyroid gland cells, the iodination process between iodine and thyroglobulin is carried out by the enzyme thyroid peroxidase (TPO). The synthesized hormones are then secreted into the bloodstream, where T3 binds to its specific intracellular receptor, activates gene transcription, and exerts its physiological effects. In these processes, zinc acts as a cofactor for deiodinase enzymes [1]. According to previous studies, when rats were fed a diet containing low levels of zinc for a certain period, a decrease in thyroid hormones within the thyroid gland cells and a reduction in the conversion of T4 to T3 were observed [2]. Adequate zinc intake has been reported to function as a protective factor against obesity by supporting metabolic regulation and preventing excessive fat accumulation.

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THE EFFECT OF ENVIRONMENTALLY UNFAVORABLE FACTORS ON THE ORIGIN OF DIABETES

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Annotation. One of the ecologically unfavorable conditions was monitoring the population in the vicinity of the "New Angren thermal power plant" of the Tashkent region for cases of endocrine diseases. According to the results in the 1st quarter of 2024-2025, the incidence of diabetes among population varied in each area when compared between 40 years and older, with higher indicators found to be advanced, higher indicator in Uvak, and lowest one in Ertosh. When lead was given in combination with a high-fat diet for 28 weeks at amount of 0.05 mg/kg, hyperglycemic indicators manifested them in the blood, and decreased activity of intestinal carbohydrazas were observed.

*Keywords***:** ecology, diabetes, unfavorable God, lead, population, Endo scrinin, heavy metals.

Methods. The first stage of our work was studied by demographic indicators among the population and statistics of cases of endocrine diseases around the new Angren thermal power plant. This work was carried out at the multidisciplinary central Polyclinic of the Okhangaron District Medical Association. In the second phase, more than 50 white rats were used for the study. Adult male rats were selected for the experiment. The animals were kept in cages in clean, bright, air-exchange rooms. Five rats were placed in each cage. The cages were made of plastic and were 50x30x28 CM in size. The temperature of the room is 22-24 °C, and the relative humidity of the air is 40-60%. The rats ' diet and water intake were not limited.

Discussion of results. Endo screening with addresses of residents aged 40 and older when the 3 months of 2025 indicators were examined, the incidence of diabetes among them was estimated at a total of 14 points. The total number of population under Oxangaron district was 113,015 in total, of which the 0-39-year-olds numbered 77,800 and the

population aged 40 and over numbered 34,140, and those with diabetes mellitus aged 40 and over numbered 1,075. Focusing on the results obtained, the incidence of diabetes among population varied in each area compared to those aged 40 and over, with higher indicators accounting for 5.4% in Progressives, 4.6% in New Hayot, 4.5% in Uvak, and 1.3% in fairytale. From these results, it can be seen that there have been varying degrees of population diabetes, even in ecologically polluted areas. From experiments, we can conclude that as a result of the spread of toxic substances into the environment in ecologically unfavorable areas, we can observe that the number of deaths per birth increased when demographic indicators were compared among the population, while natural growth decreased. In addition to it, diabetes, which is among the non-infectious diseases, is also increasing significantly from year to year.

To determine if the diabetes model in animals originated, the experiment was carried out at 7, 14, 21 and 28 weeks, testing them for blood glucose levels. According to him, blood glucose levels were found to increase by 39.1% at 7 weeks, by 60.7% at 14 weeks, and by almost 2.5 times at 21 weeks. It was noted that the amount of glucose in the blood increased by 3.5 times compared to the control group almost in the experimental group when it went to 28 weeks. It was noted that sucrose activity from intestinal carbohydrazas increased by 30.2% compared to the control figure of the experiment on days 5, by 37.2% on day 10, and by 40.1% on day 20, by 38.6% on day 30.

Poisoning of the environment with various toxic substances can increase the incidence of Type 2 diabetes mellitus (T2DM) between population. For a systematic review of this case, the Lattice has summarized evidence on ecological determinants of T2DM identified in the database [1]. In an effort to determine whether Pb and Cd are causing type 2 diabetes (T2DM) and obesity as a result of long-term exposure to the body through drinking water and soil, two cities in southern China have been investigating populations with Type 2 diabetes T2DM and obesity indices. According to the results obtained, the digestion of food after the fall of lead into the gastrointestinal tract disrupted the mechanisms of assimilation, causing the body to lose weight [2] .

In the results obtained, a long-term chronic effect of lead substance and a high-fat diet, as a result of which the amount of glucose in the blood increased several times, manifested diabetic indications. In addition to this, changes in the basal and apical parts of the pancreas have been recorded, with changes in the asinus cells, Langergans islets and ducts within the cell. In doing so, lead ions may have increased all the indicators in it by affecting the respiration and oxidative phosphorylation of pancreatic mitochondria.

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BIOMONITORING OF SOIL IN THE CITY OF GOMEL WITH THE HELP OF CLOVER

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In the work, the morphogenetic polymorphism of the creeping clover (*Trifolium repens* L.) on the urban-nested territories of Gomel was studied. It was found that the expression of the «grey» stain on the leaves increases with the increase of anthropogenic load. According to the bio-indications obtained, the most polluted area is the soil near the Gomel-Rečica motorway; the cleanest zone was found in the vicinity of «Birch grove».

Keywords: bioindication, morphogenetic polymorphism, soil, creeping clover, anteropogenic load.

Morphogenetic polymorphism is one of the key manifestations of intraspecific alteration in plants and represents the existence within a single population of individuals differing by stable morphological features having a genetic or epigenetic basis. The study of such polymorphism is important for understanding the mechanisms of adaptation of species to environmental conditions, as well as assessing the ecological sustainability of populations.

One of the subjects for such studies is the creeping clover (*Trifolium repens* L.). This species is characterized by high ecological plasticity, the ability to grow in a wide variety of habitats - from meadows and ravines to urban lawns and roadsides. The creeping clover *(Trifolium repens* L.) shows marked morphological variability due to the presence or absence of a «grey» stain on the leaves.

The work was based on the collection of leaves of clover (*Trifolium repens* L.) in various types of urbanized areas of the city of Gomel (n=9: point-1 - surroundings of Gomel Chemical Plant, point-2 - territory near the motorway Gomel-Rečica, point-3 - surroundings of the Gomselmash Plant, point-4 - mkr-n Volatova, point-5 - mkr-n Melnikov Lug ul. Golovatskogo, point-6 - surroundings of the Gomel Log Lug. Maznovel, point-7 - «Yezberovo Forest», point-8 - Rumyantsev and Paskevichi Park, point-9 - Territo near Lake Volotowskie). Assessment of the anthropogenic impact and environmental quality of cauliflower based on the expression of a «gray» stain on the leaves of the creeping clover (*Trifolium repens* L.).

As a result of the analysis of polymorphism «gray» spots of leaves of clover (*Trifolium repens* L.) under the influence of anthropogenic load identified certain patterns. We found the following results: in point-1 the number of phenotypes was 7, in point-2 - 8 fan-types, in point-3 - 7 respectively, in point-4 - 4 phenotypes, in point-5 the number of different phenotypes was 4, in point-6 - 5, in point-7 - 4 phenotypes, in point-8 and 9 the number of phenotypes is also 4.

Based on data obtained during the analysis of biomonitoring areas of the city of Gomel, it was found that the least pollution has point-7. Three different phenotypes were found in the leaves of the creeper clover (*Trifolium repens* L.) collected in the forest «Birch grove». Genotypical analysis showed that recessive homozygote vv was present in 70% of the investigated plants. The remaining phenotypes are represented by genotypes: VV (3%), Vv (7%), VHv (2%), VHV (8%), VHVB (10%), which indicates stability of the environment within the norm.

In the analysis of biomonitoring with the help of clover (*Trifolium repen*s L.) we found that point-2 (territory near the highway Homel-Rezica), characterized by the manifestation of eight phenotypes, had the greatest pollution. The most rare genotypes: VHv (2%), VHVH (3%), VPVP (3%). In ecologically polluted areas, the natural selection and mutation process leads to the expansion of phenolic groups, increased frequency of occurrence and the appearance of specific phenotypes in populations. The genetic analysis showed that the genotype vv («without drawing») accounts for only 32%. The most common genotypes are: VHVH (12%), VHVB (10%). These indicators show a significant anthropogenic load on the area from exhaust emissions as well as soil compaction.

Thus, according to the results obtained, the degree of expression of «grey» creeper clover (Trifolium repens L.) directly depends on the level of anthropogenic impact: so the most polluted territory was point-2 (highway Gomel-Rečica) - this can be attributed to high anthropogenic exposure and high emission of exhaust gases that accumulate in the soil. The cleanest area, according to our data, was point-7 (forest «Birch grove»), which indicates no accumulation of pollutants in the soil and low level of anthropogenic pressure on the environment.

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ACHONDROPLASIA IN CHILDREN

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Achondroplasia is a genetic disease characterized by damage to the skeleton and respiratory system, significant shortening of the limbs with the usual length of the body. The height of an adult with achondroplasia reaches

approximately 124-130 centimeters. The disease, as a rule, does not affect intelligence and does not directly affect life expectancy, however, adult patients have an increased risk of developing cardiovascular complications.

Keywords: achondroplasia, mutation, gene, limb deformity, kyphosis.

Achondroplasia is the most common genetic form of dwarfism, in 30-40% of cases accompanied by hydrocephalus, characterized by shortening of the proximal limbs, macrocephaly, hypoplasia of the middle of the face, and a change in the configuration of the fingers of the hands like a trident. Stigmas of embryogenesis are noted: the cerebral part of the skull prevails over the facial. Thoracolumbar kyphosis has been observed since birth. After the child begins to walk, lumbar lordosis begins to come to the fore. Moderate muscle hypotension is characteristic, a tendency to delay motor development. Intelligence, in the absence of hydrocephalus or other lesions of the central nervous system, is normal [1].

The pathogenesis of achondroplasia is associated with a mutation in the FGFR3 gene. In more than 97% of cases, the disease is caused by point substitutions of nucleotides - c.1138G> A and c.1138G> C in the tenth exon of this gene. A mutation in the gene leads to a violation of the formation of chondrocytes, which in turn leads to a violation of the normal growth of bones, their deformation and the formation of short limbs. At the same time, the organs of the internal system remain of normal size, which leads to uneven proportions of the body.

Achondroplasia is a rare disease that occurs in newborn infants with a frequency of 1:10,000. Pathological disorders are formed in the antenatal period. The child has a violation of normal proportions immediately after birth: shortening and deformation of bones, improper pelvic placement, protrusion of the abdomen, the presence of excess fat deposits on the limbs. During the first year of life, such children have some lag in physical development with normal intellectual and mental development.

The main signs of achondroplasia in newborns.

1. Classical achondroplasia (type 1) – is the most common type of disease; it is characterized by a short body, shortening of the limbs, as well as narrowing between the ribs; it usually appears in newborns, or manifests itself within the first year of life; the main cause is a mutation of the FGFR3 gene.

2. Pseudo-achondroplasia is a rare hereditary disease that results in stunted growth, short limbs and ligament and joint problems; it usually appears in early childhood and can be caused by a mutation of several different genes [2].

The clinical picture includes short limbs, reduced skull size, pronounced interdigital distance on the hands and feet, and delayed physical and psychomotor development. X-ray examination reveals characteristic abnormalities, including shortening of long tubular bones, narrowing of the zones of metaphyseal and epiphyseal growth, as well as an increase in the size of the skull. Pregnant women are sampled for amniotic fluid during gestation, followed by cytogenetic examination to determine the presence of a mutation in the fetus in the FGFR3 gene [3].

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RISK CRITERIA FOR THE DEVELOPMENT OF BONE METASTASES IN HORMONE-DEPENDENT BREAST CANCER

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Despite advances in early diagnosis and comprehensive therapy of breast cancer, bone lesions remain a frequent and serious complication of hormone-dependent forms of the disease. This review discusses the key risk factors for bone

metastases in patients with hormone-dependent breast cancer, including hormone receptor status, bone mineral density, and hormonal profile.

Keywords: breast cancer, hormones, bone metastases, steroid hormone receptors, bone mineral density, molecular subtypes.

Breast cancer is one of the most common malignant neoplasms among women both in the post-Soviet countries and worldwide. In Belarus, the age-standardized incidence rate of breast cancer in recent years has been approximately 56.6 cases per 100,000 women. Despite improvements in diagnostic accuracy and therapeutic effectiveness, a significant proportion of patients develop distant metastases after combined treatment, with bone involvement being one of the most frequent forms.

In the presence of bone metastases, mineral metabolism and calcium homeostasis are disrupted: tumor tissue may induce osteolytic lesions with loss of bone density or provoke generalized osteolysis. The study of the metastasis phenomenon remains a pressing issue in both experimental and clinical oncology, since distant metastases are most often the direct cause of mortality in patients with breast cancer.

A key area of research involves combining the assessment of bone mineral density and metabolism – using densitometry and bone scintigraphy – with the evaluation of patients' hormonal status and the receptor profile of the tumor (estrogen receptors – ER, progesterone receptors – PR). At the same time, the characterization of the molecular–genetic subtypes of the tumor is of great importance. According to modern classifications, four main subtypes are distinguished: Luminal A, Luminal B, HER2-positive, and Triple-negative. Hormone-dependent subtypes (Luminal A and B) are characterized by positive ER/PR receptor expression and generally have a more favorable prognosis than HER2-positive or triple-negative subtypes [1,2].

Based on the analysis of literature data, it is assumed that in patients with hormone-dependent tumors (ER/PR +), a dual effect may exist: on one hand, a positive hormone receptor status is associated with better survival; on the other hand, hormone-mediated influences may alter bone tissue condition (for example, increased bone mineral density as a reflection of hyperestrogenemia), thereby indirectly affecting the likelihood of bone metastases. In patients with receptor-negative tumors, bone mineral density (BMD) is significantly lower than in those with receptor-positive tumors, indicating an increased risk of bone metastases in breast cancer patients with low hormonal status indicators [3]. Moreover, reduced BMD is one of the most frequent signs of an unfavorable disease course, acting as a predisposing factor for the development of bone metastases.

Thus, the combined analysis of bone mineral density, tumor receptor status, and patients' hormonal profile may serve as a promising approach for early risk stratification of bone metastasis development in women with hormone-dependent breast cancer. Conducting such studies may improve prognostic accuracy and provide a foundation for the individualization of adjuvant therapy.

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MOLECULAR AND GENETIC ASSESSMENT OF BRCA1, BRCA2, AND CYP2C8.3 GENE POLYMORPHISMS IN PATIENTS WITH ADVANCED OVARIAN CANCER

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In this study, a molecular and genetic assessment of BRCA1, BRCA2, and CYP2C8.3 gene polymorphisms was performed in 22 patients with advanced ovarian cancer. Preliminary results showed that mutations in the BRCA1 and BRCA2 genes were detected in isolated cases, while polymorphic variants of the CYP2C8.3 gene were identified in three patients.

Keywords: BRCA1, BRCA2, CYP2C8.3, ovarian cancer, polymerase chain reaction, mutation.

Among gynecological malignancies, ovarian cancer occupies a leading position and remains one of the main causes of cancer-related mortality among women worldwide. Over the past decade, the incidence of ovarian cancer in the Republic of Belarus has remained relatively high. An open issue in the diagnosis of advanced ovarian cancer is the analysis of molecular and biological markers to determine chemotherapy sensitivity, which has both diagnostic and prognostic significance for improving treatment effectiveness and patient outcomes.

The CYP2C8.3 gene is a genetic variant of CYP2C8, which encodes the cytochrome P450 2C8 enzyme. This gene plays an important role in the metabolism of xenobiotics. In tumor tissue, both induced and constitutive expression of CYP genes is reduced compared to normal tissue, which largely contributes to the increased resistance of tumors to cytostatic agents [1]

BRCA1 and BRCA2 are tumor suppressor genes responsible for DNA repair and the prevention of uncontrolled cell growth. BRCA1 is a pleiotropic DDR protein involved in both checkpoint activation and DNA repair, whereas BRCA2 acts as a mediator of the main homologous recombination mechanism. The greatest risk factor for breast and ovarian cancer is the inheritance of a mutation in either the BRCA1 or BRCA2 gene [2].

The study material consisted of peripheral blood and tumor tissue samples from 22 patients with advanced stage III–IV ovarian cancer, aged 45 to 74 years, who were treated at the Republican Scientific and Practical Center of Oncology and Medical Radiology named after N.N. Alexandrov.

The primary focus of the diagnostic analysis was the identification of mutations in the BRCA1, BRCA2, and CYP2C8.3 genes. During the study, the molecular-biological profile of ovarian carcinomas in patients with advanced disease was investigated. Genomic DNA was isolated from peripheral blood, and mutations in the BRCA1 and BRCA2 genes were analyzed using allele-specific PCR in all 22 patients. DNA extraction from peripheral blood and identification of the CYP2C8.3 gene allelic variant were performed using real-time PCR in 12 patients.

During the study, six heterozygous mutations were identified. Among the patients in this cohort, one mutation was associated with the BRCA2 gene, and five mutations were associated with the BRCA1 gene, including three 5382insC and two 185delAG mutations. In the subset of patients with detected BRCA1 and BRCA2 mutations, the tumors belonged to the high-grade serous carcinoma morphotype (grade III).

Analysis of the CYP2C8.3 gene polymorphism using PCR identified the alleles 25625782 (Tym/Cyt) and 25625794_10 (Cyt). Three patients with advanced ovarian cancer were found to carry the 25625782 (Tym/Cyt) allele in a heterozygous state.

The study is ongoing.

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ANALYSIS OF THE INCIDENCE OF THE GENITOURINARY SYSTEM OF THE POPULATION IN THE REPUBLIC OF BELARUS

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The work analyzed the dynamics of the total incidence of the genitourinary system in the Republic of Belarus for the period from 2019 to 2023. It has been shown that the overall incidence of the genitourinary system as a whole has a

positive growth rate. The first place in the incidence of the genitourinary system is occupied by the Brest region. The minimum number of cases in the Mogilev region.

Keywords: diseases of the genitourinary system, etiology, pathogenesis, clinical picture, risk factors, dynamics of the incidence of the genitourinary system, growth rate.

In the Republic of Belarus, the total number of registered cases of glomerular and tubulointerstitial kidney diseases in 2021 amounted to 78 thousand 787, 63 thousand 507 patients are registered with dispensaries over the age of 18. In Belarus, in 2020, the number of such patients reached almost 80 thousand. Renal cancer accounts for 4% of all identified malignancies.

Kidney tumors occur predominantly in people aged 50-70 years, although this disease can occur in adolescents and even children. In men, kidney tumors are slightly more common than in women, and in the urban population they are more common compared to the rural population. The incidence of malignant kidney neoplasms in Belarus is constantly increasing and in 2010 amounted to 19 per 100,000 inhabitants.

The incidence of urolithiasis in our country is quite high: 457.3 patients per 100,000 population in 2005 and 300 patients in 2020. Therefore, RB can be attributed to the unfavorable zone for the incidence of ICD. It should be noted that the increase in incidence has been occurring continuously over the past years.

In men, kidney tumors are slightly more common than in women, and in the urban population they are more common compared to the rural population. The incidence of malignant kidney neoplasms in the Republic of Belarus is constantly increasing and in 2010 amounted to 19 per 100,000 inhabitants [1].

The highest level of the total incidence of the genitourinary system in 2019-2023 in the Republic of Belarus was detected in the Brest region. Average annual incidence rate: A0 = 3,613.74. Trend indicator: A1 = 171.2. Estimated incidence rate for the first year: U2019 = 3670.6. Estimated incidence rate for the last year: U2023 = 4329.8. The average growth rate was 12.25%.

The lowest level of the total incidence of the genitourinary system was detected in the Mogilev region. Average annual incidence rate: A0 = 1707.92. Trend indicator: A1 = -31.23. Estimated incidence rate for the first year: U2019 = 1808.2. Estimated incidence rate for the last year: U2023 = 1696.6. The average growth rate was -15.23%.

In the city of Minsk, the average annual incidence rate: A0 = 6472.12. Trend indicator: A1 = 133.89. Estimated incidence rate for the first year: U2019 = 6757. Estimated incidence rate for the last year: U2023 = 7269.7. The average growth rate was 7.49%.

The number of patients with syphilis who are under medical supervision in healthcare organizations amounted to a total incidence rate in 2019 of 22.53, in 2020 26, in 2021 31.41, in 2022 38, in 2023 43.11 cases. The average growth rate was 86.68%.

The highest leve’ of overall incidence of drug addiction and substance abuse was detected in the Vitebsk region. Average annual incidence rate: A0 = 4.44. Trend indicator: A1 = 0.92. Estimated incidence rate for the first year: U2019 = 2.7. Estimated incidence rate for the last year: U2023 = 6.3 [2]. The average growth rate is 119.35%.

In the course of the work, it was shown that during the studied period of time from 2019 to 2023 in the Republic of Belarus there is an increase in the incidence of the population of the genitourinary system, drug addiction and substance abuse, and a positive growth rate is observed. It was also found that the first place in the incidence of the genitourinary system is occupied by the Brest region, the last place is occupied by the Mogilev region. The first place in the incidence of drug addiction and substance abuse is occupied by the Vitebsk region, the last place is occupied by the Grodno region.

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MODERN METHODS OF EPILEPSY DIAGNOSIS

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The study highlights epilepsy's significance as a prevalent neurological disorder with complex etiology, polymorphic symptoms, severe course, and limited therapeutic success. According to WHO, epidemiological challenges and information deficits impair healthcare globally, affecting ~50 million people with peak incidence in youth and 4–10/1,000 prevalence. Historically known as the "sacred disease" since antiquity, epilepsy involves recurrent unprovoked seizures causing fatigue, injuries, and complications like status epilepticus and strokes; diagnosis relies on clinical signs, EEG, and imaging (MRI/CT/PET), with onset often in childhood preceded by prodromal symptoms.

*Keywords***:** epilepsy, modern diagnostic methods

Epilepsy is one of the most common and serious diseases of the nervous system. The risk of developing epilepsy significantly depends on age. Epilepsy has been known since ancient times. In ancient Greece and Rome, epilepsy was associated with witchcraft and magic and was called the "sacred disease." It was believed that the gods sent this disease to those who led an unrighteous lifestyle. As early as 400 BC, Hippocrates wrote the first treatise on epilepsy. This greatest physician of antiquity believed that seizures were caused by changes in the viscosity of the brain due to the sun, wind, or cold. In the Middle Ages, epilepsy was considered an incurable disease transmitted through breathing during seizures. At the same time, many great people, saints, and prophets suffered from epilepsy and were revered [1]. An epileptic seizure often causes drowsiness, a feeling of exhaustion, and fatigue. An unsuccessful fall can result in injuries that worsen the patient's condition. It is typical that the patient themselves cannot describe their condition and sensations during an epileptic seizure. Complications of epilepsy include: epileptic status, increased intracranial pressure, cerebral and pulmonary edema, ischemic and hemorrhagic stroke, cardiac shock, intracranial venous thrombosis, aspiration pneumonia, pulmonary embolism, renal failure, and trauma. Diagnosis of epilepsy is based on a set of basic clinical signs: recurring paroxysmal disorders; characteristic personality changes; signs of epileptic activity on the EEG. In epileptology, anamnesis and clinical examination form the basis for diagnosis, and additional research methods only confirm and clarify it [3]. A carefully collected anamnesis and thorough clinical examination allow reducing the time of diagnosis, avoiding excessive costs for unnecessary examinations, while the saved resources enable increasing the efficiency of diagnosis and treatment [3]. Neurological examination in the diagnosis of epilepsy is of limited value, as there are usually no acute focal neurological symptoms during the examination. MRI can be used to identify any serious disease that could provoke an attack, for example, a brain tumor or arteriovenous malformation (anomalies of the blood vessels) [4]. CT in the diagnosis of epilepsy is used only to exclude a condition requiring emergency intervention: increased intracranial pressure, the presence of acute hemorrhage, or calcification of brain tissue. Electroencephalogram (EEG) in epilepsy reveals paroxysmal and epileptiform activity. Positron emission tomography (PET) is an additional diagnostic method that allows assessing metabolic disorders and localizing the epileptogenic zone [2]. Epilepsy is a condition characterized by repeated (more than two) epileptic seizures not provoked by any immediately identifiable causes. An epileptic seizure is a clinical manifestation of abnormal and excessive discharge of neurons in the brain, causing sudden transient pathological phenomena (sensory, motor, mental, vegetative symptoms, changes in consciousness). In the clinical picture of epilepsy, three periods are distinguished: ictal (seizure period), postictal (post-seizure), and interictal (between seizures). The first symptoms of epilepsy are noted at the age of 5-15 years. The possible onset of an attack is indicated by characteristic signs – deterioration of sleep and appetite, increased irritability, and headache.

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LEAD AS A CAUSE OF CHRONIC KIDNEY DISEASE

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The article discusses the role of lead in the development of toxic nephropathy, including historical aspects, mechanisms of kidney damage, clinical picture, and modern approaches to the diagnosis of this condition.

Keywords: lead nephropathy, chronic kidney disease, toxic kidney damage, lead.

Lead, one of the most dangerous anthropogenic pollutants, remains a pressing issue in medicine despite the decline in its industrial use. Its ability to accumulate in the body and exert a polyvalent toxic effect makes it a significant risk factor for the development of chronic diseases, in particular, kidney damage – lead nephropathy.

Historically, the link between lead and kidney damage was established as early as the 19th century. In 1863, Lansere described cortical atrophy and tubular fibrosis in an artist who had a habit of holding his brushes in his mouth. In the 20th century, there were mass cases of epidemic nephritis in children in Australia associated with the use of lead-containing paints, as well as outbreaks of nephropathy among consumers of moonshine distilled through lead radiators. In modern world, lead can enter the human body through water, air, or food grown on lead-contaminated soil. Environmental lead contamination occurs in particular as a result of human industrial activity, such as battery production [1].

The pathogenesis of lead nephropathy is complex and multifaceted. Experimental studies in animals demonstrate that chronic lead intoxication leads to significant renal dysfunction. There is a decrease in glomerular filtration rate against a background of polyuria caused by a decrease in tubular water reabsorption. There is a characteristic increase in the excretion of sodium, potassium, calcium, and protein in the urine, as well as a decrease in urine osmolality, indicating damage to the concentration ability of the kidneys. Histologically, dystrophy and necrosis of the tubular epithelium, edema, and dystrophic changes in the glomeruli are detected [2].

The clinical picture of lead nephropathy often develops gradually and may remain undiagnosed for a long time. It manifests as chronic tubulointerstitial kidney damage, which gradually progresses to chronic kidney disease (CKD). It is important to note that nephropathy can develop even with prolonged exposure to low doses of lead, which are now considered an independent factor in the progression of CKD [1].

The diagnosis is based on medical history (occupational or environmental risks), confirmed by elevated blood lead levels and characteristic changes in urine tests (proteinuria, impaired concentration function) [2]. The difficulty lies in the fact that the symptoms are often nonspecific, and the disease can be masked by other nosologies, such as hypertensive nephropathy or diabetic kidney disease [1].

Thus, lead nephropathy remains a clinically significant problem. Despite a decrease in the incidence of acute occupational poisoning, chronic low-dose exposure to lead, especially in unfavorable environmental conditions, continues to contribute to the structure of chronic kidney disease. Increased vigilance on the part of therapists and nephrologists with regard to this etiological factor is necessary for the timely diagnosis and prevention of CKD progression.

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SYNTHESIS OF SECO-NUCLEOSIDES

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Using the reaction of periodate oxidation of cytidine **1**, uridine **2** and inosine **3**, dialdehydes **4-6** were obtained, the reduction of which with sodium borohydride gave triols **7-9**. The addition of a saturated sodium bisulfite solution to an aqueous solution of dialdehydes **4-6** led to the formation of water-insoluble bisulfite derivatives **10-12**. It has been shown that to obtain pure derivatives of seco-nucleosides **4–12**, a stage of removing the iodate ions formed during the reaction is necessary by precipitating them in the form of barium salts using a solution of barium chloride.

Keywords: antimetabolites, nucleosides, periodate oxidation.

Modification of the structure of natural metabolites based on nucleic acid components leads to the emergence of diverse biological activities in the resulting antimetabolites. Such modified nucleosides and nucleotides are used in medical practice as antitumor and antiviral drugs [1]. One of the methods for changing the structure of the carbohydrate fragment of nucleosides is the periodate oxidation of their ribose fragments [2]. The aim of this work is the synthesis of a series of seco-nucleosides from cytidine **1**, uridine **2** and inosine **3**. The synthesis of seco-nucleosides **4–12** starting from cytidine **1**, uridine **2** and inosine **3** was carried out according to the scheme shown in the figure.

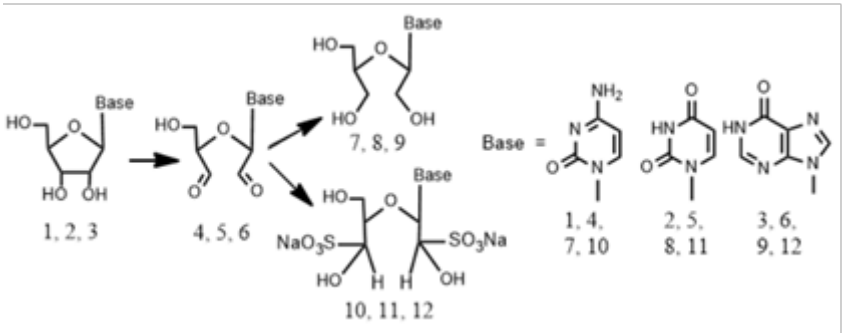

*Fig. - Scheme of synthesis of seco-nucleosides **4-12***

The progress of reactions and the content of the initial compounds **1–3** and reaction products **4–12** in the reaction medium were monitored using thin-layer chromatography (TLC) on Kieselgel 60 F254 plates from Merck (Germany) in a solvent system of chloroform/methanol (4:1 v/v). Compounds on the plates were visualized by viewing them under ultraviolet light and by wetting the plate with a 0.2% solution of nafluoresorcinol in alcohol with the addition of a 20% sulfuric acid solution in a 1:1 ratio, followed by heating the plate at 80–90°C. Spots representing the reaction products and the starting compounds were colored differently.

Dialdehydes **4–6** were obtained by reacting nucleosides **1–3** with excess sodium periodate ($NaIO_4$) in water. After the reaction was complete, the excess sodium periodate was neutralized by adding a small amount of ethylene glycol to the reaction mixture. The resulting sodium iodate ($NaIO_3$) was precipitated by treating it with a saturated solution of the calculated amount of barium chloride ($BaCl_2$) in water. The barium iodate precipitate was filtered off, and the filtrate was evaporated to dryness on a rotary evaporator. Ethyl alcohol was added to the residue, the contents were heated on a water bath, and the insoluble sodium chloride (NaCl) precipitate was filtered off. The filtrate was evaporated to dryness, yielding dialdehydes **4–6** as amorphous powders, pure according to TLC data. Triols **7–9** were obtained by adding sodium borohydride to a solution of dialdehydes **4–6** after removal of iodate ions as the barium salt. Treatment of aqueous solutions of dialdehydes with a saturated sodium bisulfite solution led to the formation of water-insoluble bisulfite derivatives **10–12**. The identity of the synthesized seco-nucleosides **4–12** was confirmed by TLC.

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ANTIBACTERIAL ACTIVITY OF HEXANE EXTRACT OF *SAUSSUREA COSTUS*

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The paper presents data on the antibacterial activity of hexane extract from the roots of *Saussurea Costus* (native to India, Pakistan and Nepal) against gram-positive (*Staphylococcus aureus)* and gram-negative (*Escherichia coli)* bacteria. The antibacterial activity of the extract was evaluated by the disc-diffusion method of analysis. The results of the study showed that both gram-positive and gram-negative bacteria are sensitive to the effects of hexane extract.

Keywords: Saussurea costus, antibacterial activity, ethanol extract, disk diffusion test

In the course of this work, cyclohexane was used as a solvent to obtain a hexane extract from the Saussurea Costus root powder. The work was based on the disc diffusion method of studying the sensitivity and resistance of microorganisms. Discs with antibiotics: meropenem, cefepime, and benzylpenicillin, as well as an empty disc without the applied substance, served as controls. Cultures were applied to the surface of Petri dishes. The empty discs were soaked with the prepared extract. The antibacterial activity was assessed by the diameters of the bacterial growth inhibition zones around the disc.

The diameters of the inhibition zones demonstrating the antibacterial activity of the hexane extract of the *Saussurea Costus* root against *St.Aureus* and *E.Coli* are shown in Tables 1 and 2, respectively:

Table 1

Antibacterial activity of ethanol extract against *Staphylococcus aureus*

Bacteria	Control		Meropenem		Cefepime		hexane extract	
	Diameter, mm	R, S	Diameter, mm	R, S	Diameter, mm	R, S	Diameter, mm	R, S
St. Aureus	0	R	24	S	25	S	21	S
	0	R	23	S	32	S	24	S
	0	R	24	S	35	S	20	S

Note: R – resistant, S – sensitive, R/S – intermediate

Table 2

Antibacterial activity of ethanol extract against *Escherichia coli*

Bacteria	Control		Benzylpenicillin		Cefepime		hexane extract	
	Diameter, mm	R, S	Diameter, mm	R, S	Diameter, mm	R, S	Diameter, mm	R, S
E.Coli	0	R	32	S	35	S	10	R
	0	R	33	S	34	S	16	R/S
	0	R	35	S	33	S	19	S

Note: R – resistant, S – sensitive, R/S – intermediate

Next, the average diameters of the growth inhibition zones were calculated, which were 21.667±2.08 mm and 15±4.58 mm for St.Aureus and E.Coli, respectively. These values indicate that the hexane extract of *Saussurea Costus* exhibits high antibacterial activity against gram-positive and moderate action against gram-negative bacteria.

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MALIGNANT NEOPLASMS OF THE MAMMARY GLAND. EARLY DIAGNOSTICS AND PREVENTION

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The article examines the dynamics of the overall incidence of malignant neoplasms of the mammary gland. The importance of early diagnostics, in particular mammography, in detecting malignant neoplasms of the mammary gland is shown. This article may be useful for specialists in the field of oncology, medical statistics.

Keywords: malignant neoplasm, breast cancer, mammography.

The problem under consideration is one of the most acute in modern clinical oncology. According to experts, every 10th woman will develop breast cancer during the 21st century [1]. The purpose of this study was to analyze the methods of early diagnosis and prevention of oncopathology in women. The data were obtained from official statistical sources of the Ministry of Health of the Republic of Belarus [2].

In 2023, a mammology office was organized as part of a polyclinic for the adult population. To assess the quality of screening activities, a group of 248 women was observed. During the observation, the women were registered with the Ozertsovo District Polyclinic of the Minsk Region.

The general strategy of screening activities involves targeted examination of women aged 40 years and older at a certain interval.

The work was carried out directly with medical documents and in direct contact with patients with breast cancer. The examination period covers 2023 - January - March 2025. The examination took into account the characteristics of the women's medical history, age, and characteristics of breast cancer detection.

In 2023, 2024 and January - March 2025, 248 women (100%) underwent mammography in the clinic, including 125 people (50.4%) underwent mammography in 2023, 93 people (37.5%) - in 2024, 30 people (12.1%) - in January - March 2025.

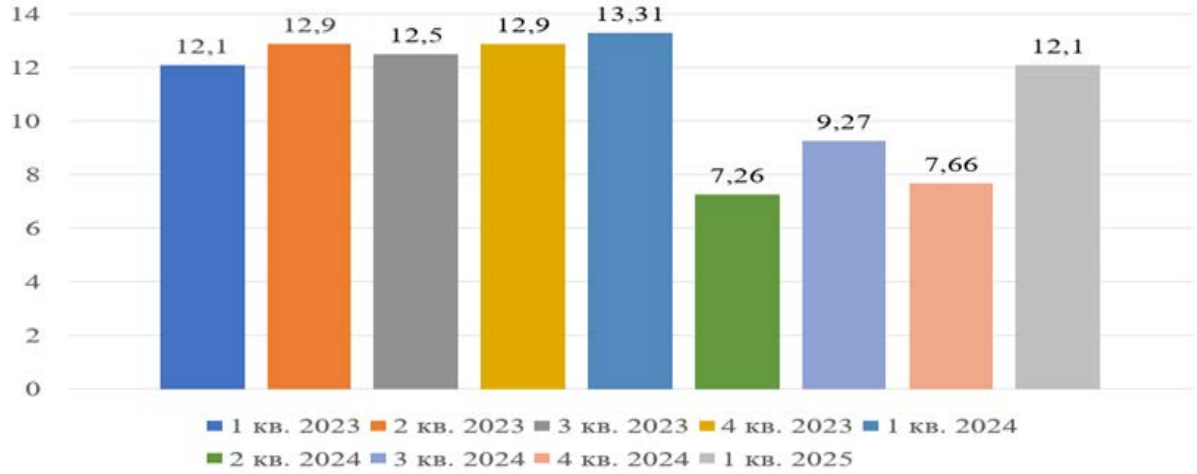

Fig. 1 Dynamics of mammography screening among women

The mammography results showed results without pathological formations, as well as results with pathological neoplasms: lipogranulomas of the mammary glands, benign formations, asymmetric involution of mammary tissues, malignant neoplasms.

The X-ray method (mammography) revealed the largest number of malignant neoplasms of the mammary gland in April - June 2023 (5 people out of 22 people, 22.7%). Although the growth and decline of detected malignant neoplasms

was observed during the study period: January 2023 - March 2024. The probable reason for the jump may be the age of women referred for mammography. Accordingly, based on all the data, early diagnosis with mammography made it possible to determine the disease in the early stages: stage 0 - stage I was in 13 people (59.1%), stage II - in 7 people (31.8%), stage III - in 2 people. (9.1%).

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COMPARATIVE ANALYSIS OF THE EFFECT OF ANTIBIOTICS AND PLANT EXTRACTS ON PATHOGENIC AND SYMBIOTIC GUT MICROBIOTA

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The study presents a comparative analysis of the antimicrobial activity and selectivity of seven antibiotics from different groups (levomycetin, levofloxacin, gentamicin, ceftriaxone, ampicillin, tetracycline, doxycycline) and four alcoholic extracts of medicinal plants (sage (Salvia officinalis), St. John's wort (Hypericum perforatum), dog rose (Rosa canina), English oak bark (Quercus robur)) against pathogenic (Escherichia coli V-238) and representative strains of gut normobiota (Lactobacillus spp., Bifidobacterium spp.).

The extracts were obtained by ultrasonic extraction followed by lyophilization. Activity assessment was performed using standard agar diffusion methods. It was found that while antibiotics levofloxacin and gentamicin demonstrated high efficacy against E. coli (inhibition zones of 41±0.1 mm and 38±0.2 mm respectively), they exhibited strong inhibitory effects on the growth of lacto- and bifidobacteria (inhibition zones of 40-45 mm).

Among plant extracts, sage extract showed the highest antibacterial activity against E. coli (inhibition zone 20±0.1 mm) and the best selectivity profile. Sage extract was shown to have significantly less damaging effect on symbiotic microbiota compared to broad-spectrum antibiotics. The research results indicate the promising potential of using medicinal plant extracts as an alternative or supplement to antibiotic therapy to reduce ecological damage to gut microbiota.

Keywords: antimicrobial resistance, gut microbiota, dysbiosis, plant extracts, antibiotics, selectivity, Salvia officinalis, Escherichia coli, Lactobacillus, Bifidobacterium.

Materials and Methods. The study used standard antibiotic discs: chloramphenicol (30 µg), levofloxacin (5 µg), gentamicin (120 µg), ceftriaxone (30 µg), ampicillin (10 µg), tetracycline (30 µg), doxycycline (30 µg). Native extracts of common sage (*Salvia officinalis*), St. John's wort (*Hypericum perforatum*), dog rose (*Rosa canina*), and English oak bark (*Quercus robur*) were obtained by ultrasonic extraction followed by lyophilization. Antimicrobial activity was assessed using the disc diffusion method for antibiotics and the agar well diffusion method for plant extracts.

Results. The antibiotics levofloxacin and gentamicin showed the highest efficacy against *E. coli* (zones of inhibition 41±0.1 mm and 38±0.2 mm, respectively) but exhibited a pronounced inhibitory effect on lacto- and bifidobacteria (zones of inhibition 40-45 mm). Among the plant extracts, the extract of common sage demonstrated the highest activity against *E. coli* and the best selectivity profile (zone of inhibition 20±0.1 mm; selectivity coefficient Ks=1.43). The sage extract showed a significantly less pronounced damaging effect on the symbiotic microbiota compared to broad-spectrum antibiotics.

Conclusion. The results confirm the potential of using native extracts of medicinal plants, particularly common sage extract, as an effective alternative or supplement to traditional antimicrobial therapy in the context of growing microbial resistance. The high selectivity coefficient of the sage extract (Ks=1.43) indicates its pronounced selectivity against the pathogen while preserving the gut normobiota.

BIOELEMENT STATUS OF YOUNG PEOPLE IN AFRICA

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Data on the elemental composition of the hair of young Africans were obtained. The mean and median concentrations of Zn, Cu, Ca, and Pb were within reference limits. Fe concentrations were elevated. The median concentrations of Ca, Cu, Fe, and Zn in the hair of young women were 1.1 to 1.6 times higher than those of young men.

Keywords: bioelement status, chemical elements, heavy metals, microelementoses, hair, youth.

The population of Africa currently faces economic, political, and environmental challenges. Hair accumulates elements and is believed to reflect the environmental situation in the region and predict health conditions. The aim of our study was to assess the accumulation of chemical elements in the hair of young African people. Therefore, the following tasks were decided: 1. Collect biomaterial samples (hair). 2. Determine the concentrations of chemical elements in the hair of young people. 3. Assess the compliance of chemical element levels in hair with reference values. The object of the study was the hair of 16 young people (9 men and 7 women) aged 18 to 30 years, who came from countries such as South Sudan, Nigeria, Cameroon, Togo and Congo to study in Belarus. The subject of the study was the concentrations of Cu, Zn, Ca, Fe, Pb. Research methods: review and analytical, statistical, X-ray fluorescence analysis [1]. Hair sampling, sample preparation and measurements were carried out according to established methods at the Laboratory of Environmental Monitoring and Management of International Sakharov Environmental Institute of BSU. Tables 1 and 2 present data on the concentrations of chemical elements in the hair of girls and boys in comparison with reference values.

Table 1

Content of chemical elements in young girls' hair (n=7; p=0.05), mg/kg

Element	Mean ± error (p=0,05)	Minimum	Maximum	Median	P=25%	P=75%	Reference values	
							Minimum	Maximum
Ca	664±197	344	907	674	530	816	300	1700
Cu	20±9	6	29	21	13	28	9	30
Fe	49±24	22	90	36	33	63	13	35
Pb	3±1	1	4	3	2	3	0	5
Zn	164±19	137	200	158	155	171	114	320

Table 2

Content of chemical elements in young men's hair (n=9; p=0.05), mg/kg

Element	Mean ± error (p=0,05)	Minimum	Maximum	Median	P=25%	P=75%	Reference values	
							Minimum	Maximum
Ca	724±254	337	1328	636	449	856	300	1000
Cu	17±7	7	32	13	12	29	9	30
Fe	38±14	24	84	31	28	39	13	35
Pb	2±1	1	3	3	2	3	0	5
Zn	156±21	128	211	146	133	166	114	320

The mean and median concentrations of Zn, Cu, Ca, and Pb were within the reference ranges. The mean and median concentrations of Fe were higher than the reference ranges for young girls. The median concentration of Fe in the hair of young men was also within the reference range. The median concentrations of Ca, Cu, Fe, and Zn in the hair of young girls were 1.1, 1.6, 1.2, and 1.1 times higher, respectively, than for young men.

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ANALYSIS OF PRIMARY MORBIDITY IN THE ADULT POPULATION OF THE MOLODECHNOYE DISTRICT IN 2020-2024

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An analysis of the dynamics of primary morbidity in the adult population served by the Molodechno Central District Hospital was conducted. A steady decline in primary morbidity rates for the district population was noted. Throughout the study period, primary morbidity rates in the district population were lower than those for the region. Respiratory diseases account for the largest share of primary morbidity (over 60%). Respiratory disease incidence fluctuates, with an indistinct trend. The incidence of musculoskeletal diseases is characterized by a steady upward trend, which requires priority attention in preventive and treatment efforts. The incidence of infectious and parasitic diseases, as well as injuries and poisonings, is declining.

Keywords: primary incidence, structure, dynamics, trends.

An analysis of primary morbidity among the adult population of the Molodechno district for 2020-2024 revealed a consistent downward trend ($R_2 = 0.7$) in primary morbidity, with some fluctuations reflecting the influence of external and epidemiological factors. The average annual decline in primary morbidity in the Molodechno district was -3.7%.

A comparative analysis of the dynamics of primary morbidity in the Minsk region and the Molodechno district was conducted. Throughout the study period, the primary morbidity rate in the Molodechno district remained below the regional average for the Minsk region, which may indicate a certain effectiveness of the preventive and organizational-medical measures implemented at the district level. The average annual primary morbidity rate in the Molodechno district was 3,811.6 cases per 10,000 population, while the incidence rate in the Minsk region was 4,528.7 cases per 10,000 population. An analysis of the primary morbidity structure revealed that the most significant nosological entities determining the overall medical and demographic burden are respiratory diseases, musculoskeletal disorders, infectious and parasitic diseases, as well as injuries and poisonings. Respiratory diseases consistently remained the most common disease throughout the period, increasing their share in the morbidity structure from 50% in 2020 to 60.5% in 2024.

A long-term trend analysis was conducted for the top-ranked nosologies. The primary incidence of respiratory diseases decreased slightly from 2020 to 2024, but increased in 2024. The rates were 2,144 cases per 10,000 population in 2020 and 2,189 cases per 10,000 population in 2024. The average annual incidence rate for the adult population of the district (A_0) was 2,077 cases per 10,000 population. The incidence of musculoskeletal diseases is steadily increasing (average annual growth rate was 3.8%), requiring priority attention in preventive and treatment efforts. The incidence of infectious and parasitic diseases, as well as injuries and poisonings, is declining.

In recent years, the Molodechno Central District Hospital in Molodechno has been actively implementing modern methods of diagnosis, treatment, and prevention of the most significant diseases. A primary focus is on improving the accessibility and quality of primary care, as well as monitoring the structure and dynamics of adult morbidity. These measures contribute to reducing morbidity and improving public health.

RETROSPECTIVE ANALYSIS OF TUBERCULOSIS MORBIDITY OF THE POPULATION OF THE REPUBLIC OF BELARUS

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Abstract: In the work, a retrospective analysis of tuberculosis morbidity of the population of the Republic of Belarus was conducted. The object of the research was information about the number of cases of tuberculosis diseases of the population of the Republic of Belarus for the period from 2015 to 2023, as well as information about the population size for the same period.

Keywords: epidemiology, morbidity, growth rates, respiratory tuberculosis, dynamics.

Annually on the planet, 10 million cases of tuberculosis infection are registered, about 2 million people die from this disease. And with the development of resistant tuberculosis, defeating it has become even more difficult. With the appearance of antibiotics, man managed to take control of a widespread and dangerous infectious disease, but it continues to remain on the list of global threats to humanity in the 21st century.

In the work, an analysis of the dynamics of primary tuberculosis morbidity of the population of the Republic of Belarus and separately of respiratory tuberculosis was conducted for the period from 2015 to 2023.

It was noted that the primary tuberculosis morbidity of the population of the Republic of Belarus during the research period was characterized by a steady decrease. The average annual indicator of the frequency of primary morbidity (A_0) amounted to 19.87 per 100 thousand population, the annual indicator of the trend (A_1) – - 2.44 per 100 thousand population.

In the work, an analysis of the dynamics of the general tuberculosis morbidity of the population of the Republic of Belarus was also conducted for the period from 2015 to 2023. The analysis showed a steady decrease in the general tuberculosis morbidity of the population of the republic during the research period. The average annual indicator of the frequency of general morbidity (A_0) amounted to 38.38 per 100 thousand population, the annual indicator of the trend (A_1) – - 7.6 per 100 thousand population. The analysis of the structure of tuberculosis morbidity of the population of the republic in the context of gender affiliation for the period from 2015 to 2023 showed that the contribution of the morbidity of the male population exceeds that for women on average by 2.5 times and amounts to 72.04%, the contribution of the morbidity of the female population, respectively, amounted on average to 27.96%. During the analysis of tuberculosis morbidity of the male population of the Republic of Belarus for the period 2015 – 2023, a steady decrease in morbidity was also noted. The average annual indicator of the frequency of morbidity (A_0) amounted to 30.74 per 100 thousand male population, the annual indicator of the trend (A_1) – - 3.5 per 100 thousand male population.

During the analysis of tuberculosis morbidity of the female population of the Republic of Belarus for the period 2015 – 2023, as for the male population, a steady decrease in morbidity was noted. The average annual indicator of the frequency of morbidity (A_0) amounted to 10.53 per 100 thousand female population, the annual indicator of the trend (A_1) – - 1.54 per 100 thousand female population. Thus, it was noted that the morbidity of the male population exceeds on average the morbidity of women with tuberculosis by more than 2.8 times during the research period from 2015 to 2022.

In the work, the structure of tuberculosis morbidity of the population of the republic in the context of age distribution was also analyzed for the period from 2015 to 2023. According to the research data, it was found that the most susceptible to tuberculosis disease is the population aged from 35 to 54 years (the contribution of this age group amounted from 43.48% to 49.45%), the smallest contribution to the structure of tuberculosis morbidity was made by the age group "from 0 to 17 years" (its contribution varied from 0.93% to 1.84%). Thus, the rank distribution of tuberculosis morbidity by age attribute is as follows: first place is occupied by the population aged from 34 to 54 years, second place - the population of the age group "from 55 years and older", third place – "from 18 to 34 years" and fourth place is occupied by the population aged from 0 to 17 years.

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FEATURES OF THE INCIDENCE OF ORAL AND PHARYNGEAL CANCER IN THE MALE AND FEMALE POPULATION OF THE REPUBLIC OF BELARUS

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Oral and pharyngeal cancer is a serious public health problem both globally and in the Republic of Belarus. In recent decades, there has been an increase in the incidence of this type of cancer, which is associated with lifestyle changes, such as increased tobacco and alcohol consumption, as well as insufficient oral hygiene. The paper analyzes the features of the incidence of oral and pharyngeal cancer among the male and female population of the Republic of Belarus for the period 2013-2022.

Keywords: oral and pharyngeal cancer, morbidity, male population, female population, Republic of Belarus.

According to the World Health Organization (WHO), head and neck cancer, including oral cavity cancer, ranks among the leading oncological diseases. In the Republic of Belarus, where the level of smoking and alcoholism remains high, the risk of developing oral cavity and pharynx cancer is particularly relevant. The symptoms of oral cavity and pharynx cancer may be minor in the early stages, which complicates timely diagnosis. Often, patients seek medical help only at late stages, when treatment becomes more complex and less effective. Therefore, oral cavity and pharynx cancer remains a relevant topic requiring attention and active actions from society and medical institutions.

In the course of the conducted studies, it was established that from 2013 to 2022 in the Republic of Belarus there was a steady increase in the incidence of oral and pharyngeal cancer among both men and women. It was 27.65 % for men and 51.43 % for women. The incidence rate among the male population was 6.36 times higher than among the female population. In 2022, oral and pharyngeal cancer accounted for 5.50 % of all detected cases of cancer among the male population, and it ranked 7th in prevalence in the Republic of Belarus. The prevalence of this disease among the female population was significantly lower – 1.00% of all cancer cases and ranked 19th in the republic. During the study period, the incidence of oral and pharyngeal cancer in Gomel, Mogilev, and Vitebsk oblasts increased among the entire population, in Minsk-only among women, and in Brest Oblast – only among men. Most of all, the incidence increased in Mogilev region, among men by 55.10 %, and among women by 102.70 %. In the Grodno region, the morbidity trend was unstable. The greatest disparity in the incidence of oral and pharyngeal cancer occurred in the Brest region, where the incidence among men was 9.32 times higher than that among women, and in Minsk and the Grodno region-the lowest 3.55 times. The highest incidence among men was observed in the Grodno region, and the lowest in Minsk, and among women, the highest incidence was observed in the Mogilev region, and the lowest – in the Brest region.

Thus, based on all the presented data in the study, it is shown that the incidence of oral cavity and pharynx cancer has a steady growth, especially among men, and regional differences associated with socio-economic factors. Oral cavity and pharynx cancer remains a significant public health problem in Belarus, requiring strengthening of preventive measures, early diagnosis, and increasing public awareness of risk factors (smoking, alcohol, oral hygiene).

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RETROSPECTIVE ANALYSIS OF THE INCIDENCE OF DIABETES MELLITUS IN MINSK

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A retrospective analysis of the incidence of diabetes mellitus among the population of Minsk for 2018-2023 was carried out. Throughout the entire period of the study, the average value of the proportion of diabetes mellitus in the structure of the incidence of endocrine pathology among the population of Minsk was about 70%. An increase in the primary and overall incidence of diabetes mellitus in general, both among the adult and child population of Minsk, was noted.

Keywords: diabetes mellitus, incidence, growth rates, dynamics, structure.

Diabetes mellitus is an endocrine disease caused by an absolute or relative deficiency of insulin, leading to a disturbance of all types of metabolism, primarily carbohydrate, damage to blood vessels (angiopathy), the nervous system (neuropathy), as well as damage to organs and tissues. Diabetes mellitus is a global problem of the whole world. According to WHO, today about 422 million people suffer from diabetes, which is 6.028% of the entire planet's population. The level of diabetes incidence grows annually. Over 20 years, the number of patients with diabetes mellitus in Belarus has increased 3 times, which indicates the need to study and assess the incidence in the country for taking preventive measures.

Throughout the entire period of the study, the share of diabetes mellitus in the structure of the incidence of endocrine pathology among the population of the Republic of Belarus accounted for about 70% of cases of endocrine diseases.

An increase in the overall incidence of diabetes mellitus was observed both among the adult and child population of Minsk for the period from 2017 to 2023. The average annual growth rates for the adult and child population were 2.69 and 8.12%, respectively. The average annual indicator of overall incidence (A_0) for the adult population was 5057.87 per 100 thousand people, and for the child population - 208.52 cases per 100 thousand children. It can be noted that the overall incidence of diabetes mellitus in the adult population exceeds the incidence in children by more than 24 times.

When analyzing the dynamics of the primary incidence of diabetes mellitus in the adult population, no pronounced change towards an increase or decrease in incidence was noted. The average annual incidence rate (A_0) was 436.96 per 100 thousand adult population. The annual trend indicator (A_1) — 5.87 per 100 thousand adult population, the average annual growth rate -- 2.9 %. The long-term dynamics of the primary incidence of diabetes mellitus in the child population is characterized by a steady upward trend with an average annual growth rate of 8.37%. The average annual incidence rate (A_0) was 29.31 per 100 thousand child population. The annual trend indicator (A_1) — 2.6 per 100 thousand child population. The primary incidence of diabetes mellitus in the adult population exceeds the incidence in children by more than 15 times.

It can also be noted that the levels of diabetes mellitus incidence in Minsk exceed the average republican indicators, which may be associated with better diagnosis of this disease.

Thus, the increase in the incidence of diabetes mellitus indicates the need for the development and approval of preventive measures. For this purpose, in the Republic of Belarus, for the treatment and prevention of diabetes mellitus, the state program "People's Health and Demographic Security" for 2021-2025 is currently being implemented, which will further reduce the number of cases.

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EFFECT OF LEAD SALTS ON PHYSICOCHEMICAL CHARACTERISTICS OF THE LIPID COMPONENT OF RAT THYMOCYTE MEMBRANES

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Possible consequences of the action of lead salts on the structural state of plasma membranes of rat thymus cells have been studied. The conducted studies on the effect of lead salts on the structural state of the thymocyte membrane have shown that this heavy metal is capable of modifying the structural and functional state of the plasma membranes of these cells. The effect of its action lies in the ability of lead to change the physicochemical characteristics of the lipid bilayer of the cytoplasmic membrane of cells.

Keywords: phospholipid, lipid bilayer, molecular mechanisms, heavy metals, lead acetate.

Lead is considered one of the most common heavy metals. It is theorized that lead may affect certain components of the lipid bilayer of cells. It is important to understand which cell membrane elements are affected by lead compounds, as well as the nature of this effect. This study may identify the most vulnerable elements of the lipid bilayer, as well as the mechanisms of heavy metal action on the cell wall [1].

The aim of this study was to investigate the effect of lead salts on the physicochemical characteristics of the lipid component of rat thymocyte membranes.

The study was conducted on mature male rats (6-8 months old) weighing 260-300 g, bred in a herd, maintained on a standard vivarium diet. All thymocyte isolation procedures were performed in the cold (at 4°C). The percentage of viable cells was then calculated, which was over 96%.

An experimental study was conducted on the effects of lead acetate on rat thymocytes. Thymocyte survival during incubation with lead acetate did not fall below 96.6%, indicating that the lethal dose of lead acetate is significantly higher than that presented in the study, as the difference in thymocyte survival between 0.04 g/L and 0.4 g/L lead acetate solutions was within 2%. When rat thymocyte membranes were exposed to lead acetate, both an increase and a decrease in lipid bilayer polarity were observed over time. However, a reliable effect on annular lipid polarity was not detected.

When studying the microviscosity of annular lipid, a significant decrease in these parameters was observed after 5, 10, and 15 minutes of incubation of thymocytes with lead. At a lead concentration of 0.04 mg/L, the microviscosity of the annular lipid initially dropped sharply, but then gradually increased at 10 and 15 minutes of incubation. This may indicate the ability of the cell membrane to adapt to the effects of lead acetate, but this mechanism requires further detailed examination. As expected, incubation of thymocytes in a lead acetate solution with a concentration of 0.4 mg/L resulted in a sharper decrease in microviscosity than incubation with lead acetate at a concentration of 0.04 mg/L. Lead is likely capable of binding to membrane proteins, as well as to the hydrophilic heads of the membrane bilayer. Thus, lead absorbs part of the negative charge, weakening the interaction between lipids and proteins of the cell membrane.

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EPIDEMIOLOGICAL ASSESSMENT OF THE INCIDENCE OF RHEUMATOID ARTHRITIS

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The paper analyzes the dynamics of the overall incidence of rheumatoid arthritis among the adult population in the Republic of Belarus for the period from 2019 to 2023. It has been shown that the overall incidence of rheumatoid arthritis generally has a positive growth rate. Rheumatoid arthritis occurs in the population with a frequency of approximately 1%. The incidence among women is 2-3 times higher than among men. The disease can develop at any age, most often from 35 to 50 years old, but it can also occur in childhood and in the elderly. The prevalence of rheumatoid arthritis among the adult population is 0.5–2% (about 5% in 65-year-old women). The ratio of women to men is 2-3:1. All age groups are affected, including children and the elderly. The peak onset of the disease occurs at 40-55 years of age..

Keywords: rheumatoid arthritis, statistics, incidence, population.

Doctors still do not understand what is the cause of the disease. It is only known that some people are genetically predisposed to rheumatoid arthritis, but the disease is not transmitted from parents to children directly. Smoking has been shown to increase the risk of developing rheumatoid arthritis. In 20-30% of patients, the disease begins after an infection, most often nasopharyngeal.

However, the long-term search for a specific microorganism that causes rheumatoid arthritis has not led to success, so there is no reason to consider this disease infectious. Another significant factor that provokes the development of the disease is severe emotional stress (quarrels, divorces, etc.). At the same time, in about a third of patients, the first symptoms appear harmful to full health, for no apparent reason.

In this regard, most scientists consider rheumatoid arthritis as a "polyethological" disease, in the development of which a particular patient has both genetic and many environmental factors.

During the considered time interval 2019-2023, the intensive incidence of rheumatoid arthritis in the population of the Republic of Belarus increased by 6.1% from 21,478 per 100,000 people to 23,328 per 100,000 people. Indicators of the coefficient of determinism R2 = 0.9957 there is a pronounced steady trend of increasing morbidity.

The average annual incidence of diseases in the population of the Republic of Belarus was 22377.6 per 100,000 people.

The overall incidence of rheumatoid arthritis in the Republic of Belarus in 2019 was 21478 cases per 100,000 population

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THE INFLUENCE OF ENVIRONMENTAL FACTORS ON THE FORMATION OF REDUCTIVE LIMB MALFORMATIONS

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The most significant role in their formation is played by adverse environmental factors acting during the critical periods of embryogenesis. Environmental pollution, toxic substances, and infectious agents disrupt the processes of cellular differentiation and morphogenesis, leading to severe structural defects of the limbs.

Keywords: ecology; reduction malformations; teratogenic factors; embryogenesis; organogenesis; embryotoxicity; periconceptional prevention.

Current embryological data demonstrate an inseparable relationship between environmental conditions and the incidence of reduction malformations in humans. The influence of adverse environmental factors at the early stages of embryogenesis can lead to disturbances in the processes of organ and system development, including limb primordia. Limbs are formed during the first weeks of embryonic development–from the 4th to the 7th week–and it is precisely during this period that exposure to external factors poses the greatest risk to the normal formation of the musculoskeletal system [1,2].

The growing anthropogenic burden–pollution of air, water, and soil with heavy metals, pesticides, and organic toxicants–contributes to an increased risk of embryotoxic effects. Lead, mercury, and cadmium compounds, as well as phthalates and phenolic derivatives, exhibit mutagenic activity, disrupting mitosis and the differentiation of mesenchymal cells, resulting in limb aplasia and hypoplasia. Ionizing radiation, hypoxia, hyperthermia, and viral infections (rubella, toxoplasmosis, cytomegalovirus) also have a significant impact, damaging embryonic tissues. Socio-environmental factors such as smoking, alcohol consumption, and folate deficiency further potentiate the effects of external teratogens. These exposures induce oxidative stress, DNA damage, and dysregulation of HOX and SHH gene expression–genes that control limb morphogenesis–leading to the formation of reduction malformations [1,3].

A total of 44 cases of congenital limb reduction defects in children (approximately 3.3% of all major congenital anomalies) were analyzed for the period 2022-2023. The findings showed that in 2022, 27 cases were documented (12 live neonates, 15 terminated pregnancies), and in 2023, 17 cases were identified (10 live neonates, 1 stillbirth, 6 terminated pregnancies). All cases presented with a challenging obstetric history, encompassing professional exposures, chronic infectious pathology, and an intricate perinatal course.

Prevention of congenital malformations must be comprehensive. Particular importance is given to periconceptional preparation of women, aimed at minimizing the impact of harmful factors before pregnancy occurs. It is recommended to avoid contact with toxic substances, abstain from smoking and alcohol, normalize nutrition, and take folic acid at a dose of 4000 μg/day for 2–3 months prior to conception. Folates play a key role in DNA metabolism and gene methylation, significantly reducing the risk of limb reduction defects by 30–50% [2,3].

Thus, environmental factors exert a substantial influence on embryonic morphogenesis, causing disturbances in organ development through genetic, cellular, and biochemical mechanisms. Reducing the incidence of limb reduction defects requires a systemic approach–strengthened environmental control, public awareness, and the implementation of periconceptional prevention programs and early prenatal diagnostics [1].

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EFFECT OF ATP AND IONIZING RADIATION ON THE CONCENTRATION OF CYCLIC NUCLEOTIDES IN IMMUNE SYSTEM CELLS OF RATS

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In the mechanisms of action of various unfavorable factors, including ionizing radiation on the organism of mammals, a special role is given to the systems of secondary messengers. The aim of the study is to determine the level of influence of ATP and ionizing radiation on the concentration of cyclic nucleotides in the cells of the immune system of rats. In the course of the work it was established that the effects of radiation on the cells of the immune system of rats irradiated at a dose of 1 Gy are due to systemic disturbances of the main intracellular regulatory mechanisms: cAMP and cGMP.

Keywords: cyclic AMP, cyclic GMP, peripheral blood lymphocytes, thymocytes, enzyme immunoassay.

Messenger (regulatory or signal-transducer) systems play a special role in the mechanisms of action of various adverse factors, including ionizing radiation, on the organism of mammals. Currently, calcium and cyclic nucleotides are considered the main components of the intracellular signaling system that regulates cell activity in response to external stimuli. The interactions that exist between changes in the intracellular calcium content and the generation and metabolism of cyclic nucleotides are very important, since, on the one hand, enzymes that control both the synthesis and destruction of cAMP and cGMP are regulated by calcium-dependent feedback mechanisms that integrate the activity of secondary messengers during hormonal stimulation. On the other hand, the degree of manifestation of Ca^{2+}-mediated effects depends on the level of cyclic nucleotides [1].

cAMP and cGMP act as secondary intracellular messengers by activating cellular protein kinases, which in turn phosphorylate effector proteins and alter their activity, causing metabolic and functional changes typical of a particular hormonal signal, altering the corresponding cellular functions.

Based on the above, the aim of this study was to determine the level of influence of ATP and ionizing radiation on the concentration of cyclic nucleotides in the cells of the rat immune system.

The studies were conducted on nonlinear male rats aged 6-8 months weighing 170-220 g. Irradiated animals were taken into the experiment on the 30th day after chronic γ-irradiation at a dose of 1 Gy, dose rate of 5.8 10^{-7} Gy/s. The group of irradiated animals had an appropriate control. Control rats were kept under standard vivarium conditions, but without a radiation source.

In the process of studying the influence of ATP and ionizing radiation, it was found that the basal level of cAMP and cGMP in rat peripheral blood lymphocytes exceeded the similar level in thymocytes by 3 times.

The dynamics of changes in the concentration of cAMP and cGMP in rat thymocytes when exposed to ATP was also studied. The level of cAMP in rat thymocytes when exposed to ATP without incubation exceeded the basal level by 6 times, and in the case of exposure of thymocytes to ATP with incubation, such level was higher than the basal by 3 times, which indicates that the incubation process reduces the level of cAMP in rat thymocytes, but the latter remains higher than the basal. The level of cAMP in rat peripheral blood lymphocytes when exposed to ATP without incubation increased by 1.5 times, and in the case of exposure of PBL to ATP during incubation for 10 minutes, it decreased by 2 times. In this case, due to the incubation process, the cAMP level in the rat PBL after exposure was already lower than the basal level. At the same time, a much greater increase in the cGMP level was observed in rat thymocytes when exposed to ATP without incubation and during incubation for 10 minutes (11 and 6 times, respectively) than in the case of cAMP. In the rat PBL, there was also an increase in the ATP level both with and without incubation by 2 times.

Also, the study found that chronic γ-irradiation after 30 days reduces the level of ATP stimulation in rat thymocytes by 2 times, while the basal level of cAMP in the thymocytes of irradiated rats remained approximately the same as in the cells of control rats.

Thus, the effects of radiation on immune system cells of rats irradiated at a dose of 1 Gy are caused by systemic disturbances of the main intracellular regulatory mechanisms: cAMP and cGMP.

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CT/MRI-BASED FINITE ELEMENT MODEL CONSTRUCTION AND BIOMECHANICAL ANALYSIS OF ACETABULAR QUADRILATERAL FRACTURES

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The acetabular quadrilateral plate, the "third column" alongside the anterior and posterior columns, is essential for maintaining normal weight-bearing function [1]. According to the Clinical Diagnosis and Treatment Guidelines for Acetabular Quadrilateral Plate Fractures (2023), fixation strategies involve either partially or completely blocking the quadrilateral plate after stabilizing the anterior and posterior columns using a "frame" structure. Various internal fixation devices have been designed and analyzed through finite element methods, including periacetabular channel screws [2], dynamic anterior plating systems [3], customized 3D-printed blocking plates [4], and specialized quadrilateral plate-integrated anatomical plates [5]. However, no standardized treatment protocol currently exists, and most approaches depend on clinical experience. This study utilized CT and MRI data from a healthy volunteer to construct a three-dimensional finite element model, comparing the mechanical characteristics of an unfixed group with three fixation methods under five loading conditions.

Study Objective: The study aims to construct a representative acetabular quadrilateral fracture model and compare the biomechanical performance of three internal fixation techniques.

Methods: CT data from 70 fractures were analyzed to create fracture line mappings. A finite element model incorporating ligaments, cartilage, and fracture lines was developed using CT/MRI data from a healthy volunteer. Five loading conditions (standing, supine, lateral lying, sitting, femoroacetabular impingement) were simulated. Four groups were compared: unfixed (Group A), posterior column screw fixation (Group B), quadrilateral buttress screws fixation (Group C), and combined posterior column and quadrilateral buttress screws fixation (Group D).

Results: The most frequent fractures were both-column and anterior wall fractures. Fracture line displacement under standing conditions was Group A > Group B > Group C > Group D. In other conditions, the trend was Group A > Group C > Group B > Group D. Peak stress on posterior column screws occurred in the supine position for Group D, while Group B had greater stress in other conditions. Quadrilateral buttress screws showed peak stress in lateral lying for Group D, but Group C had greater stress in other conditions. The highest stress among cortical screws fixed via plates occurred in the posterior screws.Conclusion: Combined posterior column and quadrilateral buttress screws fixation provides superior mechanical stability and should be preferred for clinical fixation of acetabular quadrilateral fractures. Placement of cortical screws near the fracture line is recommended, with additional screws at the sacroiliac joint if necessary. Early postoperative weight-bearing is discouraged.

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ASSESSMENT OF SPECIES DIVERSITY AND INFECTION WITH TREMATODES OF MOLLUSKS OF LAKE SVYATSO (2024–2025)

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This paper presents the results of a study on the species diversity and infestation of freshwater pulmonate mollusks of the *Planorbidae family* in Lake Svyatco, Braslav, obtained in July–August 2024–2025. It was found that in areas subject to greater anthropogenic influence, the pond snail (*Lymnaea stagnalis)* is dominant in abundance, while a decrease in aquatic vegetation (targeted mowing) leads to a change in the species composition of mollusks.

Keywords: coil mollusks, horn coil, species diversity, parasitic invasion.

Studying species diversity provides insight into the qualitative composition of the biocenosis and the quantitative relationships between species. Coiled worms are intermediate hosts for trematodes, the causative agents of many infectious diseases, including schistosomiasis, cercariasis, fascioliasis, and others. Therefore, their natural populations represent actual or potential foci of helminthic infections [1].

The aim of this work was to assess the species composition of mollusks in coastal waters under anthropogenic influence and to determine the degree of their infestation with trematode larvae.

Lake Svyatso is located within the Braslav Lakes National Park. Its surface area is 0.29 km². Its maximum depth is 4.1 meters [2]. It is located on the outskirts of Braslav and adjacent to Lake Berezh'e, with which it is connected by a small stream. The lake is located primarily on flat terrain, marshy in places, overgrown with forest and shrubs. This lake has a marshy floodplain. Hilly terrain is observed in the southern part of the lake's area. The coastal zone is predominantly sandy. Lake Svyatso shows signs of pollution as a result of anthropogenic impact. In summer, a large algae population increases, causing discoloration of the water [3].

During the study in 2024-2025, 4 sites of 80 m^2 in size were selected in biotopes with different anthropogenic influences:

1. The first site is located near a summer cottage village and the stream connecting Svyatsko and Berezh'e. The shore is sandy, with sparse vegetation. It's a natural environment, with anthropogenic impacts occurring only during the summer (tourist and fishing season).
2. The second site has more vegetation. Lake reed, manna grass, and lake bulrush are found. It is located further from the stream, in open terrain. The bottom is predominantly sandy, with some silt.
3. The third site is located among trees and shrubs. Reeds are abundant. The bottom is muddy, sandy in places. High anthropogenic impact. The area contains numerous boats, fishing huts, and evidence of campfires.
4. The fourth site is located near residential buildings on the southern part of the lake. The terrain is hilly and reeds are present. The bottom is sandy.

In 2024, the pond snail (*Lymnaea stagnalis)* predominated at the first site of Lake Svyatso, accounting for 53.8% of the total number of mollusks collected at the first site. At the second and subsequent sites, the horned scallop *(Planorbarius corneus)* dominated in abundance: 66.7%, 68.75%, and 62.5%, respectively. No infestation was detected.

In 2025, the pond snail predominated in abundance at the first and third sites of Lake Svyatso (58.3% and 53.8%, respectively), while the scaly-sided snail dominated at the second and fourth sites (57.15% and 56.25%, respectively). The change in abundance at the third site is likely due to human activity: the presence of boats, evidence of fires near

the shore, and mowing of coastal vegetation. Infestation among collected scaly-sided snails was 3.5%, and among pond snails – 3.7%.

Thus, the detection of infected mollusks in the studied area indicates the need for further monitoring to control the parasite situation.

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SECTION 3

PROBLEMS OF MODERN ENVIRONMENTAL SAFETY (BIOMONITORING, BIOINDICATION, BIOREMEDIATION, RADIOECOLOGY AND RADIATION SAFETY, ENVIRONMENTAL MONITORING, MANAGEMENT AND AUDIT. INFORMATION SYSTEMS AND TECHNOLOGIES IN ECOLOGY)

THE IMPACT OF THE MUNICIPAL SOLID WASTE CLASSIFICATION AND RECYCLING SYSTEM ON THE EFFICIENCY OF REGIONAL MATERIAL RECYCLING

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This paper explores the impact of municipal solid waste (MSW) classification and recycling systems on regional material recycling efficiency. By analyzing the operational logic of classification systems and their role in material recovery, it finds that standardized classification systems significantly reduce the difficulty of subsequent material sorting, increase the purity of recyclable materials, and lower recycling costs. Case studies from typical regions show that effective MSW classification can improve the recovery rate of key materials (such as paper, plastic, and metal) by 15%-30%. The research confirms that a sound MSW classification and recycling system is a core driver for enhancing regional material recycling efficiency, promoting circular economy development.

Keywords: Municipal Solid Waste; Waste Classification; Recycling System; Material Recycling Efficiency; Circular Economy

With the acceleration of urbanization, the output of MSW has increased sharply, bringing pressure on environmental governance and resource utilization. Regional material recycling, as an important part of the circular economy, relies heavily on the pretreatment of waste – among which MSW classification is the foundational link. A scientific classification and recycling system can connect waste generation and material reuse, directly affecting the efficiency of resource recovery.

Unclassified MSW contains a mixture of recyclables, hazardous waste, and kitchen waste, requiring a large amount of manual and mechanical sorting in the recycling stage. A standardized classification system (e.g., dividing waste into recyclables, kitchen waste, hazardous waste, and other waste) allows residents to complete preliminary sorting at the source. This reduces the workload of subsequent recycling facilities by 40%-60% and cuts down the time and labor costs of secondary sorting [1].

Impurities in unclassified waste (such as food residues mixed with paper) often lead to the degradation of recyclable materials or even make them unrecyclable. Source classification ensures that materials like plastic bottles and waste paper are collected separately, increasing their purity to over 90%. Higher purity not only improves the quality of recycled materials but also enhances the willingness of recycling enterprises to participate, forming a positive cycle of the recycling chain[1].

Conclusion: The MSW classification and recycling system has a direct and positive impact on regional material recycling efficiency. By optimizing the source pretreatment of waste, it reduces recycling costs, improves the quality and recovery rate of recyclable materials, and provides a reliable guarantee for the development of the regional circular economy. To further enhance efficiency, regions should strengthen the popularization of classification knowledge, improve supporting recycling facilities, and establish a supervision mechanism for the whole classification-recycling chain[2].

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ENERGY EFFICIENCY OF A SMALL HYDROPOWER PLANT ON THE COLD WATER RETURN CHANNEL OF A NATURAL-DRAFT EVAPORATIVE COOLING TOWER AT THE NUCLEAR POWER PLANT

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This article discusses the potential for improving the energy efficiency of nuclear power plants by utilizing the hydraulic potential of the outlet channel of a tower cooling tower. A concept is proposed for integrating a small hydroelectric power station (SHPS) into the existing water circuit of the thermal balance, which can help reduce emissions of steam gases.

Keywords: small hydroelectric power station, nuclear power plant, cooling tower, energy efficiency, reduction of steam gas emissions.

Modern nuclear power plants (NPPs) consume significant amounts of electricity for their own needs – in particular, for operating circulating pumps, ventilation fans, and auxiliary systems. Typically, up to 10% of the electricity generated by the NPP itself is directed toward meeting these internal demands [1]. In situations where the generation structure within the power system includes coal or gas-fired power stations, such significant consumption of electricity for internal needs leads to increased emissions of carbon dioxide (CO_2) and other pollutants.

The outlet channel for cold water from a tower cooling tower is characterized by stable flow rates (approximately 40 m^3/s for modern VVER-1200 reactor units) and a considerable hydraulic head formed by the height difference between the tower and the discharge point. At present, this hydraulic potential is not utilized; installing a small hydroelectric power station at a non-critical section of the channel would allow conversion of this energy into electricity. The operation of the SHPS does not require regulation of the water flow and does not affect the cooling regime of the main equipment, ensuring full compliance with ecological and technological safety requirements.

The environmental and energy effects of implementing an SHPS include reduced electricity consumption for internal needs during normal plant operation. As a result, overall emissions of greenhouse gases into the power system are reduced. Moreover, this effect is especially pronounced in regions with a high share of fossil fuels in the energy mix [2]. Additionally, the presence of an independent local energy source does not impact the reliability of power supply to auxiliary systems or the overall operational stability of the plant.

Implementing this concept aligns with global trends toward decarbonization and transitioning to integrated systems with low emission levels. For nuclear energy – already one of the lowest-carbon energy sources – this allows further strengthening its “ecological footprint,” not only during the generation process but also throughout the entire chain of auxiliary operations. Such solutions may be incorporated into programs aimed at improving energy efficiency and ecological management in the nuclear industry, as well as applied to other energy facilities such as thermal power plants (TPPs) and combined heat and power plants (CHPPs), where similar water flows with hydropower potential exist.

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ANALYSIS OF ESTIMATES OF THE ECONOMIC VALUE OF ECOSISTEM SERVISES

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The article provides average estimates of the economic value of providing (biotic/biophysical) ecosystem services, showing, among other things, the possible priority that can be applied in scientific activities. Recommendations are given on how to increase the market value of the most valuable of them, and options for working in the field of increasing the economic value of ecosystem services are presented, depending on the actors and the degree of influence of the owner. The compliance of Russian data with international standards has been verified.

Keywords: Ecosystem services, economic value, cost, state.

The General International Classification of Ecosystem Services (CICES) was used as the basis for the classification of ecosystem services. The Ecosystem Services Assessment Database (ESVD) was used to calculate the economic value. The Russian data for comparison was taken from the Ecosystem Services of Russia report.: Prototype of the national report. Vol. 1 Terrestrial ecosystem services. The number of values received from the database was entered in Table 1 (link: https://disk.yandex.ru/i/ivbj-Y_hkuHPrQ). The largest number of values were obtained for services: "Wild animals (terrestrial and aquatic) used for food purposes", "Fibers and other materials from wild plants for direct use or processing (except for genetic materials)", "Cultivated terrestrial plants (including fungi, algae) grown for food purposes", "Wild plants (terrestrial and aquatic, including fungi, algae) used for food," which can be presented as the researchers' response to assessing the true value of the most commonly used ecosystem services, which presumably can be considered rational in terms of prioritizing scientific research. There are also several more studies in the database, while not all have data on the economic value of services.

The cost of the service "Cultivated plants (including fungi, algae) grown as an energy source" is the maximum and amounted to $ 65,742/ha/year, "Fibers and other materials obtained from cultivated plants, fungi, algae and bacteria for direct use or processing (excluding genetic materials)" is estimated at 47 507 $/ha/year. The service "Cultivated terrestrial plants (including fungi, algae) grown for food purposes" is estimated at $20,229/ha/year. The service "Wild animals (terrestrial and aquatic) for obtaining food, materials or energy" is estimated at $20,999/ha/year. In some cases, estimates of economic value from the perspective of ecosystem services turned out to be higher than the market value, which indicates the need to increase the importance of ecosystem services in the market.

The state as an actor has an obvious benefit in preserving the country's natural wealth. Educational campaigns and the development of a culture of doing responsible business can eventually be reflected in the ESG strategies of enterprises and ultimately in the consumer's choice of a sustainable alternative, that is, perhaps a little more expensive, but maintaining the economic value of ecosystem services. Companies as recipients can contribute to increasing the economic value of ecosystem services by incorporating principles of responsible supply chains and procurement, thereby extending these measures to counterparties. In most cases, the defining role of the owner is noted in the description, since in most cases the owner determines the existence or absence of an ecosystem service as such, as in the case of the generalized case of agriculture. If the state is the owner, then its activity as an actor is also decisive, however, in fact, the state does not always conduct active activities throughout the territory, therefore, the presence of influence is noted.

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GEOECOLOGICAL ASSESSMENT OF SOIL POLLUNION ON TEMPORARY SNOW STORAGE ECOLOGICAL REHABILITATION SITIES IN MINSK

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This article presents the results of a comprehensive geoecological study aimed at assessing the degree and nature of soil pollution on temporary snow storage sites within Minsk city. The results revealed significant spatial differentiation in pollution levels. The obtained results are of practical importance and can serve as a basis for developing more effective winter waste management to reduce the technogenic load on the territory of Minsk.

Keywords: temporary snow storage sites, ecological-geochemical assessment, soil pollution, heavy metals, petroleum products, urban environment, urban ecosystems.

The issue of snow disposal in large cities remains relevant due to the substantial volumes of snow accumulated during winter and its high contamination levels. The snow cover in urban areas accumulates a wide range of emissions from motor vehicles, industrial facilities, and de-icing agents [1]. Temporary snow storage sites (TSSS), while being a necessary element of urban environmental infrastructure, themselves become a source of secondary environmental pollution, primarily of the soil cover at their locations. During snowmelt, a concentrated release of accumulated substances into the soils and subsoils occurs, leading to the formation of localized technogenic geochemical anomalies. Previous research indicates that meltwater from snow dumps is characterized by abnormally high mineralization and significant concentrations of heavy metals [2, 3].

To assess soil contamination in the city areas influenced by TSSS, the following analyses were conducted: the specifics of the sites' spatial distribution were examined, the concentration levels of pollutants (petroleum products and heavy metals) in the soils were determined, and the spatial patterns of soil-geochemical anomaly formation were identified. The assessments were based on field survey data and laboratory analyses performed by the author in 2022 and 2024. Site inspections and sampling were carried out at seven TSSS located in seven administrative districts of Minsk (Leninsky, Moskovsky, Oktyabrsky, Partizansky, Sovetsky, Frunzensky, Tsentralny). The obtained data were interpreted by comparing them with current hygienic standards (Maximum Permissible Concentration - MPC, Approximate Permissible Concentration - APC) [4].

Analysis of heavy metal content in the soils revealed that lead and copper are the most environmentally problematic elements. The total lead content exceeded the critical APC standard (40 mg/kg) in the soils of two sites: in the Leninsky district (51.6 mg/kg) and the Partizansky district (87.5 mg/kg). Regarding copper, an abnormally high total content of the element was recorded at the TSSS in the Frunzensky district (192 mg/kg), significantly exceeding the APC (132 mg/kg). Furthermore, a dangerously high content of the mobile form of copper was identified at the site in the Moskovsky district (16.1 mg/kg against an APC of 10 mg/kg), indicating its high bioavailability and potential hazard to ecosystems. In contrast to lead and copper, the content of zinc – both total and mobile forms – in all tested soil samples was within the established hygienic standards.

The spatial distribution of pollutants in the soils shows a clear correlation with the type of functional land use in the urban areas from which the snow was collected and is closely related to the intensity of the anthropogenic load. The highest levels of soil contamination with petroleum products, lead, and copper are associated with TSSS serving districts with developed industrial infrastructure and high traffic density (Leninsky, Moskovsky, Frunzensky). The identified consistent exceedances of APC standards for petroleum products and heavy metals in the soils indicate a significant environmental risk due to the accumulation of persistent pollutants in soils.

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ECOLOGICAL REHABILITATION OF POST-INDUSTRIAL TERRITORIES: FROM MAN-MADE LANDSCAPES TO SUSTAINABLE URBAN ECOSYSTEMS

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Human industrial activity has left behind man-made landscapes - vast disturbed territories. In Russia, there are millions of hectares of such lands destroyed by mining, construction, waste storage and other activities [1]. These territories are characterized by degraded soils, heavy metal pollution and other toxic substances, and the loss of vegetation and soil cover leads to a deterioration of the local climate and living conditions of the population. Ecological rehabilitation of post-industrial zones is aimed at overcoming this man-made heritage and turning it into sustainable urban ecosystems - new green spaces of the city with restored ecological functions and value for society.

Keywords: ecological rehabilitation, ecological safety, urban ecosystems.

In Russian practice, restoration of disturbed lands is traditionally referred to by the term "reclamation" – a set of measures to restore productivity and environmental value of degraded territories. The technical and biological stages of reclamation are distinguished [1]. At the technical stage, engineering works are carried out, such as terrain planning, removal or isolation of contaminated soils, application of a fertile layer, creation of drainage and anti-erosion systems. The biological stage includes the improvement of the properties of the substrate (application of organic matter, fertilizers, liming to neutralize acidity) and subsequent biological reclamation – planting, restoration of soil biota and fauna. Without these measures, man-made soil is often unsuitable for growth, as seeds do not germinate or seedlings die from environmental toxicity. Therefore, the key task is to form a favorable soil substrate that supports vegetation.

Environmental rehabilitation is a lengthy process that requires careful planning. It is necessary to take into account the peculiarities of each object: geography, geology, climate of the region, properties of polluted soils. A comprehensive survey of the territory helps to optimize the project and achieve maximum effect at minimum cost [2]. In some cases, innovative nature-like technologies are used. For example, phytoremediation – the use of plants to extract and neutralize pollutants – is considered as a sustainable alternative to expensive methods of soil purification [3]. The experience in Amsterdam has shown that the integration of phytoremediation into the renovation project of an industrial zone allows for the simultaneous purification of soils and the creation of a new green space. This combination of soil purification with landscaping and biomass cultivation has given the territory new ecological, economic and social functions [3]. Thus, biotechnological methods (phytoremediation, bioremediation, etc.) are increasingly being included in rehabilitation programs, complementing traditional engineering work.

Successful rehabilitation of man-made landscapes opens up the possibility to include them in the "green framework" of the city - a system of parks, squares and other natural objects. All over the world, projects for the revitalization of former industrial zones are aimed at improving the environmental situation and expanding the network of urban green spaces. Abandoned industrial sites (brownfields) are increasingly turning into public spaces that bring environmental, social and economic benefits to the city [4]. The inclusion of elements of green infrastructure (parks, water-green and other green spaces) returns natural ecosystems and their services to the city.

Ecological rehabilitation of post–industrial territories is an important condition for sustainable urban development. By turning degraded man-made landscapes into functioning urban ecosystems, cities not only eliminate the

environmental damage of the past, but also receive new green spaces that improve the quality of life of citizens and the ecological situation. Experience shows that with the support of science, community participation and the use of modern eco-technologies, such territories can be successfully returned to the urban environment. This contributes to the formation of more sustainable, healthy and attractive cities, where former "industrial wastelands" are transformed into green oases and an important part of urban ecosystems.

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MOLECULAR GENETIC METHODS FOR SEX DETERMINATION IN POPULATION OF THE EURASIAN BEAVER

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This study describes two methods for determining the gender of Eurasian beavers using molecular genetic analysis. We successfully tested two approaches on samples such as bone powder, wool, and muscle tissue. Primer pairs that amplify shorter DNA fragments are the most effective. The analysis confirms that a comprehensive approach using various detection methods is necessary to ensure maximum reliability in sex determination using molecular genetic methods.

Keywords: Eurasian beaver, sex determination, molecular genetic methods.

Studying the demographic structure of populations is a fundamental task of modern ecology and population biology [1]. A key parameter determining the dynamics, stability, and reproductive potential of any population is its sex structure. Assessing this parameter is critically important for developing effective strategies for the conservation, management and monitoring of species, especially those that are resource-based or recovering from a period of decline

The Eurasian beaver is an integral species of Belarusian natural ecosystems. Determining sex in the field is difficult due to the absence of sexual dimorphism, so molecular genetic analysis is used for reliable identification [2-3].

Molecular genetic studies to determine the sexual structure of the Eurasian beaver population were conducted on 60 samples of biomaterial, including 20 samples of bone material from Eurasian beavers from 1960-1980, wool and muscle tissue from beavers obtained in 2024-2025. DNA was extracted from bone material of historical Eurasian beaver samples using the ammonium acetate method. DNA was extracted from wool using the «ArtSpinExpert kit» (ArtBioTech, Belarus) according to the protocol. DNA was extracted from muscle tissue samples using the Jena Bioscience «Animal and Fungi DNA Preparation Kit».

The first method involves electrophoretic identification of amplification products. Two primer sets were tested: the SRY gene was amplified using SRY F and SRY R primers, and primers L14841 and H15149 of the *cybB* fragment of the mitochondrial genome were used as a positive control for a successful PCR reaction [3]. The next set focused on zinc finger nuclease (ZFN) genes on the X and Y-chromosomes [4]. The second method is based on the double-stranded DNA-binding ability of the SYBR Green I fluorescent dye. The amount of PCR products was determined in real time

by measuring the fluorescence that accumulates with each cycle. Amplification was performed with two pairs of primers, 12SO and 12SA, for positive control [5], as well as SRY F and SRY R primers, which determine sex.

During the research, primer sets targeting the amplification of sex-linked (SRY, ZFN) and mitochondrial (*cytB*/12s) markers were successfully tested. A key finding is that primer pairs amplifying shorter DNA fragments, in particular *cytB*/SRY, demonstrate maximum efficiency and reliability when working with muscle tissue, bone material, and wool. Moreover, the method based on the amplification of target DNA using primers and an intercalating fluorescent dye allowed the sex of all samples studied to be detected. To ensure maximum reliability in sex determination using molecular genetic methods, a comprehensive approach based on the application of the two detection methods described above is necessary.

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SPECIES DIVERSITY OF ANURAN AMPHIBIANS IN THE LOYEV DISTRICT

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The paper presents results of a field study on the species composition of anuran amphibians in the Loyev District (Gomel Region, Belarus). During the 2025 season, five species belonging to two families were recorded across three main habitat types: pond, mixed forest, and swamp. Differences in species occurrence were linked to habitat moisture, vegetation density, and anthropogenic influence. The study emphasizes the importance of habitat heterogeneity for maintaining amphibian biodiversity in southeastern Belarus.

Keywords: amphibians, Anura, species diversity, Belarus.

Amphibians represent one of the most sensitive bioindicators of environmental health due to their complex life cycles and dependence on both terrestrial and aquatic ecosystems [1]. The present study aimed to assess the species diversity of anuran amphibians in the Loyev District [2].

The study was conducted from May to August 2025 at three representative habitats located within the southern part of the Loyev District:

1) Pond site near the village of Peredelka – shallow standing water with emergent vegetation and silty substrate; a total of 47 individuals of *Bombina bombina* (fire-bellied toad) were recorded here.

2) Mixed forest near the settlement of Loyev – shaded, humid environment with temporary pools formed during rainfall. This site was inhabited by *Rana terrestris* (moor frog, 28 individuals) and *Rana temporaria* (common frog, 31 individuals).

3) Swamp area near the Sozh River floodplain – open, permanently waterlogged habitat dominated by sedges and reeds. Here *Rana esculenta* (edible frog, 22 individuals) and *Rana ridibunda* (lake frog, 19 individuals) were observed.

In total, five species of anurans were identified: *Bombina bombina*, *Rana terrestris*, *Rana temporaria*, *Rana esculenta*, and *Rana ridibunda*. These species represent two families *Ranidae* and *Discoglossidae* and two ecological groups: aquatic (*R. esculenta*, *R. ridibunda*, *B. bombina*) and semi-terrestrial (*R. terrestris*, *R. temporaria*).

Species abundance and distribution varied among habitats. The pond site supported the largest population of Bombina bombina, a species preferring calm shallow waters with abundant vegetation cover, serving as both breeding

and feeding grounds. The mixed forest was dominated by *Rana terrestris* and *Rana temporaria*, which were frequently observed near small pools and damp leaf litter. The swamp habitat hosted *Rana esculenta* and *Rana ridibunda*, which exhibited strong association with open sunlit wetlands and slow-flowing channels.

Environmental parameters such as soil humidity, vegetation structure, water depth, and human disturbance strongly affected species distribution. Amphibian activity peaked during evening and night hours, with calling males most often recorded in June and early July. No invasive or non-native species were detected, indicating a stable, naturally formed local amphibian community [3].

The results confirm that habitat diversity within the Loyev District supports relatively high amphibian species richness compared to other parts of the Gomel Region. Maintaining the ecological integrity of wetlands and forest edges is crucial for the long-term conservation of amphibian populations. The collected data can be used for regional biodiversity monitoring, ecological education, and conservation planning.

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DETERMINATION OF THE ACTIVITY OF NATURAL RADIONUCLIDES BY GAMMA SPECTROMETRY

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Natural ionizing radiation primarily comes from primordial radionuclides that make up the Earth's crust. These primordial radionuclides include K-40 and the decay products of U-238, Th-232, and U-235. Soil radioactivity is determined primarily by the content of these radionuclides in the parent rock and varies among soils in different parts of the world. This results in areas with varying levels of natural background radiation.

The Canary Islands are a volcanic archipelago located in the Atlantic Ocean. They have unique geological characteristics that determine the level of natural background radiation. The level of natural radioactivity on these islands is determined by the radionuclide content of volcanic rocks and coastal sediments [1].

Keywords: natural radioactivity, radionuclides, specific activity, gamma spectrometry.

For gamma spectrometric analysis, samples of black and white sand from Tenerife, weighing 432 g and 187.5 g, respectively, and a soil sample from Gran Canaria, weighing 594.7 g, were collected.

Spectrometric measurements were conducted using a GCD-100220 semiconductor gamma spectrometer with a coaxial high-purity germanium detector. The acquisition and processing of gamma spectra, identification of radionuclides in the samples, and determination of specific activity were performed using the specialized SpectraLineGP software package.

Measurement results:

1) Soil sample (Gran Canaria) – $^{232}Th = 5{,}2 \pm 1{,}3$ Бк/кг, $^{226}Ra = 5{,}9 \pm 1{,}5$ Бк/кг, $^{40}K = 233{,}7 \pm 37{,}4$ Бк/кг.
2) Black sand sample (Tenerife Island) – $^{232}Th = 3{,}7 \pm 1$ Бк/кг.
3) White sand sample (Tenerife Island) – $^{232}Th = 9{,}1 \pm 0{,}3$ Бк/кг, $^{226}Ra = 22{,}4 \pm 4{,}5$ Бк/кг, $^{40}K = 618 \pm 111{,}4$ Бк/кг.

Sedimentary rocks such as sandstone typically have higher levels of potassium-containing minerals (e.g., feldspars), resulting in higher activity of the radionuclide ^{40}K. On average, the ^{40}K activity of sandstone is approximately 680 Bq/kg, the ^{226}Ra activity is approximately 17 Bq/kg, and the ^{232}Th activity is approximately 20 Bq/kg.

In contrast, volcanic (igneous) rocks have significantly lower activity values. For basalt, the average ^{40}K activity ranges from 150 to 400 Bq/kg, the ^{226}Ra activity ranges from 10 to 20 Bq/kg, and the ^{232}Th activity ranges from 5 to 15 Bq/kg [2].

It should be noted that the calculated activity values for the soil and sand samples correspond to the activity values inherent in these rock types. Thus, the higher potassium-40 activity in the white sand in Tenerife, which was imported from the Sahara and is a sedimentary rock (sandstone), is explained by its geochemical origin.

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IRON AVAILABILITY OF YOUNG PEOPLE IN MINSK

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Data on hair iron levels in young people in Minsk were obtained (11–60.5 mg/kg). The median was within reference limits. There were no statistically significant differences (p=0.05) in hair iron levels between boys and girls. There were some cases of hair iron levels outside the reference limits, which is concerning and requires attention and further study.

Keywords: iron, deficiency, excess, bioelements, minerals, bioelement status, chemical elements, heavy metals, trace element deficiency, hair, young people, environmental pollution.

Iron is a key component involved in various biochemical processes, such as hemoglobin synthesis, maintenance of normal immune system function, and cellular metabolism. Iron deficiency or excess can lead to serious health consequences, including anemia, metabolic disorders, and weakened immune defenses. In today's world, where the environment, lifestyle, and nutrition of young people are undergoing significant changes, it is important to monitor iron levels in the body. Minsk, as the capital and a major metropolis, represents a unique research environment, as it is home to a variety of factors influencing public health.

The aim of our study was to assess iron accumulation levels in the hair of young people in Minsk. The following objectives were addressed: 1. Collect biomaterial (hair) samples. 2. Determine iron concentrations in the hair of young people and assess its compliance with reference values. The study sampled 24 young people: 18 girls and 6 boys aged 18–22, students at the International Sakharov Environmental Institute of Belarusian State University and who had been living in Minsk for more than 1 year. The study focused on Fe (iron) concentrations in hair. Research methods included survey analysis, statistical analysis, and X-ray fluorescence analysis [1]. Hair sampling, sample preparation, and measurements were performed according to established methods at the Environmental Monitoring and Management Laboratory of the International Sakharov Environmental Institute. Table 1 presents data on the concentrations of chemical elements in the hair of the young people studied, compared to reference values.

Table

Iron content in the hair of girls and boys in Minsk (p=0.05), mg/kg

Groups	Mean ± error (p=0,05) Minimum-maximum median, percentiles25-75%	Reference values	
		minimum	maximum
Girls, n=18	19,86±3,95 11 – 44 17,75; 15,6 – 22,3	13	35
Young men, n=6	23,92±18,98 14 – 60,5 16,5; 15,25 – 20	13	35

Hair iron levels in young people in Minsk ranged from 11 to 60.5 mg/kg, with the median within the reference range. The study results showed no statistically significant differences (p=0.05) in hair iron levels between boys and girls. However, cases of low and high iron levels were identified. Among girls, 11.1% were in the deficient range, 83.3% were within the normal range, and 5.6% had excess levels. Among boys, 83.3% were within the normal range, and 16.7% were above the reference range.

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DECISION-MAKING IN ECOLOGY: HOW GIS TECHNOLOGIES HELP MANAGE ENVIRONMENTAL QUALITY

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The article reveals the key role of geographic information systems in modern environmental monitoring. It discusses the main tasks of monitoring, with a particular focus on the functions of GIS aimed at supporting the optimization of environmental protection activities.

Keywords: geoinformation systems, environmental monitoring, data.

A Geographic Information System (GIS) is a hardware-software complex designed to work with spatial data. It allows for the collection, storage, analysis, and visualization of geographic information in the form of maps and models. The essence of GIS technology is based on the principle of multi-layering: distinct layers containing information about individual elements of the territory are overlaid on the primary layer of the geographic map.

The essence of environmental monitoring lies in the comprehensive collection of data from various components of the environment, followed by analysis, forecasting, and identification of change dynamics. This information serves as the foundation for evidence-based environmental regulation, with geographic information systems playing a crucial role as an essential analytical tool in this process.

GIS tools are used to perform spatial modeling that allows assessment and prediction of pollutant dispersion in the atmosphere and water systems – for example, concentration fields are generated from emissions and meteorological data, helping to estimate the potential scale of impact.

Assessment of habitat degradation: based on GIS data, maps of key environmental parameters are created. By comparing these with current information about the state of ecosystems, one can evaluate the scale and speed of degradation, as well as track anthropogenic impacts over time.

For cadastral purposes, GIS is used to create digital registries and maps of property owners: this ensures the integration of parcel geometry with attribute information and simplifies the management and analysis of land resources.

An equally important role is assigned to the monitoring of protected areas, where GIS is used to systematize information about nature reserves and other valuable zones, helping to plan conservation activities, track the status of rare biological species, regulate anthropogenic loads, and analyze land productivity. The systems also provide invaluable assistance in habitat restoration – from identifying optimal areas for species reintroduction to monitoring organism adaptation.

Additionally, GIS performs a critically important function of retrospective analysis, allowing for the evaluation of the effectiveness of undertaken conservation measures at various territorial levels.

Besides standard GIS functions, the software complex used provides: the formation and maintenance of ecological data bases for territories, enterprises, and environments (air, water, soil); a database of regulatory legal documents in

the field of ecology; a database of standards for pollutant content in various environmental components and food products; and a database of ecological monitoring instruments.

In conclusion, it can be stated that GIS technologies play a critically important role in ecological monitoring and related fields. Their implementation allows for the automation of labor-intensive processes, reduces dependence on human factors, and minimizes the number of errors.

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ASSESSMENT OF THE OCCURRENCE OF AUXOTROPHIC FORMS OF SANITARY-INDECENT MICROORGANISMS IN SOILS OF RECREATIONAL AREAS OF MINSK

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During the study, bacteria of the genus Escherichia and genus Staphylococcus were isolated and identified from soil samples. The highest numbers of auxotrophic variants of coliform bacteria, particularly *E. coli* and *S. aureus*, were found in samples from beach №2 and the lowest in beach №3. These results may indicate a potential high organic matter content in the soil. Coli titer values ranged from 0,008 to 0,1, and the coli index was 10^4, suggesting severe beach pollution.

Keywords: microorganisms, auxotrophy, total microbial count, recreational areas, soil, culture method.

Currently, due to rapid technological progress, much attention is being paid to the study of the widespread phenomenon of auxotrophy, which refers to the inability to independently synthesize certain growth factors. The fact that some epidemiologically and ecologically significant microorganisms require amino acids, nitrogenous bases, and vitamins for growth is widely used in research on prokaryotic taxonomy and genetics.

Regarding the presence of sanitary indicator microorganisms, particularly *E. coli* and *S. aureus*, in soil, their concentrations should not exceed the regulated sanitary and epidemiological indicators. For soil, such indicators include the total microbial count, the coliform titer, the *C. perfringens* titer, the nitrifying bacteria titer, the coliform index, and the thermophilic microorganism index.

During the study, bacteria of the genus Escherichia and genus Staphylococcus were isolated and identified from soil samples. Sampling was carried out from Beach №1, Beach №2 on the Drozdy Reservoir, and Beach №3 on Lake Komsomolskoye. The total microbial count from the Drozdy Reservoir samples was $3{,}57 \times 10^5 \pm 2 \times 10^4$ and $0{,}296 \times 10^5 \pm 2 \times 10^3$ CFU/g, respectively, and from the Lake Komsomolskoye samples it was $6{,}08 \times 10^5 \pm 5 \times 10^4$ CFU/g, which corresponds to the standard values.

During the study, the coli index and coli titer values were calculated for soil samples from beaches №1 and №2 of the Drozdy Reservoir and beach №3 of Komsomolskoye Lake. Soil was assessed as clean if its coli titer was equal to 1 or higher; contaminated if the coli titer was from 0,9 to 0,01; and heavily contaminated if the coli titer was equal to 0,009 or lower. Coli titer values ranged from 0,008 to 0,1, and the coli index was 10^4. Based on the coli titer and coli index results, it can be concluded that regular sanitary and microbiological monitoring of the soils in these areas is necessary.

The amount of auxotrophic variants of coliform bacteria, in particular *E. coli* and *S. aureus* in soil samples from beach №1 was 47 ± 4.03% and 26 ± 2.2%, beach №2 – 59.2 ± 5.1% and 4 ± 0.4%, beach № 3 – 17 ± 1.3% and 3 ± 0.2% for these bacteria, respectively. Such results may indicate a possible high content of organic matter in the soil.

Thus, according to the obtained results, the presence of auxotrophic variants of *E. coli* and *S. aureus* in the soil samples can be explained by the possible high concentration of organic matter. The coli titer and coli index values exceed sanitary and hygienic standards, making recreation in these areas inadvisable, as excess coliform bacteria in

beach soils can lead to increased intestinal infections among the population. This constitutes the basis for sanitary and epidemiological monitoring of the beaches.

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RESEARCH OF PHYSICAL AND CHEMICAL PROPERTIES OF SOIL IN AREAS OF POTASH PRODUCTION

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Soil salinization occurs due to clay-salt sludge and gallite waste. The formation of liquid and solid gallite waste in the Republic of Belarus is associated with the development of new potassium salt deposits. One of the possible measures for land restoration is biological reclamation. Biological reclamation is a set of measures aimed at restoring disturbed lands with the help of halophyte plants.

Keywords: clay-salt sludge, gallite waste, biological reclamation

The purpose of this work is to study the physico-chemical properties of soil in areas of potash production to justify the choice of plants for biological reclamation. To achieve it, the following tasks have been solved: 1) studies of the granulometric composition, humidity, acidity, and salinity of soil samples taken at a distance of 100 m, 200 m, and 300 m from the terricon were carried out; 2) the germination of halophyte plant seeds selected for biological reclamation of saline soils was analyzed.

The granulometric analysis of the soil was carried out using the sieve method, which is based on the mechanical separation of soil particles into different size fractions using sieves with different hole diameters. The following soil samples were used as the analyzed samples:

- Sample No. 1 (100 m from the spoil heaps);
- Sample No. 2 (200 m from the spoil heaps);
- Sample No. 3 (300 m from the spoil heaps).

The analysis of the results of the granulometric composition of the soil taken at a distance of 100, 200 and 300 meters from the spoil heaps showed that the studied samples according to the classification of N.A. Kachinsky belong to the cohesive-sandy composition.

Determination of soil moisture was carried out by drying the studied samples in an electric heating oven at a temperature of 105ºC-110ºC and subsequent determination of the loss of mass fraction of moisture. After that, the hygroscopicity coefficient was calculated to convert the analysis results to an absolutely dry soil.

The soils near the spoil heaps are quite dry, with a moisture content of no more than 8% according to the results of the studies.

The acidity of the analyzed soil samples was determined using a universal indicator paper. The pH of the analyzed soil samples is 7.5-8 (alkaline reaction).

The degree of salinity of the analyzed soil samples was determined by measuring the amount of dry and calcined residue. The mass of dry and calcined residue was determined by calculation, taking into account the hygroscopicity coefficient. The obtained data on the amount of dry residue in the water extract shows the total content of water-soluble organic mineral compounds in the soil, while the amount of calcined residue provides information on the total amount of water-soluble mineral salts. Based on the amount of dry and calcined residue, all the samples are classified as saline.

Sample No. 1 (100 m from the spoil heap) showed the highest level of salinity. The results of the analysis speak of the horizontal migration of salts.

To determine the possibility of growing halophyte plants, an experiment was conducted to determine the content of the natural radionuclide potassium 40 and the radionuclide of the Chernobyl release - cesium 137 in soils on the ALIOT device. The surface activity of the soil samples was calculated. Since it is less than one Curie per square kilometer, it was concluded that it is possible to grow plants.

The following halophyte plants were selected for biological reclamation: meadow bluegrass, phacelia tanacetifolia, sugar beet, and barley.

The highest percentage of germination on all studied soil samples (100 m, 200 m, 300 m from the terricon, control sample) is observed in barley – 70.0%, 76.7%, 83.3% and 93.3%, respectively. The germination rate of seeds of all selected crops is 10-20% higher in the control soil sample, which allows us to conclude that the initial seeding rate should be increased by 20-30% during biological reclamation on saline soils.

The results of laboratory studies showed that halophyte plants such as bluegrass, phacelia, beetroot, and barley can be used for biological reclamation of saline, sandy, dry, and alkaline soils. Barley showed the highest tolerance to saline soils, and the seeding rate for saline soils should be increased by 20-30%.

ANALYSIS OF ENVIRONMENTAL IMPACT OF PHOSPHORUS FERTILIZER PRODUCTION WASTE STORAGE FACILITIES ON SOIL COVER

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The environmental impact of storage facilities for phosphorus fertilizer production waste on the soil cover has been analyzed. Long-term, large-scale accumulation of phosphorus fertilizer production waste has led to the formation of a technogenic geochemical province in the area of phosphogypsum dumps of OJSC "Gomel Chemical Plant" and its nearby periphery. The dominant elements in this province are phosphorus, sulfur, and fluorine. Local contamination of the soil cover within the enterprise's territory by heavy metals has been observed.

Keywords: environmental protection activities, industrial waste management, phosphogypsum, soil monitoring, heavy metals, local monitoring, environmental management.

OJSC "Gomel Chemical Plant" is one of the leading enterprises in the petrochemical industry and the only company in the republic with a full production cycle for phosphorus-containing fertilizers. The raw materials used for fertilizer production are enriched natural phosphate ores - apatite concentrate from the Russian Federation and phosphorites from North African countries.

Acid decomposition of natural phosphate ores generates significant volumes of liquid and solid waste, the latter represented by phosphogypsum. Phosphogypsum is a white, loose, greasy-to-the-touch material. Its removal is carried out by freight transport to long-term waste storage sites - phosphogypsum dumps designed in the form of spoil heaps. The area allocated for these dumps exceeds 90 hectares. The height of individual spoil heaps reaches up to 90 meters, with a total length of approximately 400 meters.

An analysis of statistical data on the phosphorus fertilizer production waste management in the Republic of Belarus revealed that the accumulated volume of phosphogypsum as of early 2025 exceeded 26.4 million tons. The annual increase ranges from 700 to 900 thousand tons. The phosphogypsum recycle rate declined from 0.8% (6.43 thousand tons) in 2019 to 0.18% (1.50 thousand tons) in 2024 of the total amounts generated [1]. At the same time, the total design capacity of phosphogypsum processing facilities registered in Belarus exceeds 1.9 million tons per year [2].

The surface of phosphogypsum dumps is subject to intense water erosion due to raindrop splash dispersal of soil particles and washouts caused by temporary surface runoff streams. This leads to the formation of an erosion-accumulation cycle and contamination, primarily of the soil cover in the dump placement zone and its nearby periphery.

Long-term accumulation of phosphorus fertilizer production waste has resulted in the technogenic geochemical province formation, whose dominant elements are the main waste components - phosphorus, sulfur, and fluorine.

The average phosphorus content in the form of superphosphate in the soils of the enterprise's territory is 3.0 g/kg in the surface layer (0-5 cm) and 1.9 g/kg at a depth of 5-20 cm. A decrease in the concentration of this element with depth is observed, ranging from 1.5 to 11 times.

Total sulfur concentrations in the soils of the phosphogypsum dump zone and its nearby periphery range from 1.5 to 2.5 g/kg.

No fluoride contamination of the enterprise's soils has been detected: the average content of water-soluble forms of this element is 4.87 mg/kg in the surface horizon (0-5 cm) and 6.06 mg/kg at a depth of 5–20 cm.

Heavy metal content is within acceptable limits, with the average cadmium concentration not exceeding 0.1 MAC (Maximum Allowable Concentration). Local exceedances of MAC for heavy metals have been recorded, which are attributed to the close proximity of other industrial facilities.

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ENVIRONMENTAL DEVELOPMENT RATING DYNAMICS OF THE REGIONS OF THE REPUBLIC OF BELARUS FOR 2020–2023

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Environmental development rating dynamics of the regions of the Republic of Belarus from 2020 to 2023 have been analyzed. The rating is based on three categories of indicators, each assigned a specific weight (in %): current state and use of environmental components (30%), impact of major types of economic activity on the environment (30%), and environmental impact management and environmental policy effectiveness (40%). Analyzing the set of indicators in each category allows for ranking the regional centers and districts of the Republic of Belarus from best to worst.

Keywords: environmental protection activities, environmental rating, environment current state, environmental policy, environmental management.

Work on compiling, maintaining, and updating the environmental development rating of the regions of the Republic of Belarus has been conducted since 2020. The goal is to provide a comprehensive assessment of the environmental condition of the republic’s regions as part of the implementation of the state policy of the Republic of Belarus in the field of sustainable development and improving environmental quality [1].

The rating indicators for administrative-territorial units are grouped into indicator groups, which are then combined into categories. Each category includes 4 to 6 indicator groups (3 to 5 groups for cities). Based on statistical data, a linear scaling operation is performed to calculate scores for each administrative-territorial unit. Final category scores are determined by summing the scores of each group within the category. Based on the total scores among cities and/or districts, the absolute leader and outsider are identified [1].

In 2023, among the regional centers of the Republic of Belarus, Vitebsk ranked first in the category “Current state and use of environmental components” with 207 points, while Minsk was the lowest with 60 points. The cities were ranked from best to worst in this category as follows: Vitebsk, Brest, Gomel, Mogilev, Grodno, Minsk.

In the category “Impact of major types of economic activity on the environment,” Brest took the leading position in 2023 with 277 points, indicating the lowest environmental impact, while Gomel ranked last with 145 points. The ranking in this category is: Brest, Vitebsk, Minsk, Grodno, Mogilev, Gomel.

In the category “Management of environmental impact and environmental policy effectiveness” Minsk retained the leading position in 2023 with 404 points, while Gomel was again the lowest with 135 points. The cities were ranked in this category as follows: Minsk, Vitebsk, Grodno, Mogilev, Brest, Gomel.

Thus, the final results of the environmental development rating of regional centers across all three categories in 2023 are as follows: first place – Minsk, second – Vitebsk, third – Brest; Grodno, Mogilev, and Gomel ranked fourth to sixth, respectively. The results of the environmental development rating of regional centers for 2020–2023 are presented in Table 1.

Table

Environmental development rating of regional centers for 2020-2023

Name of the administrative-territorial unit	Position			
	2020 г.	2021 г.	2022 г.	2023 г.
Brest	2	1	1	3
Vitebsk	6	5	5	2
Gomel	5	6	4	6
Grodno	1	4	2	4
Minsk	4	3	3	1
Mogilev	3	2	6	5

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ANALYZING ENVIRONMENTAL POLLUTANTS, AFFECTING FERROPTOSIS, THEIR POSSIBLE CONSEQUENCES AND PREVENTION STRATEGIES

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Environmental pollutants suppress ferroptosis, impacting cellular bioenergetics and aging rate. A multifaceted approach combining natural compounds, pharmacology, and biotechnology is crucial to preserve mitochondrial health.

Keywords: Ferroptosis, G-quadruplexes, mitochondrial DNA, environmental pollutants, heavy metals, radiation, bioenergetics, aging

Ferroptosis was identified in 2012, and it was termed as a regulated cell death pathway associated with an iron-dependent lipid peroxidation. Now it considered to be a vital mechanism for eliminating compromised cells, preventing their accumulation, also supporting normal iron metabolism [1]. Some key cellular defense mechanisms, such as the glutathione peroxidase 4 (GPX4) and glutathione (GSH), are important in the antiferroptotic process. But under the environmental stress this protective action can be abnormal.

Iron metabolism and ferroptosis can be influenced by numerous environmental pollutants and ionizing radiation. A possible mechanism for this effect may be an impact on G-quadruplex (G4) structures in the genome, particularly in mitochondrial DNA (mtDNA) [3,4]. G4 is a guanine-rich DNA region that is particularly vulnerable to oxidative damage. Thus, some environmental toxicants can disrupt mtDNA replication and transcription, cause damage to the electron transport chain (ETC), excessive formation of reactive oxygen species (ROS), and impaired cellular energy production. These events may explain the development of age-related pathologies and accelerated aging [4]. First, several elements deserve attention: selenium, often present in agricultural waste, can increase the expression of the selenoprotein GPX4 and thus disrupt iron metabolism, potentially enhancing G4 stabilization in mtDNA genes such as ND5 [1]. Second, two other metals, zinc and cadmium, can also stabilize G4 structures in other regions (CYTB and

COX1). This may lead to similar impairments in mitochondrial function and suppression of ferroptosis [2,3]. Third, it is worth noting that radioactive elements such as cesium-137 (137Cs) can affect mtDNA G4, causing damage that disrupts the replication process and may lead to bioenergetic disturbances [4].

Regarding counteracting the impact of environmental factors on ferroptosis, a number of researchers place hope in innovative approaches. For example, the use of a number of plant metabolites, such as flavonoids and polyphenols, especially from the flora of the Russian Far East, which are capable of binding to G4 and influencing iron availability, may be very promising [2,5]. Specific ligands (e.g., TMPyP4) have a similar effect, based on the ability to bind to G4 and prevent its stabilization. Some drugs (erastin, RSL3) can directly influence the ferroptosis pathway. In the long term, the integration of new advanced technologies is expected: bioinformatics tools, including AI-based methods for the analysis of genetic variants associated with G4, and CRISPR base editing tools, which will allow for more precise manipulation of genetic material, reduce the effects of radiation mutagenesis, and promote the restoration of mitochondrial function [1,4].

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IMPROVING THE ENERGY EFFICIENCY OF LASER CUTTING STEEL MATERIALS USING HYDROABRASIVE PRETREATMENT

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Keywords: laser cutting, jet, bentonite clay, metal, machinery, mechanisms, technology, mechanical engineering, mechanics, corrosion, coating, speed, cleaning, material.

The high efficiency of modern methods for manufacturing machine parts and mechanisms is closely related to the quality of preliminary cleaning of metal surfaces from corrosion. The required level of processing is achieved through the use of jet technological solutions, especially in the context of laser cutting used at engineering enterprises of the Republic of Belarus [1-4]. One of the key indicators determining the effectiveness of laser metal processing is the speed of laser cutting (Figure 1). Let's consider an innovative approach to jet cleaning of metal materials from corrosion, with subsequent application in the laser cutting process. The distinctive feature of the proposed hydroabrasive treatment method is the introduction of special components into the high-pressure water jet – bentonite clay, soda ash, and soot. This not only ensures effective corrosion removal but also creates a surface optimal for laser cutting. At the Department of "Energy-Efficient Technologies" of the International Sakharov Environmental Institute in cooperation with the Department of "Hydraulic Engineering and Energy Construction, Water Transport and Hydraulics" of the Belarusian National Technical University, research was conducted on a new method for cleaning metal materials from corrosion with subsequent use for laser cutting. To analyze the influence of hydroabrasive treatment parameters on the laser cutting speed, industrial tests were conducted on three groups of samples made from St3, St20, and St45 steels. The sample dimensions were 200 × 200 mm with a sheet thickness range of S = 2-12 mm. Based on the results of experimental

studies, a modernized technology for hydroabrasive cleaning of metal materials was developed, intended for corrosion removal with their subsequent processing by laser cutting. The proposed technology uses a working fluid containing the following components [3]: bentonite clay (K_b = 1.5-2.5 %), soda ash ($K_{s.a.}$= 1.8-2.2 %), soot (K_s = 11-13 %), and water. The use of this working fluid allowed for an increase in laser cutting speed by 8-12 % compared to the results obtained using a similar fluid containing polyacrylamide instead of soot – and without the need for introducing additional technological operations.

Fig:1 External appearance of the HYPER-GEAR-510 laser cutting complex:
1 - laser machine module; 2 - pallets; 3 - the door closing the work area

Conclusions. Based on the conducted experimental studies, as well as the patent source [3], an improved hydroabrasive cleaning (HAC) technology was developed, intended for removing corrosion from metal materials with their further use in laser cutting processes. This technology involves the use of a working fluid prepared based on bentonite clay (K_b=1.5-2.5 %), soda ash ($K_{s.a.}$=1.8-2.2 %), *soot* (K_s=11-13 %), and water, which allowed for an increase in laser cutting speed of up to 8-12 % (compared to data [5]) without performing additional technological operations.

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AIR POLLUTION CHARACTERISTICS AND THEIR RELATIONSHIP WITH METEOROLOGICAL FACTORS IN SHANXI PROVINCE

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Base on the daily mass concentrations of 6 air pollutants (SO_2, NO_2, PM_{10}, $PM_{2.5}$, CO and O_3), air quality index (AQI), meteorological observations and Modern Era Retrospective-analysis for Research and Applications (MERRA-2) reanalysis product the characteristics of air pollution and its correlations with meteorological factors in 11 cities of Shanxi Province during 2015 - 2019 will be analyzed and presented in this study.

Keywords: air pollution, meteorological factors, Shanxi province.

China’s rapid economic growth has been accompanied by massive consumption of fossil fuels such as coal. The resulting emissions of various polluting gases and particulate matter have led to an overall decline in air quality over the past decade, with frequent occurrences of heavy pollution events. Air pollution not only harms human health and affects atmospheric visibility, urban transportation, radiation balance, and cloud-precipitation processes but also further induces

climate change, damaging industrial and agricultural production as well as economic development. Therefore, air pollution has become a major concern for both the government and the public. Currently, particulate matter and ozone pollution represent the most significant air quality issues in China.

The Beijing-Tianjin-Hebei region and its surrounding areas are key zones for air pollution in northern China. Extensive and in-depth research has already been conducted on air pollution in the Beijing-Tianjin-Hebei region. Shanxi Province, adjacent to the Beijing-Tianjin-Hebei region, is an important coal reserve and production base in China. At the same time, its unique “valley between two mountains” topography hinders the dispersion of air pollutants, leading to prominent air pollution issues in recent years. Current research on air pollution in Shanxi Province has primarily focused on key cities such as Taiyuan, Changzhi, and Linfen. Studies have indicated that surface-level ozone in Taiyuan showed an increasing trend from 2013 to 2017, with its precursor volatile organic compounds (VOC) mainly originating from industrial emissions and transportation sources. Observational and modeling studies suggest that regional transport significantly impacts air quality in Shanxi and its surrounding areas. Some research has pointed out a certain correlation between haze events in Shanxi Province and anomalies in East Asian atmospheric circulation. Moreover, the effective implementation of air pollution control policies has significantly improved air quality in Shanxi. Overall, comprehensive analytical studies on the long-term variation characteristics of multiple air pollutants in Shanxi Province still need to be strengthened.

The air quality data in this study consist of daily average mass concentrations of 6 atmospheric pollutants (SO_2, NO_2, PM_{10}, $PM_{2,5}$, CO and O_3) and the Air quality index (AQI) for 11 cities in Shanxi Province from 2015 to 2019. Monthly, seasonal, and annual averages will be calculated based on these data. The meteorological data employed in this study include daily average observations from conventional weather stations and monthly average products from The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) reanalysis dataset. The weather station data were obtained from the China Meteorological Data Center (CMDC) (http://data.cma.cn/). MERRA-2 is a next-generation reanalysis dataset developed by NASA in the United States. It focuses on weather and climate time scales as well as fields related to the water cycle. The dataset assimilates satellite-based hyperspectral infrared radiance, microwave observations, and GPS radio occultation data. The spatial resolution of the MERRA-2 product is $0.5° \times 0.625°$.

Thus, this study will comprehensively utilize daily average data on the mass concentrations of 6 air pollutants and the AQI from 11 cities in Shanxi Province from 2015 to 2019 along with meteorological station observations and MERRA-2 reanalysis products to analyze the characteristics of air pollution changes in Shanxi Province and their relationship with meteorological factors [1 - 3].

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ANALYSIS OF THE DEVELOPMENT OF THE GREEN ECONOMY IN CHINA

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The article shows that the "green economy" is a new economic structure that is being widely implemented in agriculture, the industrial sector and other economic services. It represents a growth model that is more efficient, harmonious, and sustainable. The "green economy", "green new deal" and "green society" are recognized worldwide as a common consensus and direction for the development of human civilization in the 21st century.

Keywords: digital economy; green economy; Development effect

Green development is an important strategic direction for our country's economic and social development, and it is also an important path for our country to achieve the "double carbon" goal. In recent years, our country's digital economy has developed rapidly, but it has also brought about problems such as resource consumption and environmental pollution. Explore its effect on empowering green economic development. At the theoretical level, it is mainly analyzed from the aspects of digital economy empowering green technology innovation, upgrading of green industrial structure, and release of green consumer demand. At the practical level, taking the development and utilization of data resources as an example, this paper analyzes its role in the transformation and upgrading of traditional industries and promoting consumption upgrading. At the same time, we will work together from both sides of supply and demand to give full play to the enabling effect of the digital economy in the development of the green economy and help our country achieve the "double carbon" goal.

The green economy is an economic structure, growth model, and social form that aims for efficiency, harmony, and sustainability, with ecological agriculture, circular industry, and sustainable service industries as its core components. The green economy represents a brand-new trinity of theoretical ideas and development systems. This includes a trinity of objectives - "efficiency, harmony, and sustainability"; a trinity of structures-"ecological agriculture, circular industry, and sustainable service industries"; and a trinity of development systems-"green economy, green new deal, and green society." History has shown that the green economy constitutes a new economic structure following agricultural, industrial, and service economies. It represents a growth model that is more efficient, harmonious, and sustainable, and a social form that surpasses agricultural, industrial, and service society. The green economy, green new deal, and green society are recognized globally as the shared consensus and developmental direction of human civilization in the 21st century.

The British economist Pearce first proposed the concept of a green economy in his 1989 publication, *The Green Economy Blue Paper*. In the 1990s, Jacobs, Postel, and others advocated in their version of green economics that, in addition to the three traditional factors of production in classical economics-labor, land, and man-made capital-there must be an inclusion of social and organizational capital (SOC). They also made slight modifications to the definitions of the other three types of capital: 1. Human capital: emphasizing the health, knowledge, skills, and motivation of the workforce. 2. Expanding land costs into ecological capital, or natural capital. 3. Man-made capital remains unchanged, also referred to as manufactured capital.

NEURAL NETWORKS ARCHITECTURES FOR PREDICTING POLLUTANT MIGRATION IN SOIL

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The main types of neural networks (NN) architectures for predicting pollutant migration in natural dispersed media are discussed. A description of the architecture of physically-informed neural networks for solving forecasting problems is provided.

Keywords: neural networks, physics-informed neural networks, architectures neural networks.

Forecasting the migration of pollutants in soil is a multifaceted task that involves the interaction of hydrological, geochemical, and biological processes. Traditional numerical methods, such as the finite difference method and the finite element method, offer high modeling accuracy but require significant computational resources and are sensitive to the quality of input data. In recent years, increasing attention has been paid to the use of neural networks, including physics-informed neural networks (PINNs), which allow physical laws to be incorporated into the training process [1].

The application of neural networks to pollutant migration forecasting is based on their ability to approximate complex nonlinear relationships between environmental input parameters and pollution output characteristics. The most

commonly used architectures include multilayer perceptrons (MLPs) [2], convolutional neural networks (CNNs) [3], and recurrent neural networks (RNNs) [4], each offering unique advantages depending on the input data structure and nature of the task.

A multilayer perceptron (MLP) is a basic form of neural network consisting of an input layer, one or more hidden layers, and an output layer. In pollutant migration modeling, MLPs are used to predict the concentration of a substance at a given point in space and time based on environmental parameters such as porosity, moisture content, hydraulic conductivity, initial concentration, and others. MLPs perform well in regression tasks [2], especially when large volumes of training data are available, but may struggle with modeling spatiotemporal dependencies.

Convolutional neural networks (CNNs), originally developed for image processing, are useful in tasks where data have spatial structure. For example, when modeling the spread of pollutants in two- or three-dimensional soil domains, CNNs can effectively extract local patterns related to medium heterogeneity. Convolutions help identify migration patterns associated with terrain features, porosity distribution, and localized sources of contamination.

RNNs, including their variants such as Long Short-term Memory (LSTM) and Gated Recurrent Unit (GRU) neural networks, are applied for modeling the temporal dynamics of pollutants migration. These networks can capture sequences of events, such as changes in pollutant concentration over time at a single location. This is particularly important for modeling processes influenced by weather conditions, seasonal fluctuations, or cyclical anthropogenic impacts. However, RNNs can be sensitive to the vanishing gradient problem, which limits their effectiveness over long time intervals.

Hybrid architectures such as Convolutional LSTM or Convolutional GRU combine the strengths of CNNs and RNNs, providing opportunities of simultaneous modeling of spatial and temporal dependencies. These models are especially promising for tasks that require predicting pollutant dispersion across space and time using multidimensional input data.

PINNs as a hybrid architecture deserve special attention. Unlike classical neural network architectures, PINNs allow pollutant transport equations to be incorporated directly into the loss function, enabling the model to learn not only from laboratory or field data but also from physical constraints. It enhances the model's robustness to input data noise and improves its generalization capability.

PINNs are trained so that their output satisfies the governing equations at every point in space and time, allowing for physically based predictions even with limited input data. Recent studies [1,3,5] have demonstrated the successful application of PINNs to modeling transport processes in porous media, such as advection and diffusion.

Thus, integrating PINNs into pollutant migration forecasting tasks opens new avenues for environmental modeling compared to more traditional NN architectures. So it makes PINNs attractive to use for predicting pollutants migration in soil because of their robust and physically grounded predictions which has already been proven in practice.

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ELEMENTAL COMPOSITION OF GERMAN CHAMOMILE *(MATRICARIA RECUTITA L.)*

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The elemental composition (Ca, Cu, Fe, Hg, Mn, Pb, Sr, Zn) was determined in pharmaceutical raw material of German chamomile (*Matricaria recutita L.*) sold in pharmacy networks of the Republic of Belarus and produced in Vitebsk and Grodno regions. The content of all determined elements was within sanitary and hygienic standards.

Keywords: German chamomile, Matricaria recutita L., elemental composition, heavy metals, macro- and microelements

German chamomile (*Matricaria recutita L.*) is an annual herbaceous plant; species of the genus *Matricaria*, family *Asteraceae (Compositae)*, the type species of this genus. The root is taproot, weakly branched. The stem is erect, 15-60 cm high. Leaves are alternate, sessile, broadly lanceolate or ovate. Inflorescences are conical baskets, numerous, located on pedicels. Fruits are achenes. The plant is widely distributed in Eurasia and North America; actively cultivated; as an introduced species occurs in almost all extratropical regions of both hemispheres. German chamomile is a popular pharmaceutical remedy in folk medicine; however, plants are capable of absorbing almost all elements of D.I. Mendeleev's periodic system from the environment, the content of some of which is important to control, which determines the relevance of this study.

The aim of our work was to evaluate the elemental composition of German chamomile. Therefore, the following tasks were solved: 1. Provide botanical description of German chamomile. 2. Investigate the elemental composition of German chamomile. 3. Compare the elemental composition of German chamomile with sanitary and hygienic standards.

For this study, we purchased the following chamomile samples from one of Minsk pharmacies: 1. Chamomile flowers Meditea "MPC Biotest" (manufacturer Grodno, Republic of Belarus), 20 filter bags of 1.5 g. 2. Chamomile flowers Meditea "MPC Biotest" (manufacturer Grodno, Republic of Belarus), loose. 3. Chamomile flowers coarse powder LLC "Kalina" (manufacturer Vitebsk region, Orsha district, Pishchalovo village, Republic of Belarus), 20 filter bags.

In German chamomile samples purchased in Minsk pharmacies, the following elements were determined by X-ray fluorescence method: Ca, Cu, Fe, Hg, Mn, Pb, Sr, Zn. The highest Ca content was found in sample No. 2 – 2624 mg, which is 1.5 times higher than in sample No. 1, where calcium content was 1721 mg. The highest Cu content was in sample No. 2 – 5.1 mg, which is 1.1 times higher than in sample No. 3, where the content of this element was 4.6 mg. Fe content: the highest value was in sample No. 3 – 159 mg, which is 2.7 times higher than in sample No. 2, where the element content was 58.6 mg. The content of Hg and Pb was the same in all samples – 0.1 mg and 1.7 mg respectively. The highest Mn content was in sample No. 3 – 28.9 mg, which is 1.19 times higher than in sample No. 2 – 24.1 mg. The highest Sr content was in sample No. 2 – 21.8 mg, which is 2.5 times higher than the content of this element in sample No. 3 – 8.7 mg. The highest Zn content was in sample No. 2 – 26.2 mg, which is 1.37 times higher than in sample No. 1 – 19.1 mg.

The obtained elemental composition and element concentrations in German chamomile samples were compared with sanitary and hygienic standards. The concentrations of Cu (in samples within 4.6–5.1 mg), Hg (in all samples 0.1 mg), Mn (in samples within 24.1–28.9 mg), Pb (in all samples 1.7 mg), Zn (in samples within 19.1–26.2 mg) were within normal limits.

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CRITERIA FOR SELECTING THE REFERENCE PERSON AND REPRESENTATIVE PERSON FOR ASSESSING RADIATION DOSES FROM TRITIUM IN VARIOUS EXPOSURE SITUATIONS

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The modern system of radiation protection is based on a differentiated approach to dose assessment, including from tritium, which involves the use of two key concepts – the reference person and the representative person. These concepts find different applications depending on the exposure situation: planned, emergency, or existing. The assessment of radiation doses from tritium is particularly relevant for the Republic of Belarus in connection with the commissioning of the Belarusian NPP. The development of criteria for the reference person and representative person adapted to national conditions is crucial for improving the country's radiation safety system.

Keywords: tritium, representative person, reference person, exposure situations, radiation safety

The reference person is a standardized biokinetic and dosimetric model with a fixed set of anatomical and physiological parameters. For tritium, the key characteristics of this model are total body water content and water turnover rate, lung ventilation rates for different activity levels, skin absorption parameters for tritiated water (HTO), and daily consumption of water and foodstuffs. In planned exposure situations, the reference person model is used for dose assessment using dose coefficients, establishing authorized discharge limits, and subsequently planning protective measures. In emergency situations, this model is applied for dose prediction in the early phase of an accident and for developing criteria for protective measures [1].

The representative person is a hypothetical individual whose characteristics reflect the conditions of the most exposed part of the population in a specific exposure situation. The criteria for selecting the representative person in planned exposure situations include the principle of reasonableness, which involves using real data on the consumption of local food and water; the principle of sustainability, requiring that consumption habits are maintained over a long period; and the principle of homogeneity, meaning the representation of a population group with similar characteristics [1, 2]. In emergency situations, the approach to defining the representative person shifts towards using scenarios of maximum plausible exposure, accounting for short-term changes in population behavior, and applying more conservative parameters. In existing exposure situations, priority is given to using environmental monitoring data, accounting for actual dietary habits of the population, and analyzing the actual use of local resources [2].

Of particular importance in assessing radiation doses from tritium is accounting for its specific characteristics. Critical aspects are the dominance of oral intake with water, the significance of percutaneous intake for HTO, age-dependent metabolic features, and the rapid achievement of equilibrium in the body. According to [2, 3], three age categories are used for dose assessment: infants (0-5 years) with parameters of a 1-year-old child, children (6-15 years) with parameters of a 10-year-old child, and adults (16-70 years) with adult parameters. For tritium, the infant group is often critical due to high specific water consumption, intensive water turnover, and specific distribution characteristics in the body.

Thus, the criteria for defining the reference person and representative person for tritium must account for the specifics of various exposure situations. In planned exposure situations, priority is given to sustainable and justified scenarios; in emergency situations – to conservative estimates; in existing situations – to real monitoring data. For Belarusian conditions, particular importance is placed on accounting for regional features of water consumption and dietary structure when determining the parameters of the reference person. The development of national criteria for assessing radiation doses from tritium will optimize the radiation monitoring system and enhance the effectiveness of protective measures in the area of the Belarusian NPP location.

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ENVIRONMENTAL RISKS ASSOCIATED WITH NUCLEAR POWER

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Annotation: This article examines nuclear power engineering and analyzes the risks associated with the production of a nuclear cycle. The ways of minimizing such risks are considered.

Keywords: nuclear power, environmental impact, uranium production, radiation.

Nuclear power occupies a strategic place in the global energy mix, offering low-carbon electricity generation on an industrial scale. Its uniqueness lies in the fact that environmental risks and obligations that arise throughout the entire life cycle extend over an unprecedentedly long period of time, covering centuries. All environmental threats associated with nuclear energy must be considered in the context of the Nuclear Fuel Cycle (NFC), which includes three main stages: the front end (extraction, conversion, enrichment), operation and the back end (nuclear fuel waste management, reprocessing, disposal of radioactive waste and decommissioning).

It is advisable to divide the environmental threats associated with NFC into two large groups: radiation and non-radiation. Radiation risks are directly related to exposure to ionizing radiation (alpha, beta, gamma) and the spread of radionuclides. These risks require specialized radiation monitoring and isolation throughout the entire cycle. Non-radiation risks include thermal pollution, chemical exposure, landscape degradation and occupational risks, which, although not directly related to the atom, are an integral part of the environmental responsibility of the nuclear industry [1].

Uranium mining, both open-pit and underground, inevitably leads to large-scale degradation of the landscape and changes in the hydrological regime in the regions of development. A key long-term environmental problem is the formation of huge volumes of waste rock dumps and tailings dumps. The empty rock that remains after ore extraction can serve as a permanent source of gamma radiation. Such circumstances require that uranium tailings dumps be functionally considered as objects of low-level radioactive waste. Consequently, the cessation of mining does not relieve the environmental burden, but transfers it to the stage of centuries-old environmental control, obliging operators to carry out not only physical remediation of the landscape, but also to ensure centuries-old physical and hydrological isolation of these wastes from the environment.

Numerous studies confirm the critical importance of thermal pollution of water bodies: issues of thermal pollution are a mandatory and important part of environmental expertise in the regions of operating nuclear power plants. This requirement underlines that the choice of a site for a nuclear power plant is a long-term environmental commitment that is rigidly linked to the ability of a water body to withstand a constant thermal load.

After analyzing the production process of the fuel, it can be seen that uranium production is associated with a high level of occupational risks to the health of personnel. The development of occupational lung diseases is mainly associated with inhaled exposure to radon (an inert gas) and its short-lived daughter products, as well as uranium dust. Radon migrates easily and concentrates in confined spaces of mines. Its daughter solid radionuclides settle in the respiratory tract, causing localized alpha radiation, which is directly related to serious diseases such as lung cancer, pneumoconiosis, tuberculosis and emphysema, and blood diseases. Based on this, the risks of uranium mining require the implementation of not only radiation, but also specialized dust protection, as well as the creation of a highly developed medical infrastructure to reduce social, demographic and economic damage.

A detailed study based on the technical documentation for VVER-1200 type reactors demonstrates that environmental obligations do not cease with the final shutdown of the power unit, but require monitoring for periods significantly exceeding the operational life.

The predicted mass distribution of activated materials shows that long-term exposure is critically important for reducing the category of waste activity. For example, a decrease in the activity category of a significant mass of highly radioactive waste (HW) (from 236 tons to 106 tons) occurs after a long half-life, up to 100 years.

A promising direction in solving the problem of long-term management of highly active nuclear waste is the transition to a closed NFC. Transmutation technologies can reduce the long-term radiotoxicity of waste by "burning" long-lived actinides. Repeated fuel recycling also helps to reduce the amount of waste sent to the final geological disposal, thereby minimizing the environmental burden on the geological layer.

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ECOLOGY AS AN AREA OF APPLICATION OF NEUROMODELING

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The analysis shows that ecology should be considered one of the most promising and priority areas for the application of neuromodeling.

Keywords: artificial intelligence, neuromodeling, artificial neural networks, ecology, environmental forecasting.

Neuromodeling as a technology of the so-called artificial intelligence today penetrates into a variety of spheres of life. Moreover, according to experts, it can be useful and successfully applied in almost all areas of human knowledge and practice [1, etc.]. As the amount of data and information that needs to be processed, analyzed and evaluated is growing everywhere. And the increasing capabilities of modern computer tools and technologies allow them to cope with increasingly large-scale and complex tasks.

One of the most promising areas of application of neuromodeling, in our opinion, should be considered the field of ecology [2, 3, etc.]. It is no coincidence that in recent years a lot of work has appeared on its application to analyze and solve some environmental problems and problems. However, it can be noted that the authors of many review publications still do not attribute ecology to a number of the main areas of modern use of neuromodeling. Therefore, we tried to make some own assessment of the possibilities of its application in the ecology.

Artificial neural networks, being a key element of neuromodeling, are capable of searching for and finding patterns in large arrays of diverse data. In doing so, they can uncover patterns that are difficult or almost impossible to detect using traditional methods. This provides grounds for concluding that neuromodeling can significantly increase the quality of forecasts for changes that are occurring or may occur in the natural environment, and enhance the accuracy of assessing the prospects for the development of natural processes under the influence of both natural and anthropogenic factors. As a result, ecological forecasting can become more operational and, in many cases, more timely. This applies not only to the prediction of slow and gradually developing processes and changes, but also to environmental emergencies. Numerous specific examples of the importance of accuracy and timeliness in environmental forecasting can be provided. At the same time, the development of open artificial intelligence platforms can allow specialists and interested parties from various countries, including those with limited resources, to have access to neural modeling tools and the results obtained through them in near real-time. What can facilitate the timely adoption of essential management decisions in extreme environmental situations, such of a large-scale natural disaster, including those affecting neighboring countries and regions.

Therefore, the use of neural modeling in ecology is relevant and can be highly beneficial. Therefore, we believe that the field of ecology should be considered one of the priority areas for its future application.

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PROSPECTS FOR USING CHEMICAL NICKEL PLATING WASTE AS MODIFIERS FOR SILUMINS

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An analysis of existing issues in the practical application of silumins has been conducted. Current approaches to modifying the structure and properties of silumins by alloying and by increasing the melt cooling rate were studied. The idea of modifying the structure of hypereutectic silumins using a fine-dispersed NiP powder a by-product of chemical nickel plating was proposed and investigated.

Keywords: silumins, nickel, phosphorus, modification, waste.

To date, the main unresolved problem for both wrought silumins (hypoeutectic and eutectic compositions) and cast silumins (hypereutectic compositions) produced by conventional methods without additional alloying is their high brittleness, because they are characterized by heterogeneous microstructures and coarse phase dispersions primarily of silicon, and of iron in secondary phases [1-2].

Aluminum-based alloys occupy a special position among structural materials. By consumption volume they rank third after steel and cast iron. Therefore, research aimed at improving the microstructure and enhancing the functional properties of silumins is timely and is being actively pursued along two main lines. The first approach involves selecting effective master alloys and modifiers. The second approach focuses on increasing the solidification rate. One commonly used modifier for silumins is phosphorus.

Meanwhile, during electroless nickel plating a fine NiP powder is generated as a result of spontaneous decomposition of spent plating baths. The chemical deposition of nickel-phosphorus coatings on parts made from aluminum alloys is employed in the manufacture of aerospace and specialized equipment [3].

Studies of the microstructure of hypereutectic silumins obtained at a cooling rate of 100 K/s have shown that alloying with Ni-P powder leads to splitting and branching of eutectic silicon plates. This may be associated both with a local retardation of the solidification of the silicon plates and with changes in their growth directions due to the presence of AlP clusters and P atoms at the growing silicon surface. A comparison of rapidly solidified foils synthesized at a melt cooling rate of 10^7 K/s also demonstrated a beneficial effect of NiP particle modification on the structure – namely, refinement and changes in the morphology of the silicon phase [4].

Thus, the use of these powders to modify the structure and properties of silumins would not only make it possible to create new materials with improved characteristics, but also promote the rational reuse of NiP powders recovered from spent solutions, thereby solving the environmental problem of treating spent solutions.

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DEVELOPMENT OF AQUACULTURE EFFLUENT TREATMENT IN WATER ENVIRONMENT PREVENTION AND CONTROL

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China is the country with the largest scale of aquatic production in the world. The environmental pollution caused by aquaculture effluent has become a core factor restricting Chinas aquatic ecological environment.The recirculating water farming system that utilizes tailwater circulation is a new type of ecological farming model that has emerged in response to the concepts of circular economy and environmental protection.

Keywords: aquaculture; circulating water treatment; water environment; environmental management

Background: By 2015, Chinas aquaculture output had exceeded 40 million tons. Against the backdrop of limited aquaculture space, how to maximize breeding efficiency while reducing wastewater discharge or even achieving zero discharge and minimizing environmental pollution has become a core concern in the industry, leading to the rise of industrial recirculating aquaculture technology. Industrial recirculating aquaculture systems offer significant advantages, not only drastically reducing required space and enabling intensive, efficient water resource utilization, but also significantly decreasing wastewater discharge, yielding substantial economic and environmental benefits [1].

Development: Chinas industrial recirculating aquaculture began in the mid-1980s. In the early stages, due to the disconnect between management concepts and practical applications, the operational efficiency of related equipment was poor. In the early 1990s, China initiated research and technological development in the field of industrial recirculating aquaculture. After nearly 30 years of continuous R&D, a breakthrough was ultimately achieved, transitioning from technical exploration to industrial promotion. From 2015 to the present, China has independently developed a series of technical equipment, including multifunctional protein separators, multifunctional solid-liquid separation devices, modular disinfection equipment, high-speed aerators, and elastic brush-type biological purification media. The water purification processes required for recirculating aquaculture have also been significantly optimized and upgraded.

Currently, the water recycling efficiency of this system has surpassed 90%. Aquaculture is increasingly adopting standardized, mechanized, intelligent, and intensive practices that better align with environmental protection and circular ecological requirements. By organically integrating the recirculating aquaculture model with comprehensive ecological wastewater purification technologies, the industry has successfully achieved zero-waste production and "zero-discharge" standards. Future development of the aquaculture sector will be driven by core factors including automation upgrades, intelligent empowerment, economic value enhancement, and strengthened environmental protection.

Conclusion: As the only safe and environmentally friendly aquaculture method currently available that ensures chemical-free products and prevents heavy metal contamination, the recirculating aquaculture system not only plays a pivotal role in the industry but also aligns with Chinas national strategies for green transformation, circular economy development, and environmental emission reduction in aquaculture [2]. This system significantly enhances the efficiency of aquaculture-related treatment processes, effectively reduces environmental pollution, promotes efficient water recycling, and advances sustainable development of aquatic ecosystems.

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EFFECTS OF HEAVY METAL EXPOSURE ON OXIDATIVE STRESS IN HEPG2 CELLS

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This study examined cadmium and lead induced oxidative stress in HepG2 cells. Both metals decreased cell viability, increased ROS and MDA, and reduced SOD and GSH in a dose-dependent manner. Cadmium showed stronger toxicity, confirming oxidative stress as a key mechanism of heavy metal liver damage.

Keywords: Heavy metals, Oxidative stress, HepG2 cells, Reactive oxygen species, Lipid peroxidation, Antioxidant system

Heavy metal pollution constitutes a global ecological and health concern. As the primary metabolic and detoxification organ, the liver represents a critical target for heavy metal toxicity. Previous studies have indicated that heavy metals can disrupt cellular redox homeostasis by promoting ROS generation and inhibiting antioxidant enzyme activity, thereby inducing lipid peroxidation and DNA damage [1].

This study treated HepG2 cells with $CdCl_2$ and $Pb(NO_3)_2$ at 0, 10, 20, and 50 μM for 24 hours. Cell viability (CCK-8 assay), ROS levels (DCF-DA probe), MDA content, SOD activity, and GSH levels were measured.

Results showed dose-dependent decreases in cell viability, with 50% survival at 50 μM ($p < 0.001$). ROS levels increased 1.5-1.8 times in 10 and 20 μM groups ($p < 0.001$), with Cd^{2+} inducing stronger fluorescence than Pb^{2+} (Figures 1 and 2). These findings align with Li Y. et al. (2019), who showed lead induces lipid hydroperoxides in HepG2 cells [1].

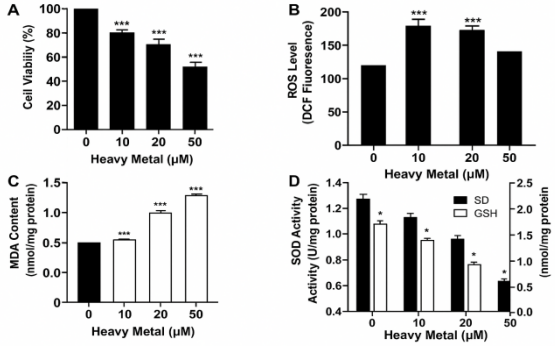

Fig.1. Effects of Heavy Metal Exposure on Oxidative Stress Indicators in HepG2 Cells

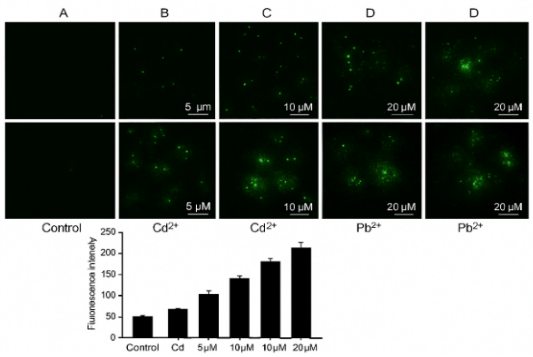

Fig.2. Changes in ROS Levels in HepG2 Cells Following Cd^{2+} and Pb^{2+} Exposure

MDA content reached 2.5 times control levels at 50 μM ($p < 0.001$), while SOD and GSH decreased to 0.6 U/mg protein and 0.8 nmol/mg protein respectively ($p < 0.05$), indicating antioxidant system disruption. These results support Yedjou C.G. and Tchounwou P.B. (2007), who confirmed N-acetyl-L-cysteine mitigates lead-induced oxidative stress [2, p. 135].

Both cadmium and lead induced oxidative stress in HepG2 cells through decreased viability, increased ROS and MDA, and reduced SOD and GSH, with cadmium showing greater toxicity. These findings confirm the pathway: heavy metal exposure → ROS accumulation → antioxidant inhibition → lipid peroxidation → cellular damage.

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COMPREHENSIVE MORPHO-ANATOMICAL ANALYSIS OF HARDWOOD AS A PROMISING METHOD FOR BIOINDICATION OF URBAN ECOSYSTEM STATE

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The article discusses the possibilities of applying a comprehensive morpho-anatomical analysis of wood to assess the state of urban plantations under anthropogenic load.

Keywords: morpho-anatomical analysis, wood, bioindication, urban ecosystems, dendrochronology, environmental monitoring.

Woody plantations form the structural and functional basis of urban ecosystems, playing a key role in maintaining their ecological balance [1]. Under intensive anthropogenic load, traditional methods for the assessment of a tree state can only detect significant disorders, failing to identify preclinical stages of stress impact [2]. A comprehensive analysis of the morpho-anatomical parameters of wood provides a unique opportunity for retrospective assessment and forecasting of the state of woody plants, since wood accumulates information on the impact of stress factors throughout the entire growth period [3].

The most informative research objects are species with clear annual ring differentiation and distinct anatomical structure demonstrating high sensitivity to anthropogenic stress [4]. A comprehensive assessment includes the analysis of dendrochronological parameters, anatomical characteristics, and structural anomalies that allows to obtain an integrated assessment of plant state [5].

Modern methods of computer image analysis combined with multivariate statistical methods are used for data processing (figure 1). This approach makes it possible to identify hidden patterns and establish cause-and-effect relationships between specific anatomical changes and stress factors of the urbanized environment [4].

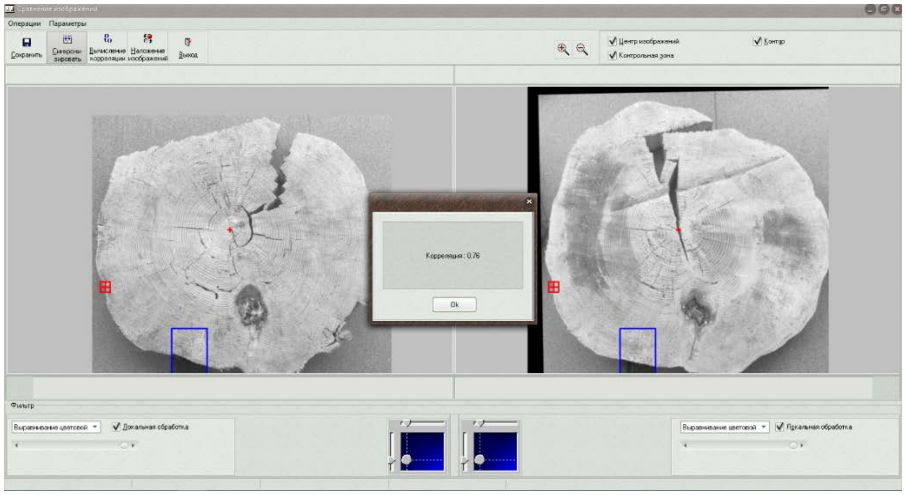

Fig. 1 – The software interface for matching wood cross-sections

The prospects for the practical application of comprehensive morpho-anatomical analysis are associated with the development of early diagnostic systems, improvement of urban green space monitoring, and optimization of the selection of tree species for landscaping. The development of non-destructive control methods and automated analysis

of wood tissues creates the basis for the development of standardized protocols for assessing the state of urban plantations.

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INFLUENCE OF SALINITY AND IONIZING RADIATION FACTORS ON AGRICULTURAL PLANTS: WINTER RAPESEED

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Considering that most plants are sensitive to salt stress, high salinity can be considered one of the most severe abiotic environmental factors. Given that drought conditions and high levels of radiation are common in the Republic of Belarus, the combined effects of ionizing radiation and soil salinity on plant growth and development are of interest. Therefore, efforts are being made to mitigate these negative impacts.

Keywords: factor; salinity; ionizing radiation; winter rape.

Despite the fact that to date, most attempts and studies conducted to increase plant salt tolerance, improve their morphogenetic capabilities, and physiological characteristics have concluded that the combination of salinity and ionizing radiation has both stimulating and inhibiting effects.

A dependence on radiation dose and salinity concentration has been observed in the winter rapeseed variety «Zenit»

The response of winter rapeseed of the «Zenit» variety, grown under the same salinity conditions, varied depending on the irradiation dose of 10, 50, and 100 Gy. With increasing irradiation dose, within the same salinity level, germination energy was inhibited. These results indicate that the studied plant has a more stable sensitivity to ionizing radiation: the half-lethal dose of winter rapeseed is LD50 = 1200-1400 Gy.

Results on the effect of salt stress on winter rapeseed plant development show that a salt concentration of 0.5% stimulates seed germination.

It can be concluded that the combined effects of ionizing radiation and salinity lead to changes in germination energy and seed viability.

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DIVERSITY OF MITOCHONDRIAL DNA IN THE NOBLE CRAYFISH (*ASTACUS ASTACUS*) IN BELARUS

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This study presents the first comprehensive analysis of mitochondrial DNA in noble crayfish (*Astacus astacus*) from Belarus. We identified two European lineages and seven haplotypes, also revealing the Neman River as a unique diversity hotspot and a key postglacial corridor, which is crucial for conservation planning.

Keywords: noble crayfish, Astacus astacus, mitochondrial DNA, genetic diversity, conservation.

Introduction. The noble crayfish (*Astacus astacus*) is a species threatened with extinction throughout Europe. Populations of this species are experiencing significant decline due to multiple factors, including habitat loss, spread of invasive species, and infectious diseases [1, 2]. The study of the species genetic diversity is particularly relevant as it determines its adaptive potential and long-term viability [3]. Despite substantial phylogeographic research on *A. astacus* in Europe, populations in the eastern part of its range, particularly in Belarus, have remained understudied. The aim of this study was to conduct a comprehensive analysis of mitochondrial DNA to determine the phylogeographic structure and assess genetic diversity of noble crayfish populations in Belarus.

Materials and methods. The study included 103 *A. astacus* specimens collected from 26 locations between 2014 and 2024. Two mitochondrial markers were used for genetic analysis: cytochrome c oxidase I gene (COI) 620 bp long and 16S rRNA gene 496 bp long. DNA amplification was performed using standard primers in a C1000 Touch thermal cycler. PCR products were sequenced on an ABI 3500 automated sequencer. The obtained sequences were aligned and analyzed using MEGA X and DnaSP v6 software. Median-joining haplotype network construction was performed in PopArt v1.7. Statistical analysis of population differentiation was conducted in ARLEQUIN.

Results. Mitochondrial DNA analysis revealed seven haplotypes, five of which are unique. Belarusian populations belong to two main phylogeographic lineages (1 and 2) previously described for Europe [4]. Haplotype distribution shows clear geographical structure: 5 haplotypes with maximum haplotype diversity (Hd = 0.337) were found in the Neman River basin, 3 haplotypes (Hd = 0.169) in the Western Dvina basin, while only 2 haplotypes (Hd = 0.083) were identified in the Dnieper River basin. A unique feature of the Neman River basin is the simultaneous presence of both phylogeographic lineages, indicating its historical role as an important migration corridor during the postglacial period [5]. Statistical analysis confirmed significant differentiation between populations from different river basins ($p < 0.001$).

Conclusion. The obtained results indicate a high level of genetic diversity in *A. astacus* populations in Belarus, particularly in the Neman River basin. The revealed phylogeographic patterns emphasize the need for developing differentiated conservation strategies that consider river basin boundaries. The Neman River basin requires special attention as a unique reservoir of the species genetic diversity on the scale of the entire Baltic Sea catchment area.

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ALUMINUM IN SOILS. BIOECOLOGICAL ASPECT

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Aluminum compounds in soils are very diverse. These are aluminosilicates, aluminum oxides and hydroxides, minerals containing aluminum salts; simple and complex Al compounds with organic substances. The mobility and bioavailability of this element depends on the forms of its presence in soils. The most mobile forms of aluminum in the soil are the ionic form, hydroxide complexes, and exchangeable aluminum. The toxicity of this element in the soil is manifested mainly in conditions of soil acidification.

Keywords: forms of aluminum in soil, mobility, bioavailability, toxicity, acidity.

Aluminum is the third most abundant element in the Earth's crust, with a mass fraction of 8,8%. Aluminum is characterized by a pronounced concentration differentiation depending on the rock. Ultrabasic rocks contain on average about 0,45% A1, and sedimentary rocks (clays, shales) it increases to 10-11%. Acidic, medium and basic rocks (granites, diorites, basalts, etc.) occupy an intermediate position – 7-9%.

The total aluminum content in soils is usually 5-15% by weight, mainly in the form of minerals. These include:

- clay minerals (the most common group): These minerals are formed from rock weathering and account for up to 20-60% of soils (kaolinite ($Al_2Si_2O_5(OH)_4$), illite ($KAl_2(Si,Al)_4O_{10}(OH)_2$), montmorillonite ($Al_2Si_4O_{10}(OH)_2 \cdot nH_2O$), chlorite ($(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$) and others;
- aluminum oxides and hydroxides: These minerals are formed under acidic conditions (gibbsite ($Al(OH)_3$), Bemite (AlOOH), diaspore;
- aluminum silicates: include primary minerals from rocks that are weathered (feldspars - for example, orthoclase $KAlSi_3O_8$); micas (muscovite $KAl_2(AlSi_3O_{10})(OH)_2$);
- other minerals: corundum (Al_2O_3), spinel ($MgAl_2O_4$), and alumophosphates are found in smaller quantities.

Aluminum in the composition of minerals is inert and practically does not participate in its circulation and other processes of soil formation. Its behavior is highly dependent on environmental conditions. The key environmental problem of this element is the mobilization of toxic forms of aluminum in conditions of acidification of the soil environment, which leads to negative consequences for agrocenoses and natural ecosystems.

The reason for aluminum's transition to a dangerous state is an increase in soil acidity below pH 5,0–5,5. With a significant decrease in pH, aluminum passes into the soil solution in the form of toxic cations. The Al^{3+} ion is the most toxic and bioavailable form, dominating in highly acidic soils (pH < 4,5); hydroxide complexes ($AlOH^{2+}$, $Al(OH)_2^+$); exchangeable aluminum is a form displaced from the soil absorbing complex, which has a direct toxic effect. These forms of aluminum become factors that harm living organisms and the environment. The toxicity of aluminum manifests itself already at a concentration of 1-2 mg/l in a soil solution and has a complex character. In this case, a vicious circle is formed – the acidity increases the solubility of aluminum, and the products of its hydrolysis generate additional H^+ ions, further acidifying the medium.

The toxic effect of aluminum on living organisms and, in particular, on plants is expressed in the destruction of the root system – Al^{3+} ions block cell division in the root meristem. There is a violation of mineral nutrition – aluminum forms insoluble compounds with phosphates, causing phosphorus starvation. It also inhibits the absorption and transport of potassium, calcium, magnesium and sulfur. Cellular and metabolic stress is manifested – aluminum ions destroy cell membranes, inhibit enzyme activity and can cause damage at the genetic level. All these effects are visually expressed in chlorosis, leaf necrosis, dwarfism and a sharp decrease in plant productivity.

For soils, the negative effect of mobile forms of aluminum is expressed in the deterioration of physico-chemical properties – aluminum causes dispersion (spraying) of colloidal particles, which leads to the destruction of the soil structure, compaction, deterioration of aeration and water permeability. Aluminum controls the hydrolytic acidity of soils – the more this element is in ionic form (Al^{3+}) in the soil solution, the higher the hydrolytic acidity.

The presence of a large number of mobile forms of this element in the soil solution disrupts biochemical cycles – by binding to soil organic matter, aluminum impairs its quality and accessibility to microorganisms. The activity of the soil microflora and fauna responsible for the processes of mineralization and humification is suppressed.

In natural conditions, aluminum migration is an agent of podzolization, a process that leads to depletion of the upper horizons and the formation of infertile podzolic soils.

The mobile forms of aluminum migrate with the downward currents of moisture, are washed out into the groundwater and end up in rivers and lakes. Aluminum is no less dangerous for aquatic ecosystems: its maximum permissible concentration for aquatic organisms is 0,04 mg/l. Once in water bodies, it causes toxicosis in fish and other aquatic organisms.

Thus, the bioecological status of aluminum in the soil and adjacent ecosystems depends on the forms of its presence in soils.

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USE OF GIS FOR MODELING THE BIOENERGETIC POTENTIAL OF TERRITORY

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The article examines modern approaches to assessing the bioenergetic potential of territories using geographic information systems (GIS). An analysis of the advantages of GIS technologies in accounting for spatially distributed factors such as biomass type and productivity, transport accessibility, terrain relief, and environmental constraints is conducted. The conclusion is drawn about the high effectiveness of GIS as a tool for supporting strategic decision-making in sustainable energy.

Keywords: bioenergy, bioenergetic potential, geographic information systems (GIS), spatial analysis, biomass, sustainable development.

In the context of global energy transition and economic decarbonization, bioenergy occupies one of the key positions among renewable energy sources (RES). However, the effective use of biomass resources requires accurate assessment of their volume, spatial distribution, and economic feasibility of operation. Traditional accounting methods based on statistical data do not consider territorial spatial heterogeneity, which leads to significant errors in calculations.

Geographic information systems (GIS) represent a powerful tool for solving this problem, allowing the integration, analysis, and visualization of heterogeneous spatial data. The purpose of this article is to demonstrate the methodology and advantages of using GIS systems for comprehensive modeling and assessment of bioenergetic potential.

The bioenergetic potential of territory is traditionally classified into several types:

Gross (theoretical) potential - total amount of energy contained in the region's biomass.

Technical potential - part of gross potential that can be used considering existing technical limitations.

Economic potential - part of technical potential whose use is economically feasible under current prices and tariffs.

Modeling in the GIS environment is based on sequential "screening" of potential through overlaying spatial constraints.

The research methodology must include the following stages:

1. Formation of a geo-information database. At this stage, spatial data is collected and prepared:
   - Land use data (types of vegetation cover, agricultural land, forest areas).

- Climate data (precipitation, temperature, insolation).
- Digital elevation model.
- Infrastructure data (roads, settlements, location of existing power facilities).
- Data on environmental and nature protection restrictions (protected natural areas, water protection zones).

2. Calculation of gross biomass potential. For each land use type (for example, arable land, meadow, forest), based on statistical or expert data, biomass productivity coefficients (t/ha/year) are assigned. In GIS, raster calculations are performed, resulting in a map of theoretical energy potential.
3. Spatial analysis and constraint overlay. To transition to technical and economic potential, overlay operations are performed:
   - Exclusion of protected areas and lands of other purposes.
   - Accounting for transport accessibility (creation of buffer zones around roads and calculation of logistical costs).
   - Accounting for relief (excluding territories with excessive slope unsuitable for mechanized biomass harvesting).
   - Determining zones of economic efficiency based on analysis of distance to energy consumers and processing facilities.

The main advantages of this approach are visibility (results are presented in map form), systematicity (many interconnected factors are considered simultaneously), and relevance (databases and models can be updated promptly).

The application of geographic information systems for modeling the bioenergetic potential of territory transforms the planning process from the realm of abstract calculations into the practical plane of substantiated spatial analysis. The presented methodology allows not only to assess the volume of available resources but also to determine optimal locations for their processing, which is critically important for reducing bioenergy costs.

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AGRICULTURAL CROPS AND THEIR TROPHIC IMPORTANCE FOR THE CONSERVATION OF WILD ANIMALS AND BIRDS POPULATIONS IN BELARUS

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Abstract. This publication presents the results of research to establish the role of Belarusian agricultural lands in preserving and increasing wild animal and bird populations. It characterizes agricultural crops and determines the trophic significance of crops and the technological losses of the main species for wild animals. An assessment is made of the use of agricultural plants by wild representatives of Belarusian fauna within the seasonal patterns of the year, as well as seasonal bird migration.

Keywords: agricultural crops, technological losses of agricultural crops, wild animals and birds, feeding stations, migration period.

Belarus's natural resources have always provided ideal habitats for wild animals and birds. Belarus has over 9.7 million hectares of forested land, accounting for almost half of its total territory. The forest cover ratio increases annually; in the last 30 years alone, forest area has increased by almost 1 million hectares. (The forest cover ratio is the

degree of forest coverage in an area, determined by the ratio of forested area to the total area of the country, district, forestry enterprise, etc., expressed as a percentage.)

Belarus's river network includes 20,800 rivers and streams with a total length of 90,600 kilometers. The total surface area of lakes in Belarus is 1,600 square kilometers, with a total water volume of approximately 7 cubic kilometers. There are also 85 reservoirs (with a water surface area of at least 100 hectares). All of this points to ideal habitats for wild animals and birds in Belarus.

However, the food supply provided by agricultural crop production in the Republic of Belarus contributes significantly to their population growth. The total area of agricultural land is approximately 8,283,900 hectares (5,660,000 hectares of arable land and 2,520,800 hectares of meadow land). Wild animals, in one way or another, use all of these territories as habitats. Regularly visiting these areas, wild representatives of Belarusian fauna utilize agricultural crops to supplement their primary diet. During the autumn-winter and winter-spring periods, agricultural lands and fields with crop residues become the main feeding grounds for some animal and bird species.

In our research, we conducted field studies of the agricultural lands they frequent to determine the role of agricultural crops and their trophic significance in preserving wild animal and bird populations. Research conducted on the hunting grounds of the Volozhin and Molodechno districts of the Minsk region to determine the trophic role of agricultural crop losses for wild animals and birds suggests their great importance for animal [1, 2]. Remaining legume and root crop crops allow resource-rich animal species to maintain high population levels (Fig. 1).

Fig. 1 – Roe deer feeding on agricultural land. *(Photo by Yu.G. Liakh, April 9, 2025, Volozhin District, Minsk Region)*

The increase in wild animal density observed in recent years prevents a reduction in the forage capacity of hunting grounds. Agricultural crops and the portion of the harvest remaining in the fields after harvest provide an additional source of food for forest inhabitants. Despite constantly improving harvesting techniques, a certain amount of the harvest remains on the ground. Grain losses range from 0.1-0.8% to 3-5% or more [3, 4].

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KISSPEPTIN-10 INHIBITS PAPILLARY THYROID CANCER PROGRESSION BY REGULATING P38 MAPK/P53 AND VEGF SIGNALING PATHWAYS

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Papillary thyroid cancer (PTC) is the most common malignant tumor of the endocrine system, with an increasing incidence worldwide [1]. Despite a favorable prognosis, diagnosis and treatment of both invasive and metastatic PTC remains challenging. The kisspeptin (KPs)/GPR54 system plays a complex regulatory role in various tumors, and its specific function and molecular mechanism in PTC remain unclear [2].

The aim of this study was to investigate the effects of kisspeptin-10 (Kp-10) on the biological behavior of human PTC cells (TPC-1) and the signaling pathways regulating RET/PTC1 expression.

Methods: The Cell Counting Kit-8 (CCK-8) was used to detect changes in cell proliferation and viability; cell invasion was assessed using the Transwell Matrigel invasion assay. Fluorescence quantitative real-time PCR (qRT-PCR) was used to determine vascular endothelial growth factor (VEGF) mRNA expression levels. The expression of p53, P21, Sirt1, and VEGF proteins, as well as the phosphorylation level of p38 mitogen-activated protein kinase (MAPK), were determined using Western blot. To confirm the role of the p38 MAPK signaling pathway, the selective p38 inhibitor SB203580 [3] was used.

Results: Kp-10 inhibited TPC-1 cell proliferation in a dose- and time-dependent manner. Using a four-parameter nonlinear regression model (4PL), it was calculated that the half-maximal inhibitory concentration (IC50) value decreased sharply over time: from 0.030 nM after 24 hours to 5.69×10^{-4} nM after 48 hours. Furthermore, Kp-10 inhibited the invasive ability of TPC-1 cells by 86% compared to the control group ($p < 0.01$), and at a concentration of 0.1 nM, treatment of cells with Kp-10 (10 nM) for 24 hours resulted in an 88% decrease in VEGF mRNA expression ($p < 0.01$). Western blotting showed that Kp-10 increased p53 expression and decreased VEGF, P21, and Sirt1 expression at the protein level. Crucially, pretreatment with the p38 inhibitor SB203580 significantly attenuated the increase in p53 expression and the decrease in VEGF expression induced by Kp-10 ($p < 0.01$), confirming the involvement of the p38 MAPK signaling pathway in the effect of Kp-10.

Conclusion: The results of this study demonstrate the potent antiproliferative and antiinvasive effects of Kp-10 on PTC cells in vitro. These biological effects are mediated by its significant suppression of the expression of the key proangiogenic and prometastatic factor VEGF. We propose a molecular model according to which Kp-10 increases p53 expression and decreases VEGF expression through activation of the p38 MAPK signaling pathway. The results of this study not only deepen our understanding of PTC pathogenesis but also provide an important experimental and theoretical basis for the development of new therapeutic strategies for the treatment of PTC using the kisspeptin signaling pathway.

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APPLICATION OF BRACKET FUNGUS IN ECO-LEATHER PRODUCTION

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Nowadays finding natural and eco-friendly materials became one of priority goals for bio economy and circular economy development because it can help to get lower the ecological footprint: pollution, the emission of greenhouse gases, the waste of water and energy. One of eco-friendly materials we can use as an analogue of eco-leather- Mushroom skin, which is made from tinder mushrooms. This article provides the research about such materials, manufacturing technology and evaluation for biodegradability.

Keywords: tinder mushrooms, eco-leather, Mushroom skin, biogradable materials, bio economy.

Despite the versatility and popularity of genuine leather, its production has significant environmental harm. Tanning processes that rely on aggressive chemical compounds lead to pollution and pose health risks to workers when safety regulations are not followed. Therefore, the implementation of green technologies and the development of sustainable, safe materials have become priority tasks for science and industry. Modern requirements dictate the need to create materials that combine versatility, energy efficiency, and environmental safety at all stages of the life cycle.

Modern leather alternatives available on the market have several advantages, including visual similarity to natural material, satisfactory functional characteristics, and relatively low cost. However, many of them have a synthetic base and are not biodegradable. Producing eco-leather from the mycelium of tinder mushrooms allows for minimizing environmental impact and creating functional products with a sustainable, closed-loop life cycle. At present, companies in the Russian Federation that are developing such products are unpresented, which opens up significant opportunities for research in this area.

The goal of the project is to develop and test a method for producing eco-friendly leather "Mushroom skin" from the bodies of tinder mushrooms, followed by creating a prototype for practical application.

The bodies of tinder mushrooms were used as raw material for producing the eco-friendly leather "Mushroom skin." An original methodology was developed for its processing, which includes several steps: cleaning from contaminants, boiling for 15–20 minutes in a 1% NaOH solution, forming a preparation from mushroom pulp, mechanical processing, and drying at a temperature of 150°C for 1.5 hours. The samples obtained in this way were stitched, dyed with natural inks, and treated with wax to enhance consumer properties.

To preliminarily assess the environmental friendliness of the material, a biodegradability test was conducted. A sample weighing 57.2 g was placed in soil. After 30 days, the sample was reweighed, showing a 2% reduction in weight (to 56.0 g), confirming the material's ability to biodegrade under natural conditions.

The research successfully developed and tested the technology for producing eco-leather "Mushroom skin" from tinder mushrooms. Several prototypes suitable for practical use were created. The biodegradability test demonstrated the high potential of the material as an environmentally sustainable alternative to traditional materials.

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DUST-FILTERING CAPACITY OF WOODY PLANTS USING THE EXAMPLE OF THE LOSHITSKY ESTATE AND PARK COMPLEX IN MINSK

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This study analyzes the effectiveness of tree leaves as dust filters in urban environments. Results indicate that Tilia cordata Mill. and Acer platanoides L. possess the highest dust retention capacity, confirming their importance in improving ecological conditions in landscape-recreational zones of Minsk.

Keywords: dust retention capacity, green plantings, dust filter, Lositsa Park-Estate complex, woody plants.

In modern cities, green spaces serve many functions. The sanitary and hygienic qualities of green spaces are based on the high gas-absorbing and accumulative properties of vegetation. Trees act as a constantly active filter through processes of adsorption, absorption, filtration, and infiltration. The role of plants as dust filters has been studied by many authors, including O. Chernyshenko, N. Podzorov, M. Doncheva-Boneva, Ya. Supuka, G. Ilkun, D. Kiseleva, and others. Tree leaves play an important role in filtering dust from the air. The level of dust accumulation partially reflects the ability of plants to sequester dust and assesses the environment-purifying role of vegetation throughout the growing season. Thus, trees growing in urban environments are regularly "buried" in a layer of harmful substances. Constant exposure to emissions leads to dust accumulation on leaves and bark, a decrease in photosynthetic activity, and other negative consequences.

The aim of the study was to examine the condition of leaves and their role as a dust filter in condominant woody plant species (downy birch (*Betula pubescens* Ehrh.), norway maple (*Acer platanoides* L.), small-leaved linden (*Tilia cordata* Mill.), brittle willow (*Salix fragilis* L.) and weeping willow (*Salix babylonica* L.)) in landscape and recreational areas.

To assess the dust-filtering capacity of woody plants, the Loshitsky estate and park complex was selected. The sites were located no more than 400 m from the highway. The Loshitsky estate and park complex is located in the Leninsky district of Minsk, between the Loshitsa and Serebryanka microdistricts, and covers an area of 102.3 hectares. Loshitsky Park borders only the highway of Mayakovsky Street (880 m). The roadway runs 15-20 meters from the nearest trees. The internal area is designated for pedestrian and bicycle traffic, creating favorable conditions for maintaining clean air and healthy vegetation.

For this study, leaf samples were collected at a height of 1.5-2 meters, with 100 leaves from trees of the above-mentioned species. To determine the amount of adsorbed dust, the leaves were washed in 100 ml of distilled water, and the amount of solid sediment was then determined gravimetrically on a filter after drying [1]. Leaf blade area was determined in cm^2 using the Petiole.LeafArea app. The data obtained are presented in the table.

Table

Dust-retention capacity of tree leaves (using the Loshitsky estate and park complex as an example)

Name of the species	Leaf area, cm^2	Dust-holding capacity of leaves, mg/m^2
Tilia cordata Mill.	40,39±9,89	935,31
Acer platanoides L.	118,44±50,91	548,68
Betula pubescens Ehrh.	19,77±5,61	151,73
Salix fragilis L.	15,52±4,03	96,62
Salix babylonica L.	11,00±2,84	90,92

According to the data obtained, *Tilia cordata* Mill. and *Acer platanoides* L. have the highest dust-retaining capacity, while *Salix fragilis* L. and *Salix babylonica* L. have the lowest.

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ASSESSING THE ECOLOGICAL CONDITION OF FORESTS AND METHODS OF THEIR RESTORATION USING ARTIFICIAL INTELLIGENCE

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The assessment of the state of forest ecosystems and their restoration using data from various sources and artificial intelligence technologies is considered. It is shown that digital methods – satellite and drone sensing, neural network analysis – increase the accuracy of monitoring, predict risks and optimize recovery measures. The importance of precision forestry is emphasized as a tool for sustainable forest management in the context of climate change.

Keywords: ecosystem restoration, forests, monitoring, remote sensing, artificial intelligence.

The current degradation of forest ecosystems is complex and is caused by multiple negative factors, including climate change, forest fires, illegal logging, pests and diseases, which leads to disruption of the structure and functions of forest communities. Traditional forest monitoring methods based on ground control and visual patrolling are experiencing practical difficulties in implementation due to a shortage of workers, the inability to automate the processes of detecting changes and limited spatial and temporal coverage of territories. Given the scale of Russian forests and the increasing negative impacts, the traditional monitoring approach is becoming insufficient to identify and prevent degradation processes in a timely manner. The use of digital technologies and artificial intelligence in forestry demonstrates significant advantages: neural network algorithms work 62% faster than humans and 12% more accurately, which makes it possible to automate the processing of large amounts of remote sensing data, predict changes in forest conditions and ensure accurate ecosystem restoration based on a comprehensive analysis of multi-source information.

The current state of forest ecosystems is characterized by ongoing degradation under the influence of several interrelated factors. Deforestation and capital reforestation erase natural landscape structures, reducing the volume of old-growth forests and the diversity of ecotypes. Fires, including extreme and recurring ones, deplete forest resources and disrupt succession cycles, leading to lengthy rehabilitation of some areas. Climate change is exacerbating stressful conditions: rising temperatures, changing precipitation, and the frequency of extreme weather events lead to the weakening of trees, the spread of diseases, and the invasion of pests. Diseases associated with pathogens and pests spread faster due to warmer conditions and reduce the viability of forest ecosystems, especially in young stands and individual age groups. These factors not only reduce biodiversity, reducing the number and diversity of plant, animal and fungal species, but also enhance the greenhouse effect: reducing the area of biodiversity forests reduces the ability of forests to capture carbon and stabilize the climate, as well as the consequences of influencing the water regime, soil erosion and local microclimates. As a result, there is a growing need for a systematic assessment of the state of forests in large areas, which requires the integration of remote sensing data, field observations and forecast models in order to form objective indicators of forest health, identify risk areas and plan strategic restoration measures across regions and countries.

The main data sources for forest assessment include satellite imagery, drone data, and ground-based observations. Satellites such as Landsat and Sentinel provide a global overview and long-term monitoring of forest areas. Drones allow you to take detailed pictures of local areas, and ground-based sensors and field studies provide additional data on the state of the soil, tree and microclimate. Modern systems combine this data into a single analytical platform for comprehensive analysis and decision support for forest restoration.

Artificial intelligence (AI) plays an important role in forest analysis and restoration. It allows you to automatically detect changes in vegetation by processing satellite and drone images, quickly detecting deforestation, desiccation and regeneration. AI also predicts the risks of fires, droughts, and diseases by analyzing climate and environmental data, which helps to take timely preventive measures. Automation of mapping and modeling of restoration using AI allows you to create accurate maps of restoration zones, choose optimal planting patterns and tree species, taking into account genetic diversity and climatic conditions. These technologies combine data from different sources and provide decision support at the regional and national levels, contributing to the sustainable restoration of forest ecosystems in a changing climate.

Precision forestry is based on the use of modern technologies for optimal management of forest resources. Artificial intelligence and remote sensing make it possible to accurately plan plantings and allocate funds, taking into account the characteristics of specific sites, such as soil type, topography and climatic conditions. This approach reduces costs, increases crop survival, and minimizes negative impacts on the ecosystem. Successful projects in Russia, China and Brazil demonstrate the effectiveness of these technologies: they contribute to the sustainable restoration of forests and the rational use of natural resources. The application of precision forestry will increase the productivity of forestry and preserve biodiversity in a changing climate.

Thus, digital technologies play a key role in the restoration of forest ecosystems, providing accurate and timely monitoring, risk forecasting and optimization of resource management. Modern platforms, such as ForestCloud, integrate satellite, drone, and ground-based sensor data to effectively coordinate restoration projects and prevent wildfires. The prospects for the development of monitoring systems are related to the expansion of the scale of digital solutions and their increased accessibility for various countries and regions. For sustainable forest management, it is necessary to combine the capabilities of artificial intelligence, scientific research and environmental policy, creating conditions for the conservation of biodiversity and the adaptation of ecosystems to a changing climate. Such an integrated approach will improve the efficiency of reforestation and ensure the long-term sustainability of natural resources.[1,2]

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A COMPARATIVE ANALYSIS OF IMAGE GENERATION PLATFORM: CAPABILITITES, WORKFLOWS, AND ECONOMIC EFFICIENCY

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This paper presents a practical comparative analysis of several leading platforms – Midjourney (via BotHub), Grok (xAI), Canva (Magic Media), Microsoft's Image Generator – evaluating their operational workflows, output quality, generation speed, and economic models. Using a standardized, complex prompt, we benchmark these services to provide insights for content creators, designers, and researchers seeking to integrate AI-generated imagery into their workflows efficiently.

Keywords: AI Image Generation, Generative Artificial Intelligence, Comparative Analysis, Visual Content Creation, AI Models Benchmarking.

The traditional process of sourcing visual assets – ranging from digital editing to extensive stock photo searches – is often time-consuming and can stifle creative momentum. The advent of generative artificial intelligence (AI) offers a paradigm shift, enabling the near-instantaneous translation of conceptual ideas into visual representations. This technology holds significant potential for accelerating content creation for social media, marketing, presentations, and design prototypes.

Comparative Analysis of Platforms

1.1. Midjourney via BotHub

Midjourney is renowned for its high-quality, artistic outputs but is primarily accessible through third-party aggregators like BotHub for users outside its native Discord environment. Workflow & Economics: BotHub operates on an internal currency system ("caps"). The test prompt consumed 40,000 caps from an initial grant of 100,000 caps provided upon referral-based registration. This model abstracts direct pricing but functions on a de facto pay-per-query

basis. Performance: Generation time was approximately 40 seconds, yielding four distinct, high-detail images. The results demonstrated strong compositional understanding and artistic rendering.

1.2. Grok (xAI) with Flux Backend

Grok integrates seamlessly into the X social media platform, offering a highly accessible user experience. Workflow & Economics: The service is currently free to use, providing four images per prompt without an explicit daily or monthly limit at the time of testing. Performance: Generation was rapid, completing in under 30 seconds. The output from the Flux model was of high quality, accurately interpreting all elements of the complex prompt with a realistic leaning.

1.3. Canva Magic Media

Canva integrates its AI generator directly into its comprehensive design suite, positioning it as a feature for rapid asset creation within a workflow. A notable limitation of the tool is its tendency to generate images in a cartoonish style. This makes it well-suited for specific applications like children's content or illustrations but less ideal for projects demanding realism. Upon generation, four images are produced, which can be instantly downloaded or edited further within the Canva editor.

1.4. Microsoft Image Generator

This service offers a streamlined, minimalist interface for image generation, powered by a robust underlying model. A significant functional advantage is the ability to pre-define the output's aspect ratio, which obviates the need for subsequent resizing and streamlines the post-production workflow. However, its free tier is limited to 15 boosts (generations) per month, after which service speed or access may be restricted. Paid plans start at approximately $10 for 100 images. Performance: Generation speed is fast (a few seconds per image), producing four images per prompt. The quality is generally high, though the restrictive free tier is a considerable limitation for frequent users.

The results indicate a clear trade-off between accessibility, cost, output quality, and control. Platforms like Grok and Freepik AI offer compelling value, combining high-quality outputs with economically viable models (free and freemium, respectively). Canva's strength lies not in its standalone generator but in its deep integration into a broader design ecosystem, despite its slower speed and stylistic limitations.

The significant language barrier observed with DeepAI underscores the ongoing challenge of multilingual processing in some AI models, highlighting the need for users to utilize English prompts for optimal results across most services. Furthermore, the economic models range from subscription-based (Microsoft, implied by BotHub's "caps") to ad-supported (DeepAI) and credit-based freemium (Freepik), requiring users to align their choice with their expected generation volume.

This comparative analysis demonstrates that the landscape of AI image generation is diverse, with no single platform dominating all criteria. The "best" choice is highly contextual, dependent on the user's specific needs regarding style, integration, budget, and required volume.

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TOXIC SUBSTANCES IN THE ENVIRONMENT AND THEIR RELATIONSHIP WITH CANCER

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Environmental toxicants are chemical, physical, or biological agents capable of harming human health. They enter the ecosystem from industrial emissions, agriculture, transportation, and household waste. According to the World Health Organization (WHO), many of these substances are classified as carcinogens – factors that trigger the development of cancer. Cancer occurs due to damage to cellular DNA, leading to uncontrolled cell division and tumor formation. The link between toxins and cancer has been confirmed.

*Keywords***:** toxic substances, carcinogens, cancer.

Toxic substances affect the body through various pathways: inhalation, ingestion (absorption through food or water) and skin contact. They can accumulate in tissues (bioaccumulation) and cause mutations, inflammation, or suppression of the immune system. Key examples:

- Asbestos: A fibrous mineral used in construction. Causes mesothelioma (pleural cancer) and lung cancer. Mechanism: Fibers penetrate lung tissue, causing chronic inflammation and mutations.

- Heavy metals (arsenic, cadmium, lead): Leak into water and soil from mines and industry. Arsenic is linked to skin, lung, and bladder cancer; cadmium is linked to lung and kidney cancer. Mechanism: DNA binding, cell cycle disruption, and oxidative stress.

- Organic Compounds (Benzene, Polycyclic Aromatic Hydrocarbons - PAHs): Benzene - from gasoline and smoke; PAHs - from fuel combustion. Benzene causes leukemia; PAHs - lung and skin cancer. Mechanism: Metabolism in the body forms epoxides, which damage DNA.

- Pesticides and Herbicides (DDT, Glyphosate): Used in agriculture. Linked to breast, prostate, and lymphoma cancer. Mechanism: Endocrine disruption and genotoxicity.

- Radiation (ionizing, such as radon): Radon is a gas from the soil; causes lung cancer. Mechanism: Ionization of DNA, leading to mutations.

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Risk factors are aggravated by combined exposure (cumulative effect) and vulnerable groups (children, elderly, low socioeconomic status).

Risk mitigation includes strict emission controls (EPA and EU standards), environmental monitoring, and personal measures such as using water filters and avoiding contaminated areas. The WHO recommends limiting exposure through legislation and education. Research shows that early detection and detoxification (antioxidants, diet) can mitigate the effects.

Environmental toxicants are a significant factor in cancer, as scientifically proven. Understanding these links is important for prevention and policy. Further research is needed to assess emerging threats, such as microplastics.

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BIOMONITORING OF URBANIZED TERRITORIES AS A TOOL FOR ASSESSING THE ECOLOGICAL SAFETY OF MAN-MADE ECOSYSTEMS

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Urbanized territories are man-made ecosystems where natural components experience intense anthropogenic effects, such as industrial emissions, vehicle exhaust, man-made accidents, etc. Ensuring the ecological safety of such ecosystems requires reliable methods of monitoring the state of the environment. Biomonitoring is an important tool based on the use of living organisms to assess the quality of the habitat. In contrast to purely physico-chemical monitoring, biomonitoring reflects the combined impact of many factors on biota and makes it possible to identify hidden effects of pollution that are difficult to detect by direct measurements of concentrations.

Keywords: biomonitoring, urbanized territories, ecological safety.

Biomonitoring of urban ecosystems is based on bioindication methods – registration of changes in indicator organisms under the influence of anthropogenic factors. Approaches to the organization of monitoring of various components of biota and criteria for assessing changes in biogeocenoses under the influence of man-made objects have been developed [1]. The main methods include:

1) Air lichenoindication is an assessment of atmospheric purity based on the composition and condition of epiphytic lichens. Lichens are extremely sensitive to air pollution (especially sulfur dioxide and heavy metals) and are widely used to map urban air quality.

2) Phytoremediation indicators – analysis of pollutants in plant tissues. Thus, the leaves, bark and annual rings of trees accumulate heavy metals and toxins, serving as indicators of the level of pollution of the atmosphere and soils. For example, a comparison of the accumulation of metals in the foliage and bark of poplars and linden trees in Moscow revealed higher concentrations of Pb, Fe, Sr, and Zn in the industrially loaded Southeastern District compared with the relatively clean Southwestern District [1]. The data confirm the different levels of anthropogenic load in the areas of the megacity.

3) Bioindication of soils and aquatic ecosystems – assessment of the state of the environment by communities of living organisms. In urbanized landscapes, changes in the structure of the microflora and mesofauna of the soil are indicative (for example, a decrease in the number of earthworms due to toxic pollution) and the composition of aquatic organisms in reservoirs. Studies show that the degree of water pollution is most clearly reflected by the communities of zoobenthos [2].

4) Cytogenetic monitoring – detection of genotoxic environmental effects using tests for damage to the genetic apparatus of bioindicators. Thus, the analysis of chromosomal aberrations in the meristem of tree buds is used to assess the total mutagenicity of the urban environment [3]. A ten-year study in an industrial city showed a significantly increased level of chromosomal rearrangements in the rudimentary leaves of poplars and elms near a chemical plant [3].

5) Biotesting – rapid laboratory methods using live test objects (algae, daphnia, bacterial cultures, etc.) to assess the toxicity of air, water, and soil samples. In recent years, instrument biotests have been introduced into the practice of environmental monitoring, which make it possible to determine the total toxicity of the environment in a short time [2].

Thus, biomonitoring of urbanized territories is complex. It combines different trophic levels and groups of organisms, giving a holistic picture of the ecosystem. Biomonitoring of urbanized territories has proven to be an effective tool for assessing the environmental safety of man-made ecosystems. Using living organisms as "sensors", it integrates the effects of a variety of pollutants and factors, identifying even mild and chronic effects. This makes it possible to detect threats to ecosystems and human health in a timely manner and take measures to neutralize them. In the context of urban growth and the technosphere, biomonitoring complements traditional control methods, providing a scientifically sound basis for managing the quality of the urban environment and maintaining its safety.

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REAL TIME AIR QUALITY MONITORING SYSTEM BASED ON IOT-SENSORS

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Urban air pollution (CO_2, $PM_{2,5}$, NO_2 and O_3) poses serious health risks and requires continuous monitoring. Traditional stationary monitoring stations are sparse and expensive. A distributed IoT-based solution can provide granular, real-time data at lower cost.

Keywords: air quality, monitoring system, IoT-sensors.

Air quality monitoring stations (AQMS) are critical tools for tracking atmospheric pollutants and assessing environmental health. These systems represent integrated hardware-software complexes designed to measure, record, and transmit key air quality parameters. The deployment of AQMS is essential for urban planning, public health management, industrial compliance, and climate research.

With the growing demand for automated environmental monitoring, modern AQMS increasingly rely on embedded technologies – microcontroller-based systems optimized for low power consumption, compact size and robust field operation. Such systems enable the creation of geographically distributed sensor networks capable of continuous, real-time air quality assessment. The development of AQMS starts with the careful selection and integration of core hardware components. The sensing layer includes gas sensors (CO_2, $PM_{2,5}$ / PM_{10}, NO_2, O_3 etc. (SCD4x, SDS011, ZE07, ME3 etc.), meteorological sensors (temperature / humidity, pressure, wind speed / direction etc. (BME280 etc.) and optional high-accuracy calibration references. This is paired with a processing unit (microcontroller such as ESP32 or STM32, data logger with non-volatile memory and RTC module), a communication module (supporting Wi-Fi, LoRa, or NB-IoT along with protocols like MQTT, HTTP(S), or CoAP), a power system (solar panel + rechargeable battery with power management IC), and a weather-resistant, ventilated enclosure (IP65 + rated) with mounting hardware.

The deployment process spans hardware integration – ensuring sensor specifications match monitoring goals and electrical compatibility – followed by firmware development (in C / C++ or MicroPython), calibration and validation (laboratory calibration, field validation against reference stations and drift compensation), and network configuration (MQTT broker / HTTP server setup, data payload structure in JSON / CBOR, security via TLS and device authentication). Once deployed, routine maintenance ensures long-term accuracy: sensor cleaning every 1 - 3 months, battery checks, firmware OTA updates, monthly accuracy verification, and recalibration every 6 - 12 months. Collected data feeds real-time dashboards (with AQI), historical analysis, alert systems, and smart city platforms, using formats like JSON / MQTT streams, CSV / Parquet files, and geospatial databases (PostGIS). The technological stack often includes ESP32 / STM32F4 microcontrollers, Sensirion / Alphasense / Plantower sensors, MQTT over TLS, Node.js / Python Flask backends, PostgreSQL / InfluxDB, and visualization tools like Grafana and Leaflet. This approach delivers cost efficiency, scalability, real-time responsiveness, public accessibility, and regulatory compliance.

Thus, the development of air quality monitoring stations using embedded technologies represents a powerful approach to environmental management. By combining low-cost sensors, efficient microcontrollers, and cloud connectivity, these systems deliver actionable air quality data for public health, urban planning, and industrial

applications. Proper design, calibration, and maintenance ensure reliable operation, making embedded AQMS a cornerstone of modern environmental monitoring infrastructure [1].

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CONSIDERATION OF THE INFLUENCE OF NATURAL AND CLIMATIC FACTORS AS PART OF ENVIRONMENTAL MONITORING OF EMISSIONS FROM TANKS

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The aim of the paper is to consider the influence of climatic and meteorological factors on the emissions of pollutants into the atmospheric air from oil and petroleum products storage tanks. The study provides a brief description of the types of tanks, the main influencing factors, as well as an example of comparing indicators using the calculation method. The significance of the differences between the factors under consideration and the relevance of the topic are clearly shown.

Keywords: tank, climatic factor, meteorological factor, emissions monitoring.

Oil and petroleum products storage tanks are an integral part of every oil refinery, tank farm, thermal power plant, gas station and other production facilities. There are many types of reservoirs, but the main classification is by location in space (horizontal and vertical). Vertical tanks, in turn, are divided into: vertical steel tank (RVS with a fixed roof), vertical steel tank with a pontoon (RVSP), vertical steel tank with a floating roof (RVSPK).

Emissions of pollutants into the atmospheric air from reservoirs are called "breathing" of the reservoir, which occurs as a result of the evaporation process of the contents. There are 2 main types of emissions: "big breaths" occur when the tank is filled with petroleum products, "small breaths" – due to daily fluctuations in air temperature in the tank [2]. Emissions are subject to environmental monitoring to control the state of the environment.

All types of "breathing" of reservoirs are influenced by a number of factors: climatic (landform, climatic zone, which in the long term determines the factors mentioned below), meteorological (air temperature, atmospheric pressure, humidity, wind speed, precipitation, as well as special phenomena, such as fog). The temperature and air pressure are directly related: as the temperature rises, the pressure increases, which leads to increased evaporation and the release of the contents of the tank into the atmosphere; as the temperature decreases, the opposite effect is observed.

Increased humidity can lead to condensation of moisture and flooding of the tank contents, while in the atmosphere it (as well as calm) can keep emissions in the surface air layer. Strong wind and fog contribute to the active circulation of air masses, and along with this, the distribution of released vapors. The climate significantly affects not only the temperature, but also its daily amplitudes. For example, in a severely continental climate, the amplitude will be greater than in a moderately continental climate, which will affect the "breathing" of the reservoir. To carry out environmental monitoring, all factors must be taken into account [2].

To evaluate the "small respiration" of the reservoir and compare different meteorological and climatic conditions, a calculation was performed, which is currently performed according to the formula of Professor N.N. Konstantinov [1]:

$$Gмд = \sigma \cdot Vг \cdot \ln\left[\frac{(Pa - Pкв - Pmin) \cdot Trmax}{(Pa + Pкд - Pmax) \cdot Trmin}\right],$$

где: σ - average mass content of oil vapors in PVS; $Vг$ - the volume of the gas tank space; $Pmin$ и $Pmax$ - accordingly, the minimum and maximum partial pressures of oil vapor in the gas tank during the day; $Trmin$ и $Trmax$ - minimum and maximum temperatures of the GP tank during the day.

The initial data was taken as an abstract RVS with a volume of 5,000 m3 with light oil (p = 820 kg/m3) at two points different in terms of the factors described above – Perm and Chita. As a result of the calculations, the following results

were obtained: oil losses from the "small breathing" of the RVS in Perm in July 2025 amounted to 1128.71 kg; in Chita – 1177.07 kg. Thus, the loss of RVS in Chita is 48.36 kg more than the loss of RVS in Perm, due to differences in climatic and meteorological conditions.

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STUDY OF ECOLOGICAL BENEFITS OF URBAN FOOD SYSTEM TRANSFORMATION

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This article introduces the dietary structure transformation of replacing traditional beef with alternative proteins to alleviate the current ecological and environmental pressure. Measures such as the transformation of urban food and dietary systems provide a key path to achieving the dual carbon goals. Under different shared socio-economic pathways (SSPs), alternative proteins have the greatest potential for ecological benefits under the Sustainable Development Pathway (SSP1).

Keywords: ecological benefits, urban food system, transformation.

With the continuous growth of the world's population, it is one of the main factors causing large food consumption, resource shortage and environmental crisis. Cities have become key hotspots in terms of resource consumption and environmental impact, and their dietary structure plays a decisive guiding role in global agricultural production. Traditional beef production is widely regarded as one of the most resource-intensive food production methods. Its environmental costs are reflected in greenhouse gas emissions, land occupation and water resource consumption. In recent years, the replacement of beef with alternative protein, due to its resource-efficient and environmentally friendly characteristics, has reshaped urban food consumption habits and generated good ecological benefits.

Research shows that replacing beef with alternative protein is sufficient to have a significant impact on the total net greenhouse gas emissions. The dynamic changes in land caused by alternative proteins: The land area required for the production process of alternative proteins is significantly reduced, thereby alleviating deforestation and ecological degradation caused by the expansion of pastures, creating conditions for the maintenance and restoration of biodiversity. At the same time, the production of alternative proteins consumes less water, which helps to relieve regional water resource pressure. It also provides higher protein production efficiency under the same land resource conditions, which has a positive impact on the sustainability of water resources. Meanwhile, the scenario analysis of the ecological benefits of alternative proteins under different development paths can more intuitively feel the degree of realization of their ecological benefits. Through the analysis of ecological benefits in different scenarios, it is demonstrated that the transformation of urban food consumption plays a positive role in the sustainable development of the future ecological environment.

This paper systematically and comprehensively demonstrates the crucial and indispensable role of alternative proteins in the transformation and evolution of urban food systems. The strategic application and extensive integration of alternative proteins have great potential to fundamentally alleviate and reduce the huge ecological and environmental pressures currently faced by our planet. In the complex structure of urban food systems, the large-scale adoption and practical application of alternative proteins are supported by clear, well-defined and operational implementation approaches, as well as solid and continuously growing empirical evidence and real-world practical foundations.

It is not merely an abstract or idealized concept confined to the theoretical level, but a practical and feasible reality. Through rigorous analysis, comprehensive assessment and multi-faceted evaluation, this study clearly reveals the intrinsic feasibility, realistic relatability and overall feasibility of this important goal. The ultimate goal and significant

contribution of this work is to provide a powerful, sustainable and forward-looking approach for achieving the “dual carbon” goals. To effectively alleviate the increasing pressure on the ecological environment and ensure and safeguard national ecological security and the long-term sustainability of resources.

Thus, this study aims to provide a scientific, reasonable, evidence-based and reliable basis for the formulation, development and improvement of relevant policies, strategic guidelines and regulatory frameworks, thereby supporting informed decision-making and proactive governance to achieve a more sustainable and resilient future [1, 2].

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ASSESSMENT OF THE TREE STANDS CONDITION IN PAVLOV PARK

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The article shows the dynamics of the assessment of the tree condition in Mikhail Pavlov Park. The changes in the tree condition coefficient of the urban park have been identified.

Keywords: ecological condition of parks, anthropogenic impact, tree stand condition coefficient.

In contemporary urban ecosystems, green infrastructure plays a critical role, fulfilling not only recreational functions for the populace but also contributing significantly to environmental health enhancement, augmentation of the aesthetic value of urban areas, and the formation of a rational and harmonious spatial structure of the urban environment. Consequently, the maintenance, rehabilitation, and conservation of woody vegetation across various urban territories present a pressing ecological challenge. Urban parks, as key elements of green infrastructure, often exhibit a condition that fails to comply with established normative requirements [1].

Minsk, being one of the largest industrial hubs in Belarus, is subject to substantial anthropogenic pressure on its ecological systems, particularly its phytocenoses. Within urban ecosystems, parks serve essential recreational functions, facilitating comfortable leisure activities [2]. The presence of arboreal vegetation directly influences urban air quality by partially mitigating pollutants from vehicular and industrial emissions; additionally, plants act as acoustic barriers and modify adverse wind patterns.

Mikhail Pavlov Park, located in the Moskovsky District of Minsk between the Malinovka, Yugo-Zapad, and Brilevichi residential areas, covers an area of 41 hectares. An assessment of the ecological status of the park's dendroflora was conducted on sample plots characterized by varying degrees of anthropogenic load. The evaluation of tree vitality was performed based on visual morphological traits (using a 1 to 5-point scale), enabling the calculation of the tree stand condition index for each species and respective plot.

The dendrological composition of the park is represented by seventeen taxa, among which introduced species constitute over 50%. The most common species are: Silver Birch (Betula pendula), Large-leaved Linden (Tilia platyphyllos), Common Ash (Fraxinus excelsior), Manitoba Maple (Acer negundo), and White Willow (Salix alba).

We conducted an analysis of the state of tree vegetation from 2021 to 2025. The tree stand condition coefficient in Pavlov Park on the selected plots did not change significantly. For the plots with the highest anthropogenic impact, the tree stand condition coefficient (K) indicated that these plots have a weakened tree stand (from K=1.74 in 2021 to K=1.81 in 2025). For the plots with the lowest degree of anthropogenic impact, the values of the tree stand coefficient changed more significantly (from K=1.13 in 2021 to K=1.36 in 2025).

The overall tree stand condition coefficient for Mikhail Pavlov Park in 2021 was K=1.86, which classified it as a "weakened" category. In 2025, the value of the park's overall tree stand condition coefficient was K=1.61, indicating a more favorable situation in the park; however, the obtained value still corresponds to the "weakened" tree stand category.

The results of the conducted research indicate the implementation of a range of park improvement measures by the district administration.

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USING ARTIFICIAL INTELLIGENCE TO MONITOR QUALITY AND RESTORATION OF SURFACE WATER RESOURCES

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The rapid degradation of water bodies due to pollution, global warming, and anthropogenic activities necessitates newer methods of restoration. The current research presents the application of artificial intelligence (AI) for real-time monitoring of water quality, management, and parameter analysis for accelerating ecosystem recovery. AI makes anticipatory interventions such as automatic pollutant monitoring and efficient resource allocation possible through machine learning algorithms, IoT sensors, and predictive analytics.

Keywords: artificial intelligence, aquatic ecosystems, water quality monitoring, real-time management, ecosystem restoration.

An aquatic ecosystem is an ecosystem found in and around a body of water, in contrast to land-based terrestrial ecosystems. Aquatic ecosystems contain communities of organisms – aquatic life – that are dependent on each other and on their environment. The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems. Aquatic ecosystems like rivers, lakes, and oceans are vital to climate, water supply, and biodiversity. Yet they face threats in the form of eutrophication, chemical pollution, and habitat destruction that can take years to recover on their own. Traditional monitoring is labor-intensive and late, limiting immediate response. Artificial intelligence can provide a paradigm shift by enabling smart real-time ecosystem management systems.

AI applications in water quality monitoring include machine learning algorithms to predict parameters like pH, dissolved oxygen, turbidity, and nutrients. As a point of illustration, convolutional neural networks (CNNs) and recurrent neural networks (RNNs) work on the sensor values of IoT sensors to detect anomalies in real-time. In aquatic restoration, AI platforms integrate satellite images, drone patrol, and underwater sensors for integrative analysis. Predictive models forecast the ecosystem response to interventions such as bio-remediation or flow adjust-ments to optimize restoration strategy.

Real-time management is maximized by AI algorithms that are capable of automating management systems. As an example, reinforcement learning is able to dynamically adjust water treatment procedures based on incoming data, reducing pollutant loads and supporting biodiversity restoration. Research demonstrates that AI-fused systems can shorten restoration timelines by 30-50% through the capability of early threat detection of algal blooms.

Empirical evidence from global applications bring forth the practical benefits of AI in aquatic restoration. In aquaculture, IoT-driven AI systems have been successfully utilized to monitor key parameters in real time, preventing outbreaks of disease and ensuring yield sustainability through precise regulation of the environment. Similarly, in marine conservation efforts, AI-based automated tools have facilitated monitoring of large-scale habitats, resulting in site-specific interventions that enhance the resilience of ecosystems against climate stressors.

Therefore, the evidence strongly supports AI as a cornerstone for the future of aquatic conservation. While challenges in implementation remain, its capacity to enable precise, predictive, and adaptive management underscores its indispensable role in safeguarding these critical ecosystems for generations to come.

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SOIL QUALITY IN ORGANIC AND CONVENTIONAL AGRICULTURAL SYSTEMS

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Organic agriculture significantly improves soil structure, carbon sink function and nutrient cycling resilience by increasing soil aggregate content, enhancing carbon sequestration capacity and optimizing microbial communities. Despite the low initial yield, it stabilizes after five years and outperforms conventional agriculture, demonstrating superior soil health and long-term sustainability.

Keywords: soil quality, organic agriculture, soil organic carbon, microbial diversity, carbon sequestration, agroecosystem resilience

Organic agriculture is defined as a production system that relies on natural processes rather than synthetic chemicals, genetically modified organisms, or artificial additives. It represents a paradigm shift toward renewable food production, grounded in agroecological principles that prioritize soil health, biodiversity conservation, and resource efficiency, with the aim of mitigating climate change impacts while ensuring long-term food security. This study conducts a systematic comparison of soil quality between organic and conventional farming systems, addressing critical knowledge gaps regarding their differential effects on soil integrity and sustainability.

Drawing on data from long-term field trials, this research evaluates soil quality through physical, chemical, and biological indicators. Key findings indicate that organic systems significantly enhance soil structure: large aggregate content (>2 mm) increases by 47.3% compared to conventional farmland, and soil erosion is reduced by 38% under heavy rainfall conditions. Soil organic matter (SOM) accumulates in organic systems at a rate of 0.35 t C/ha per year, doubling the carbon sequestration capacity relative to conventional agriculture. Microbiologically, organic management increases microbial biomass carbon by 35.2% and arbuscular mycorrhizal colonization by 28.7%, thereby enhancing the diversity and functionality of the soil food web. These improvements are associated with enhanced nutrient cycling nitrogen mineralization rates increase by 19% during drought periods, contributing to greater resilience under climatic stress.

From an economic perspective, although initial yields in organic systems are 12–18% lower than those of conventional systems, they stabilize at 82% of conventional yields after five years due to progressive improvements in soil health. Carbon footprint analysis reveals that organic systems reduce CO_2 emissions per unit of output by 32%, though the productivity gap must be assessed contextually. From a social standpoint, organic farming reduces externalized costs by 103 euros per hectare annually compared to conventional practices, particularly in areas such as water pollution mitigation.

Thus, the introduction of elements of organic agriculture shows some positive aspects compared to the traditional way of farming, which are expressed in a more favorable effect on soil cover, carbon uptake and long-term sustainability, despite the existing yield compromises and socio-economic problems. Future research should prioritize regional specifics of adaptation strategies and interdisciplinary collaboration to fully realize the potential of sustainable food systems using organic farming systems.

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REDUCING ENVIRONMENTAL RISKS IN THE WATER TREATMENT SYSTEM OF ENERGY PLANTS

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The study presents the results of the possible use of clarified water purification methods in closed hydraulic ash removal systems of thermal power plants, without the use of chemical reagents. A dangerous rise in the water level in the sections can lead to a breach of the enclosing dams and a spill of clarified water into nearby territories. The use of excess water in the technological needs of enterprises is also difficult due to the discrepancy in quality requirements for process water. For these reasons, there is an urgent need to develop and implement non-traditional methods of industrial wastewater treatment based on the principles of waste-free production. One of the possible methods may be the thermodynamic treatment of wastewater and the possibility of their use for the technical needs of the enterprise.

Keywords: cavitation, wastewater treatment, ash removal system, clarified water, environmental risks.

In modern conditions of growing interest in environmental issues and stricter environmental legislation in both the Russian Federation and other countries, strict requirements are imposed on the methods of industrial wastewater treatment. These restrictions serve to increase the environmental safety of industrial enterprises and are an incentive to create closed water use systems. The electric power sector is the key to stable economic growth and industrial development in the country. In the context of growing cities, there is an increase in the strategic importance of energy complex enterprises, because the life and health of a large number of people depend on their uninterrupted operation.

Water is one of the most demanded natural resources consumed by industrial enterprises, while thermal power plants are no exception. This natural resource is cheap, universally available, and suitable for various technological needs of power plants. Water is used to recharge the cycle of the plant and the heating network, for condensation and cooling of spent steam, cooling of mechanisms, hydraulic cleaning, chemical flushing of equipment, and so on. These methods of using natural water inevitably lead to the formation of polluted industrial wastewater. The concentration and composition of pollutants in this wastewater depends on the type of power plant, the fuel it uses, the composition of natural water, and the culture of operation. During the operation of thermal power plants, cooling waters, as a rule, are not polluted if no foreign effluents enter them. In this case, thermal pollution of the reservoir may occur, because the temperature of the waste water is higher than the natural one. In this regard, many thermal power plants use closed cooling systems.

Coal-fired power plants traditionally use a closed hydro ash removal system. In this regard, there is a problem of purification and further use of clarified water effluents, because the emergence of a positive balance in the system is almost inevitable. The method of water purification used in settling ponds at the ash dump does not ensure the environmental safety of handling such types of wastewater. Another potentially applicable way to use wastewater is to use it as process water. However, quality requirements are also imposed on process water, which are not achieved by filtration in ash dump areas.

The aim of this research is to study changes in water properties under the influence of cavitation and to consider the possibility of using these technologies as a non-reagent method of purification of clarified water of a thermal power plant.

The object of laboratory research is on the physico-chemical parameters of clarified water resulting from the transportation of ash and slag waste generated by the combustion of brown coal in the Kansk-Achinsk fuel basin. The studied clarified water samples were taken at the ash and slag dump, which is used for the operational storage of ash

formed as a result of burning brown coal in the Kansk-Achinsk basin. The physico-chemical properties of the selected clarified water samples were determined.

The object of the study is clarified water obtained as a result of purification in settling ponds, used to transport ash and slag obtained by burning brown coal grade B2. Table 1 shows the initial concentrations of pollutants determined as a result of quantitative chemical analysis.

A Silverson L5M high-speed laboratory mixer was used to process clarified water. During processing in three modes, a chemical analysis of the sample of each mode was performed. The data from these analyses are also shown in Table 1.When analyzing the data obtained, it can be concluded that the efficiency of wastewater treatment is quite high.

Table

Concentrations of impurities in the source and treated water

Indicator, units	Initial sample	Processed sample		
		1 mode *	2 mode **	3 mode ***
Dry residue, mg/dm^3	912,00	1044,00	1002,00	1112,00
Sulphate ion, mg/dm^3	80,50	83,50	77,20	62,50
Hydrogencarbonate ion, mg/dm^3	less than 6,1	less than 6,1	less than 6,1	less than 6,1
Carbonate ion, mg/dm^3	1206,00	768,00	864,00	730,10
Hydrogen index, units, pH	12,12	12,02	10,21	8,55
Overall stiffness, mg-eq/dm^3	17,84	12,72	13,04	9,92

The proposed technical solutions ensure the necessary water quality for reuse. The main advantages of the reagentless method based on hydrothermodynamic cavitation include: a wide range of purification, the possibility of implementation into existing systems, reducing environmental risks, reduction of operating costs, system autonomy.

Hydro-ash removal systems are one of the most important elements of a coal-fired thermal power plant. The reliability of the ash-collecting and ash-removing equipment depends on their effective operation. Now, when the problem of environmental efficiency is acute, it is important to develop and implement new technologies in existing outdated systems. These technologies should be based on waste-free and agent-free methods, which will keep pace with progress and meet modern international requirements for waste-free production.

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RARE EARTH MATERIALS, THEIR PROPERTIES AND APPLICATIONS

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Rare earth materials are a group of 17 elements, including scandium, yttrium, and the lanthanides. In this article, we will focus on elements such as scandium, terbium, ytterbium, dysprosium, yttrium, and neodymium. All these elements are in the third group and share the common name – lanthanides.

Keywords: rare earth materials, scandium, terbium, ytterbium, dysprosium, yttrium, neodymium.

Rare earth materials are a group of 17 elements that received their name due to the fact that they are relatively rare in the Earth's crust and form refractory, practically insoluble in water oxides. This key property, which historically justified the inclusion of the word "earth" in their name, is directly related to their chemical nature and determines the wide range of practical applications of these elements in modern technologies, from electronics to heavy industry.[1]

The chemical element lanthanum (density ρ=6.16 g/cm³, melting point τ=920 °C, abundance in the Earth's crust about 0.0034%) occurs in nature as a mixture of two isotopes: stable lanthanum-139 and radioactive lanthanum-138. Lanthanum is widely used in medicine and various industries (production of optical glasses, hydrogen storage alloys, high-temperature ceramics) due to its high catalytic activity and ability to form superconductors.[2-3]

The chemical element scandium (ρ=2.99 g/cm³, τ=1540.85 °C, abundance in the Earth's crust about 0.001%) is a mono-isotopic element; only one stable isotope, scandium-45, is found in nature. It exists in two crystalline modifications: α-scandium with a hexagonal close-packed lattice and β-scandium with a body-centered cubic lattice. Scandium is widely used in metallurgy, microelectronics, nuclear energy, and medicine due to its light weight, high strength, and high melting point.[4]

The chemical element terbium (ρ=8.229 g/cm³, τ=1356 °C, abundance in the Earth's crust about 0.00034%) has a single stable isotope, terbium-159. The longest-lived radioactive isotope is terbium-158 with a half-life of 180 years. Terbium is used in the production of magnetostrictive alloys, magnetic materials, and optical materials.

The chemical element ytterbium (ρ=6.9654 g/cm³, τ=823.85 °C, abundance in the Earth's crust about 0.000033%) occurs in nature as seven stable isotopes. Ytterbium is widely used in the creation of laser materials, thermoelectric materials, magnetic materials, as well as in nuclear energy due to its ability to emit light in the infrared range and its capacity to improve the mechanical properties of metals in alloys.

The chemical element dysprosium (ρ=8.55 g/cm³, τ=1411 °C, abundance in the Earth's crust about 0.0005%) occurs in nature as seven main natural isotopes; among these, the most common is dysprosium-164, which constitutes 26.26% of all natural dysprosium. Dysprosium is widely used in metallurgy and nuclear energy due to its magnetic and nuclear properties.

The chemical element yttrium (ρ=4.47 g/cm³, τ=1521.85 °C, abundance in the Earth's crust about 0.0026%) is a mono-isotopic element; in nature, it is represented by one stable isotope, yttrium-89. Yttrium is widely used in the creation of yttrium ceramics because it transmits infrared radiation very well.[5]

The chemical element neodymium (ρ=7.007 g/cm³, τ=1020.85 °C, abundance in the Earth's crust about 0.0025%) occurs in nature as seven isotopes, five of which are stable and two are weakly radioactive: neodymium-144 undergoes alpha decay with a half-life of 2.29*10^15 years, and neodymium-150 undergoes double beta decay with a half-life of 9.3*10^18 years. The atomic mass of neodymium is 144.24 g/mol. Neodymium is widely used in the creation of powerful permanent magnets, neodymium glass, and is also extensively used in electronics due to its magnetic and strength properties.[6]

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THE RELATIONSHIP BETWEEN THE LEVEL OF HEAVY METAL CONTAMINATION IN DRINKING WATER AND THE PREVALENCE OF URINARY TRACT DISEASES

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This article reveals the problems of drinking water contamination with heavy metals and describes the mechanism of the impact of such contamination on the urinary system.

Keywords: water quality, heavy metals, morbidity.

Heavy metals are components of the Earth's crust, but their concentration in the environment can increase significantly as a result of human activity. As industrial waste products, they end up in water that is then used for drinking. These substances are highly toxic and can have a negative impact on the human body.

The urinary system is a kind of "filter" for our body, so it is the first to be affected by drinking water contaminants. The condition of this organ system affects the condition of the body as a whole, so it is important to monitor its health and prevent damage [1].

The assessment of the risk of heavy metal exposure to the body depends on the type of pollutant. Heavy metals such as cadmium, lead, and mercury are nephrotoxic, i.e., they can destroy kidney tissue. Accumulating in kidney cells, they cause oxidative stress, inflammation, and DNA damage, which subsequently leads to the development of chronic kidney diseases (glomerulonephritis, urolithiasis, chronic kidney disease). Other metals, such as arsenic, are carcinogenic. Once inside the body, they can disrupt DNA repair processes in bladder cells, which contributes to the accumulation of mutations and, as a result, increases the risk of cancer. In addition, virtually all pollutants of this type are immunotoxins. They cause immune dysfunction, which leads to increased susceptibility to urinary tract infections [2].

To prevent the consequences of heavy metal contamination of drinking water, there is a list of measures that includes: monitoring the quality of drinking water, improving water treatment technologies, timely replacement of water pipes, protecting drinking water sources from industrial waste, and raising public awareness of this issue. These actions minimize the risks associated with the impact of pollutants on human health and reduce the number of patients with urinary system pathologies [3].

Thus, the presence of heavy metals in water has a negative effect on the health of the human urinary system. Chronic exposure to this type of pollutant significantly increases the risk of developing chronic kidney disease, bladder cancer, and other pathologies. To prevent this, there is a set of measures for monitoring water quality and purifying it, which is one of the priority tasks for maintaining public health.

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POCKET PARKS EMPOWER SUSTAINABLE URBAN DEVELOPMENT

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This paper explores the role of pocket parks in sustainable urban development. Based on the case of Minsk, China and Belarus, it points out their functions, maintenance, and ecological challenges, proposes optimization paths such as planning, design, and policy, and looks forward to the green cooperation between China and Belarus. The "15-minute city" concept promotes sustainable urban development by integrating pocket parks into community life circles.

Keywords: Pocket park, sustainable urban development,15-minute city, urban renewal, ecological sustainability, China-Belarus cooperation.

Pocket park is miniature public gree spaces created using idle corner spaces in the city for residents to relax nearby. Pocket park and the theoretical basis of sustainable urban development.Pocket parks should be multifunctional composite spaces with rest, play, viewing, earthquake prevention and disaster reduction, education, etc., and public green space with human activities as the main body[1]. They have become an important carrier for realizing the "15-minute city" concept. The design principles of pocket parks[2] provide residents with ecological services and social places, and promote urban sustainable development in the three dimensions of environment, society and economy. From the Paris community green network to Singapore's high-density greening practice, global cases have confirmed the value of pocket parks in building livable cities. Current status of pocket parks in Minsk, China and Belarus.

A survey of pocket parks in Minsk, Suzhou and Shanghai, China, found that both faced common problems in urban renewal, such as difficulty in facility maintenance[3], unscientific planning and layout, and insufficient ecological sustainability. Effective maintenance mechanisms and improved community participation models need to be established.

Innovative development and future prospects.Systematic innovative strategies are needed to improve the benefits of pocket parks. A functional composite model should be implemented at the planning and design level to create age-friendly spaces. A cross-departmental coordination mechanism should be established at the policy level to explore sustainable models that combine parks with commerce and improve the community co-construction and co-governance system. Under the framework of the Belt and Road Initiative, China and Belarus can cooperate in multiple fields, explore development models that adapt to different cultural backgrounds, and provide new ideas for the sustainable development of global cities.

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OPTIMIZATION RESEARCH ON LOW-CARBON AND HIGH-EFFICIENCY WATER TREATMENT SYSTEMS INTEGRATING AI AND MEMBRANE TREATMENT TECHNOLOGY

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Wastewater treatment is a major energy consumer. Under the 'Dual Carbon' goals, energy conservation and consumption reduction have become one of the most urgent needs in the industry. Currently, the vast majority of wastewater treatment plants still rely on manual experience or simple PID controls, resulting in extensive operation,

weak resistance to shock loads, and significant fluctuations in effluent quality. 'Intelligentization' is the inevitable path for industry upgrading.

Keywords: Wastewater, energy saving, membrane technology, AI

With the advancement of the "Dual Carbon" goals, the water treatment industry faces dual challenges of energy saving, consumption reduction, quality improvement, and efficiency enhancement. Membrane technology, as a core separation method, has energy consumption and operational stability that are key to determining the carbon footprint of water treatment systems. In recent years, the rise of artificial intelligence technology has provided a revolutionary new path for achieving the low-carbon and high-efficiency optimization of membrane treatment systems.

Traditional membrane system optimization primarily relies on physical models and expert experience, struggling to cope with the dynamic complexity of water quality fluctuations and membrane fouling. The integration of AI and membrane technology is profoundly changing this situation across three levels. Firstly, in terms of intelligent control and predictive maintenance, machine learning models can accurately predict membrane fouling trends based on historical and real-time data, dynamically optimize backwashing and chemical cleaning cycles, and adjust operating pressure. This significantly reduces energy and chemical consumption while ensuring water production flux, achieving "targeted low-carbon" operations. Secondly, in energy consumption and carbon footprint modeling, AI algorithms can integrate energy consumption data from all system units to build global energy efficiency models, identify energy flow bottlenecks, and couple with the variable output of renewable energy sources (like solar and wind power). This enables the coordinated optimal dispatch of membrane systems and green energy, reducing carbon emissions at the source. Finally, in digital twins and global optimization, by constructing a digital twin of the membrane system, AI can simulate and deduce the performance of the entire process under different working conditions, providing optimal decision-making support for adjusting process parameters and selecting/configuring membrane modules. This maximizes system energy efficiency from individual equipment to the entire water treatment plant.

In summary, the deep integration of AI and membrane technology is an inevitable trend for driving the water treatment industry towards low-carbon and intelligent transformation. Future research should focus on constructing high-quality datasets, developing cross-media (water-energy-carbon) collaborative optimization models, and the embedded integration of edge computing and AI algorithms, aiming to ultimately achieve the "unmanned" low-carbon and high-efficiency operation of water treatment systems.

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MECHANISM ANALYSIS OF MULTI-OMICS INTEGRATION IN SOIL MICROPLASTIC-HEAVY METAL COMBINED POLLUTION MONITORING

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Soil microplastic-heavy metal combined pollution threatens farmland ecosystems, but integration of multi-media mechanisms and accurate monitoring is lacking [1]. This study integrated literature data and applied multi-omics to reveal that microplastics regulate soil pH to affect heavy metal mobility [4]; the plastisphere enriches functional microorganisms and modulates synergistic gene expression. A three-tier "physicochemical-microbial-functional" monitoring system, superior to traditional indicators, provides theoretical and practical support for pollution monitoring [1,5].

Keywords: Microplastic-heavy metal combined pollution; Multi-omics integration; Plastisphere; Soil monitoring system

Combined pollution alters soil properties and exacerbates risks via plastisphere microbial community reconstruction [1]. Existing studies focus on single pollutants, lack integrated analysis of the "microplastic type-dose-heavy metal form-microbial response" chain, and rely on single-dimensional indicators [3]. This study integrates multi-omics literature to clarify regulatory mechanisms and support a sensitive, accurate monitoring system, breaking single-research fragmentation and guiding farmland surveys.Core literatures (pot experiments/metagenomics) were selected by strict criteria: farmland combined pollution focus, ≥2 omics technologies, complete data, and publication in high-impact journals (past 8 years). Data were standardized and integrated from three dimensions: physicochemical (pH, heavy metal bioavailability) [5], microbial (plastisphere core genus abundance, functional gene expression) [2], and functional (enzyme activity, metabolite concentration) [1].

There are three points :First,pH and heavy metal mobility: Traditional microplastics reduce pH to promote mobility; biodegradable ones inhibit mobility via late-stage alkalization (verified by multiple studies) [5].Second Plastisphere microorganisms: Microbial communities differ from bulk soil; traditional microplastics enrich heavy metal-resistant bacteria, biodegradable ones enrich degrading bacteria. Synergistic expression of degradation/resistance genes aids adaptation to combined pollution [2].Third Enzymes and metabolites: Biodegradable microplastics enhance key enzyme activity via carbon release; traditional ones inhibit specific enzymes. Specific metabolites act as pollution/degradation markers, some linked to heavy metal toxicity [1].

A verifiable three-tier system with literature-supported, quantifiable, high-response indicators [3]: Physicochemical layer: Early warning via soil pH safety range and heavy metal bioavailability risk value [4]; Microbial marker layer: Risk signal when indicator genus abundance or resistance gene expression hits thresholds;Function verification layer [2]: Judge via key enzyme activity thresholds; use metabolites to indicate pollution/degradation [1].

Verified in contaminated farmland, this system is more accurate, faster, and sensitive than single indicators, meeting on-site monitoring needs. Microplastics affect contaminated soil ecology via "pH regulation-microbial enrichment-gene expression" chain (literature-verified); Plastisphere-specific microorganisms/metabolites serve as combined pollution markers; A feasible framework for the three-tier monitoring system is provided.

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IMPACT AND PREDICTION OF CLIMATE CHANGE ON BIODIVERSITY AND ECOLOGICAL PROCESSES IN MOUNTAIN GLACIER ECOSYSTEMS

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Mountain glacier ecosystems, renowned as "white treasures" and "solid reservoirs", play irreplaceable roles in regulating regional climate, maintaining downstream freshwater supplies, and supporting unique biodiversity. As sentinels of global climate change, these ecosystems are among the most vulnerable to warming temperatures – with even subtle glacial retreat triggering cascading effects on ecological processes and species survival. This paper explores the multifaceted impacts of climate warming-induced glacier ablation on biodiversity and key ecological processes (e.g.,

biogeochemical cycling, vegetation succession) in mountain glacier ecosystems. It also predicts their evolution under different future shared socio-economic pathways (SSPs) and proposes targeted conservation strategies. Studies indicate that accelerating glacier retreat not only reduces habitat availability but also profoundly restructures biological communities, disrupts nutrient cycling, and alters species interactions. Specifically, under shared socio-economic pathways (SSPs), Rimeier et al. (2025) found that the loss of specialized taxa (e.g., cold-adapted invertebrates) and functional transition of microbial communities will be more pronounced in high-emission scenarios (e.g., SSP5-8.5), while sustainable development pathways (e.g., SSP1-1.9) may mitigate such degradation by slowing glacial loss [1]. This research provides a scientific basis for understanding, monitoring, and responding to ecological changes in mountain glacier ecosystems, which is critical for safeguarding global ecological security.

Keywords: Climate change; Mountain glacier ecosystems; Biodiversity loss; Ecological processes; SSP scenarios; Conservation strategies

Mountain glacier ecosystems are complex, interconnected systems that encompass three core habitats: supraglacial (on-glacier) environments, subglacial (beneath-glacier) zones, and proglacial (post-glacial) areas. These habitats are defined by extreme environmental conditions – near-freezing temperatures year-round, high ultraviolet (UV) radiation at high altitudes, and oligotrophy (low nutrient availability) – which have driven the evolution of highly specialized biological communities. For example, supraglacial communities often include cold-tolerant cyanobacteria and algae that form "glacier algae" (visible as red or green patches on ice), while subglacial environments support chemoautotrophic bacteria that rely on mineral-rich meltwater for energy [2].

Liu et al. (2024) further clarified that supraglacial and subglacial ecosystems contribute differentially to proglacial system function: supraglacial organic matter (e.g., from algae and wind-blown debris) fuels proglacial soil fertility, while subglacial meltwater delivers essential minerals (e.g., phosphorus, nitrogen) that support downstream plant growth [2]. This functional differentiation highlights the fragility of glacier ecosystems – disturbance to one habitat can disrupt the entire system. Since 2000, global glaciers have lost approximately 5% of their total mass, with even greater losses in high-mountain regions: Chinese glaciers, for instance, shrank by 6% between 2008 and 2020, primarily driven by anthropogenic warming (e.g., greenhouse gas emissions) and black carbon deposition (which reduces ice albedo and accelerates melting). These changes are already triggering cascading ecological effects, from reduced meltwater supply to the loss of specialized species, threatening both ecosystem integrity and downstream human livelihoods.

Climate change drives profound and interconnected changes in mountain glacier ecosystems, manifested as specialized biodiversity loss, accelerated vegetation succession, and disrupted biogeochemical cycles. Future trajectories are closely tied to emission pathways: high emissions will exacerbate ecological degradation, while sustainable pathways offer a chance to mitigate loss [1]. Protecting these ecosystems requires urgent global action to reduce emissions, enhanced monitoring, and integrated management – measures that are not only critical for safeguarding glacial biodiversity but also for ensuring downstream freshwater security and global ecological balance. As Liu et al. (2024) emphasized, preserving the functional integrity of supraglacial and subglacial habitats is key to maintaining the resilience of entire glacier ecosystems [2]. Only through coordinated, science-based efforts can we ensure the long-term survival of these "white treasures".

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ECHINOCYSTIS *(ECHINOCÝSTIS LOBÁTA)* AND ITS DISTRIBUTION IN BELARUS

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The abstracts provide data on the spread of alien fauna in Belarus, which are considered one of the main threats not only to the biodiversity of plants and animals, but also leading to more serious consequences. In particular, to economic, environmental and social ones.

Belarus is no exception in the issue of the appearance of introduced species of plant origin on its territory. Measures to clear territories of these species are carried out as tangible negative consequences of their presence arise. One of the main representatives of alien plant species actively spreading across the territory of Belarus is Echinocystis lobata. Its presence poses a threat to the extinction of local plant and animal species in the places where it grows.

Keywords: интродукция, эхиноцистис колючеплодный, чужеродные виды, экономический ущерб, экология и защита окружающей среды.

In accordance with the legislation of the Republic of Belarus "On the Protection and Use of Fauna and Flora", invasive and alien species of wild plants are wild plants that are outside their natural range, forming viable populations in a state of natural freedom, the distribution and number of which pose a threat to biological diversity. Currently, on the territory of the Republic of Belarus there are more than 50 species of invasive plant species that have appeared on the territory of modern Belarus [1].

An alien or invasive species is a species whose introduction threatens ecosystems, other biological species, and causes (ecological) economic damage [2].

Echinocystis lobata or thornberry is a plant that has enormous growth energy and, in a short period of time, if no measures are taken to destroy it, it takes over the floodplains of Belarusian rivers, land plots of abandoned buildings, and agricultural lands. The thornberry is capable of destroying entire sections of young forest plantations, entwining trees and depriving them of sunlight. The unpretentiousness of this plant to the soil, the huge number of seeds with almost 100% germination and, as mentioned earlier, the enormous starting energy of growth allowed this plant to spread across the territory of Belarus, causing enormous economic damage to the national economy.

Seedlings of *Echinocystis lobata* in early spring on the edge of a corn field *(Molodechno district, Minsk region. Photo by Yu.G. Liakh, S.A. Klimkova, April 23, 2025)*

The territories occupied by power lines are the best places for the formation of Echinocystis plantations. It is in such places where this alien species has settled that the aboriginal species of plants and animals experience the greatest oppressive pressure.

Long-term growth of Echinocystis in the same area completely changes the species composition of plants that have grown there for centuries. Under the shade of Echinocystis, there is practically no possibility of vegetation of other plants. Only in early spring, when the seeds of native species of local flora have the opportunity to germinate, they eventually die, since they are not able to compete with Echinocystis for the reasons given above.

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STUDY OF CHARACTERISTICS AND SOURCE TRACING OF HEAVY METAL POLLUTION IN GROUNDWATER OF TYPICAL INDUSTRIAL CITIES

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This study focused on heavy metal contamination of groundwater in industrial cities, analyzing its characteristics, distribution, sources, and mechanisms, identifying heavily polluted areas associated with industrial activities. By integrating multiple methods, the study quantified the sources of pollution and assessed its ecological and health risks.

Keywords: characteristics and source tracing, heavy metal pollution, groundwater

This study presents a systematic investigation of heavy metal pollution in the groundwater systems of a representative industrial city in China, with extensive mineral resource exploitation and diversified industrial activities. Through an extensive monitoring network and comprehensive laboratory analysis, researchers identified lead (Pb), cadmium (Cd), mercury (Hg), and chromium (Cr) as the predominant contaminants, with concentrations in ~68 % of wells exceeding national drinking water standards by 2 - 15 times, especially near industrial parks. Spatial distribution showed substantial heterogeneity, strongly correlating with proximity to non-ferrous metal smelting, electroplating, and chemical plants. Notably, these heavy metals pose potential health risks to human organs.

The methodology combined conventional hydrogeochemical analysis with spatial interpolation modeling and multivariate statistics, including Principal Component Analysis and Hierarchical Cluster Analysis. This enabled precise source apportionment, distinguishing three major contamination sources: industrial wastewater discharges (45 - 60% of heavy metals), traffic-related emissions (15 - 25%), and natural geological background (20 - 30%). Supplementary isotopic tracing of lead and chromium further validated that historical industrial waste in unlined landfills, atmospheric deposition, and leakage from corroded pipelines are primary contamination pathways.

Critical to understanding contaminant behavior was the detailed examination of hydrogeological factors governing heavy metal transport. The study showed that specific geological characteristics – such as soil permeability (10^{-3} - 10^{-5} cm / s), aquifer porosity (15 - 35 %), and complex groundwater flow – significantly influence contaminant migration and accumulation. Areas with karst fractured formations and shallow aquifers (water table less than 5 meters) were especially vulnerable, facilitating contaminant mobility and increasing exposure risks to nearby residents.

The health risk assessment quantified carcinogenic and non-carcinogenic risks for approximately 250 000 residents relying on groundwater as their primary drinking source. Cadmium and lead were the most critical contaminants, with the total hazard index (HI) reaching 3,8 and carcinogenic risk (CR) exceeding acceptable limits by 10 - 45 times in severely affected zones. The model incorporated multiple exposure routes – direct ingestion, dermal contact, and inhalation – providing a comprehensive public health evaluation across demographic groups.

This study aims to establish a preliminary scientific framework for groundwater quality management in a typical industrial area, providing practical guidance and reference value for local environmental protection and urban planning authorities. This integrated approach, combining traditional hydrogeochemical analysis with multivariate statistical techniques, can serve as a reference model for assessing groundwater contamination in similar industrial settings, but its broader application requires further validation in diverse geological settings. Within the limited scope of this study, the results provide foundational data for developing targeted remediation strategies for heavily polluted areas and

establishing a basic monitoring system for vulnerable water resources. The identification of major pollutants and their spatial distribution patterns provides a technical basis for prioritizing intervention measures.

Thus, furthermore, this study recommends the implementation of cost-effective monitoring programs and the adoption of an integrated watershed management approach to address real-world environmental issues and future research should expand the sampling network and incorporate long-term monitoring data to validate and refine the proposed framework [1, 2].

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REVIEW OF CHERNOBYL CONTAMINATION REMEDIATION AND ENVIRONMENTAL MONITORING IN BELARUS

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This review examines Belarus' remediation strategies – physical, chemical, and biological methods – and advanced monitoring technologies, including remote sensing and bioindicators. Despite progress, challenges such as low-level contamination and land-use conflicts persist, underscoring the need for sustainable solutions. The paper synthesizes current efforts and future directions to inform global nuclear pollution management.

Keywords: climate change, ecosystems, biodiversity, adaptation, mitigation

This paper reviews Belarus's main approaches to mitigating the long-term consequences of the Chernobyl accident. About 23% of the country's territory remains contaminated with cesium-137 and strontium-90, primarily in the Gomel and Mogilev regions [1]. Remediation efforts combine physical, chemical, and biological measures to reduce radionuclide mobility and ecological risk. Physical methods include removal or isolation of polluted soil, while chemical stabilization uses potassium and phosphate amendments to decrease bioavailability[2].

Modern monitoring integrates remote sensing, Geographic Information System (GIS), and bioindicators. Satellite and drone data enable mapping of radiation hotspots, while biological indicators such as moss and lichens provide low-cost, high-sensitivity monitoring. National databases and GIS-based decision systems now combine environmental and agricultural data to guide land-use planning and assess remediation efficiency.

To enhance decision-making in contaminated land management, several computational models have been developed in Belarus to simulate radionuclide behavior and assess ecological risks. Table 1 summarizes representative examples, including models based on radionuclide migration equations, machine learning prediction, and GIS-integrated ecological risk assessment.

Table

Overview of Nuclear Pollution Monitoring and Prediction Models

Model name	Application areas	Core methods/techniques	References
Dynamic migration model of cesium-137	Simulating the long-term migration of Cs-137 in soil-plant systems and predicting the spread of contamination	Migration equations based on physical and chemical processes, combined with soil type, precipitation, and vegetation parameters	[3]
Machine learning pollution prediction model	Using satellite and ground data to predict Cs-137 concentrations in farmland to support agricultural land planning	By studying random forest algorithm data, remote sensing and monitoring data are integrated	[4]

GIS integrated ecological risk model	Quantify the ecological risks of polluted areas	GIS spatial analysis, combining radioactivity levels, population density and land use data	[5]

On April 30, 2021 Belarus mandates daily CBM (contamination background monitoring) measurements using dosimeters or equivalent methods, with a static error margin ≤20%. If CBM levels exceed the three-month regional average by 0.20 μSv/h, hourly monitoring is enforced – a critical protocol for maintaining stability.

Future efforts could leverage artificial intelligence for big-data analysis and deploy robots for high-risk zone sampling, minimizing human exposure. Integrating technological innovation, interdisciplinary collaboration, and global resources is essential to unraveling Chernobyl's enduring legacy.

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SPATIAL STRUCTURE OF THE *APROCEROS LEUCOPODA (HYMENOPTERA: ARGIDAE)* POPULATION IN THE REPUBLIC OF BELARUS AND EUROPE (INVASIVE SPECIES), AND IN CHINA (NATURAL ECOSYSTEM)

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Keywords: Aproceros leucopoda; invasive species; spatial structure; parthenogenesis; mapping; Belarus; Europe; China; forest ecosystems.

The spread of invasive species is one of the pressing environmental issues of our time, significantly affecting biodiversity and ecosystem functioning. This study focuses on the sawfly Aproceros leucopoda (Hymenoptera: Argidae), which has spread from its natural range in East Asia (China) to Europe, including the Republic of Belarus, where it has been intensively exhibiting invasive properties and causing damage to elm plantations. Studying the spatial structure of populations of this species in various geographical and ecological conditions contributes to understanding the mechanisms of invasion and developing measures to control its spread. Analysis of data from mapping the distribution areas of the above-mentioned representative of the Hymenoptera family was the main task of the study.

The main routes of A. leucopoda's spread to Europe, and in particular to Belarus, are international trade in plant material, transport corridors, and climate change. The import of elm seedlings from East Asia and the movement of insects along railways and motorways have contributed to the catastrophic spread of the species throughout Europe (Fig. 1). Modern geographic information systems allow us to track both the spatial and temporal dynamics of species distribution, including invasive species such as the elm sawfly within the European part of the continent.

Fig. 1. Distribution of A. leucopoda in Europe (4)

Climate warming has created favorable conditions for reproduction and survival, as evidenced by the expansion of the range northward. In invasive regions, unlike in China, A. leucopoda causes massive defoliation of elm trees, weakening them and reducing their resistance to disease, which leads to disruption of ecosystem functions and economic losses in forestry.

A. leucopoda is characterized by a short life cycle (25–40 days) with the possibility of forming 2–3 generations per season, which ensures rapid population growth. A unique feature is parthenogenesis – reproduction without males, which significantly increases its invasive potential. In China's natural ecosystem, the species' population is controlled by parasitic wasps and predators, the sawfly's natural enemies in the environment, which maintains a stable and low population density. In addition, the population is regulated by diseases of various etiologies. In Europe and Belarus, the absence of natural enemies and the widespread availability of food sources (Ulmus spp.) lead to sharp and massive outbreaks and serious damage to elm plantations.

In invasive regions (Europe and Belarus in particular), populations of A. Leucopoda are clustered, with pockets of high density, mainly near transport routes, urbanized areas, and forests with elm trees. In the Minsk region, the density of larvae reaches 50–100 individuals per tree, leading to complete defoliation. In China, on the contrary, the distribution is more uniform and the density is significantly lower (5–10 individuals per tree) due to natural regulators and climatic constraints.

The use of geographic information systems (GIS) has made it possible to visualize the range and distribution of A. leucopoda in different regions. In China, detection points are evenly distributed across the forest areas of Hebei, Shandong, and Liaoning provinces. In Europe as a whole and in Belarus in particular, clusters with high density have been identified along major rivers and transport corridors (e.g., the M1 highway in Belarus, the Tisza and Vistula rivers in Europe). This confirms the significant leading role of anthropogenic factors in invasive spread.

In conclusion, a comparative analysis of the spatial structure of Aproceros leucopoda populations in the natural ecosystem of China and invasive European regions, including Belarus, has revealed the key factors for the species' success: parthenogenesis, adaptability, absence of natural enemies, and the influence of anthropogenic pathways of spread. Invasiveness manifests itself in a clustered distribution with high densities and significant damage to elm plantations. The results of the study emphasize the need for comprehensive monitoring using GIS, strengthening quarantine measures, and studying biological control using natural enemies from the area of origin. This will allow for effective management of the spread of A. leucopoda and preservation of the biodiversity of forest ecosystems in the context of global environmental change.

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CARBON AEROGEL FROM COTTON AS EFFICIENT AND RECYCLABLE SORBENT FOR OIL WASTE

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This study presents the synthesis and characterization of a cotton-based carbon aerogel that can be used as a reusable absorbent for oil cleanup. The developed material exhibits high oil absorption capacity (~30 times more than its own weight) and can be regenerated by simple combustion. Although the absorption capacity gradually decreases over several cycles due to thermal degradation, the aerogel represents a promising, cost-effective, and environmentally friendly alternative to traditional disposable sorbents.

Keywords: carbon aerogel, cotton, recyclable sorbent, pyrolysis, oil waste.

To address environmental issues caused by oil and oil-containing product spills, the development of effective and reusable sorbents is essential. Natural organic materials such as straw and wool, as well as synthetic polymers, are used as sorbents. However, these materials often have significant limitations, including low absorption capacity, low selectivity for oil-water separation, lack of reuse, and the generation of secondary waste.

An ideal sorbent should not only possess high absorption capacity and hydrophobicity but also sufficient mechanical strength to allow repeated regeneration and reuse, which increases cost effectiveness and minimizes environmental impact. Carbon aerogels have attracted considerable attention due to their exceptional properties, such as ultra-low density, high specific surface area, and hydrophobicity. However, traditional production of carbon aerogels often requires expensive or toxic precursors and complex synthesis methods, hindering their large-scale practical application. To address these issues, the development of sustainable biomass-based aerogels is being explored. Cotton, one of the world's most abundant natural cellulose fibers, is a promising, readily available precursor for the production of carbon materials. The aim of this study is to synthesize, characterize, and utilize a cotton-derived carbon aerogel for oil absorption.

Pieces of cotton were soaked with deionized water and pressed into cylindrical shape and then dried at 30 °C for 24 h. The residual water was removed under high vacuum at the pressure of 10^{-6} mbar for 3 h. Under evacuation the height of cylindrical sample was increased ~2 times. On the next step, cotton cylinders were pyrolized in tubular furnace. In order to prevent the oxidation, the furnace was evacuated, and then purged with argon flow. Then, the furnace was heated up to 800 °C at a heating rate of 5 °C/min for pyrolysis and held at 800 °C for 2 h with 300 sccm argon flow. Finally, the furnace was cooled down to room temperature.

After the pyrolysis, the weight and diameter of carbon aerogel cylinders sufficiently decrease compared to the raw cotton. The product of pyrolysis lost up to 93-96 % of the initial weight. According to the results of scanning electron microscopy, the raw cotton fibers form an interconnected 3D network, with most fibers extending to several centimeters in length, while the carbon aerogel fibers display a reduced diameter and more furcate morphology that corresponds to the increase of specific surface area after pyrolysis. A layered structure of thermally exfoliated carbon was also observed.

For an oil absorption test, 0.048 g of carbon aerogel was soaked with a highest possible amount mineral oil waste. Then the aerogel with oil was combusted in an atmospheric air. The strong sorption capability of carbon aerogel was demonstrated: the sample absorbed about ~1.4 g (i.e. ~30 times more than its own weight) on the first cycle of soaking in an oil waste. After the first combustion the weight of dry carbon aerogel decreases to ~0.023 g and remained constant during 5 subsequent cycles. However, the oil absorption capacity gradually decreases to ~0.67 g after 5 cycles, due to the thermal destruction of aerogel fibers and deposition of residues on their surface of fibers leading to the decrease of specific surface area.

To sum it up, this study introduces a superior sorbent made from upcycled cotton, offering exceptional absorption capacity, as well as the ability of reuse after a simple combustion. Carbon aerogel from cotton could be a sustainable and cost-effective alternative to conventional oil sorbents, which are often single-use and non-biodegradable.

DIRECTIONS FOR IMPROVING OF LOCAL ENVIRONMENTAL MONITORING

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Local environmental monitoring includes a system of observations, assessment of the state and dynamics of environmental change, and forecasting of such changes under the influence of natural and anthropogenic factors. In practice, the primary focus is on observations: sampling and measuring chemical concentrations. Results are recorded without establishing of cause-and-effect relationships, assessing spatiotemporal differentiation, forecasting changes in environmental conditions. The core purpose of monitoring is lost. To remedy this situation, it is necessary to widely implement assessments of spatiotemporal differentiation and forecasting of environmental changes.

Keywords: Local environmental monitoring, assessment, forecasting of environmental changes.

One of the directions of improvement of the local environmental monitoring system is strengthening the organizational approach. Local environmental monitoring should be based on scientifically sound criteria for the inclusion of legal entities in the local environmental monitoring system, taking into account the state of environmental components and the characteristics of the legal entity's activities. The system of assessment parameters should be tailored to the specifics of the enterprise's environmental impact and adjusted based on the data assessment results: either downward or upward, if necessary and with appropriate justification.

It is also necessary to link it to the area of responsibility and to consolidate the definition of the term at the legislative level, such as: local environmental monitoring is a system of observing the state of the environment, assessing the ecological state and the dynamics of its change, as well as forecasting changes in the state of the environment under the influence of anthropogenic factors in relation to the territory, which is the area of responsibility of the entity carrying out economic and other activities accompanied by the use of natural resources and impact on the environment [1].

The network of local environmental monitoring sites should be developed using the principles of representativeness: the ratio of the accuracy of the information obtained to the cost of obtaining it; representativeness of the network of sites (sample plots): key sites should be selected based on a preliminary survey, including, among other things, the establishment of landscape-geochemical patterns and characteristics of the study area; a minimum sufficiency of number of sites (sample plots).

Strengthening the methodological (analytical) approach to local environmental monitoring is reflected in the practical implementation of the following:

– biological methods (bioindication/bioassay) – the use of living organisms to assess environmental quality and the extent of pollution;

– earth remote sensing data: the use of aerospace and other types of surveys to assess large areas and identify pollution halos;

– modeling and forecasting – the use of collected data to analyze trends in environmental change and predict the future impact of industrial zones.

Implementation of an integrated approach: monitoring is observation plus assessment plus forecast.

Without assessment, there are no environmental protection measures, since environmental change trends have not been established, nor is it clear in what direction the situation needs to be corrected. Simply recording «exceedances» does not provide the complete information necessary for developing environmental protection measures.

Without a forecast, there are no development prospects for an enterprise or industrial zone, as a cluster of anthropogenic objects whose operation determines the potential development of adverse consequences of environmental changes and the formation of environmental risk zones.

Without the implementation of an integrated approach to assessment and forecasting, the local environmental monitoring system will continue to record «exceedances» and duplicate environmental control.

In the long term, to rectify the situation, it is necessary to widely implement assessment of spatiotemporal differentiation and forecasting of environmental changes. It is advisable to carry out such work not for a single enterprise, but for the industrial zone of the city and (or) the industrial sector as a whole, with the identification of the sources of the most intensive entry of pollutants into the environment, the development and implementation of a set of measures aimed at reducing (optimizing) the level of anthropogenic load.

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SECTION 4
BIOINFORMATICS

DEPENDENCE OF THE STANDARD DEVIATION AND COEFFICIENT OF VARIATION ON MEAN HEIGHT

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Statistical analysis of anthropometric data from 12 population groups revealed a positive correlation between mean height and its standard deviation within each group, while no such relationship was observed with the coefficient of variation.

Keywords: Standard deviation, coefficient of variation, mean height.

Article [1] presents the results of a study based on UK Biobank data, demonstrating the appropriateness of applying the classical model of normal distribution and additive effects in analyzing adult growth. The authors showed that when analyzing hundreds of thousands of individuals, the assumption of normality of residuals and the purely additive nature of the influence of gender, genes and environment is no longer sufficient. Analyzing data from 50 countries, the authors found that as the average height of the population increases, its standard deviation increases. At the same time, the coefficient of variation remains unchanged, which is typical for a lognormal rather than a normal distribution. This indicates that the variability of average height is proportional to its magnitude, rather than constant, as assumed by the normal additive model.

This paper presents the results of calculations of the standard deviation (SD) and coefficient of variation (CV) of average height in 12 groups formed taking into account the gender, region of origin and age of participants (table). The sample included families from Belarus and China, including data on fathers, mothers, and their adult daughters and sons. The data were obtained in the course of research conducted at the Belarusian State University of Physical Culture. The main characteristic studied in all groups was height, which made it possible to assess the variability of this indicator in different populations and generations. Data processing and calculations were performed using MS Excel spreadsheets and statistical packages of the R programming language.

Table

Average height in population groups, its standard deviation and coefficient of variation

Mean height	169.14	180.99	166.44	182.19	179.05	168.40	168.5	174.67	161.17	178.92	172.87	163.87
SD	6.73	6.97	6.75	7.87	7.34	6.38	3.83	5.92	4.92	7.54	4.41	5.29
CV	0.04	0.038	0.041	0.043	0.041	0.038	0.023	0.034	0.031	0.042	0.025	0.032

Standard deviation serves as a measure of the dispersion of individual growth values around the arithmetic mean. Based on standard deviation, the coefficient of variation is calculated – a dimensionless measure of relative variability that allows comparing the degree of dispersion between groups with different mean growth values.

The Shapiro – Wilk tests revealed that the distribution of the analyzed data is approximately normal. For average height, p-value = 0.5393 was obtained, for its standard deviation – 0.564, for the coefficient of variation – 0.1679. In all three cases, the Wilk coefficients are less than the critical value, and the p-value exceeds the standard significance level of 0.05, indicating no statistically significant deviations from the normal distribution.

The correlation between standard deviation and average height was studied using linear regression. The model showed a statistically significant positive correlation: the regression coefficient is 0.1179 (p-value = 0.0261). The coefficient of determination R^2 was 0.4051, and Pearson's correlation coefficient was 0.664, which means that about 44% of the variation in standard deviation is explained by the variation in average height. This indicates that groups with higher average height also have greater absolute dispersion of height values.

At the same time, there is no dependence of the coefficient of variation on average height: for a regression coefficient equal to 0.0004, p-value = 0.104, i.e., the coefficient is not significant at the 0.05 level, which confirms the validity of the null hypothesis of no dependence.

Thus, the relative variability of average height, which is characterized by the coefficient of variation CV, unlike the absolute variability (standard deviation SD), does not show a reliable linear relationship with the average height in the study groups. This is consistent with expectations for biological traits that are subject to proportional variability.

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AUTOMATED SCHEDULE PARSING AND NOTIFICATION THROUGH TELEGRAM BOT

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This article describes a Python project implementing a schedule parser and a Telegram bot that provide students and teachers with instant access to schedule data. The system automatically updates the schedule information and sends the new schedule to users if any changes occur.

Keywords: Schedule parser, Telegram bot, python.

The idea for this project arose when the schedule website periodically went down due to a large number of users. The initial concept did not include a Telegram bot; the first version featured a minimal TUI interface for retrieving schedules based on pre-saved parser data.

At the design stage, it was necessary to determine the technologies to be used. The project was initially conceived as asynchronous so that users would not have to wait long periods to receive up-to-date schedule information. The first step was to choose a storage method for the schedule data. Since the project was non-commercial and subject to frequent server migrations, Firebase and PostgreSQL were unsuitable. SQLite was selected for its open-source nature, cross-platform compatibility, and ease of use. Python was chosen as the main programming language because it efficiently handles I/O-bound tasks and provides a rich ecosystem of libraries.

An analysis of the schedule website revealed that it did not expose any hidden APIs, making it necessary to parse the HTML content directly. It also became clear that the website was built using ASP.NET.

The following libraries were used in the implementation:

1. aiohttp – for handling asynchronous HTTP requests;
2. BeautifulSoup4 – for parsing HTML and XML pages;
3. aiosqlite – for performing asynchronous queries to the SQLite database.
4. Aiogram – Telegram API

During the analysis of the site’s request flow, it became evident that reproducing a valid user session without including special keys such as __EVENTTARGET, __VIEWSTATEGENERATOR, and __EVENTVALIDATION was impossible. To retrieve the schedule, the client must follow the entire request sequence step by step, with each stage corresponding to a separate HTTP request. All special keys are embedded within the form body of the HTML page.

To determine how the data would be stored and transmitted, JSON lists were selected, where the index represents the week number. Each element of this list contains an HTML-formatted message generated by the parser from the corresponding table data.

Because the parser is resource-intensive, it operates concurrently with the Telegram bot but in a separate thread. The event loop is executed in a dedicated thread to run the parser independently, while the main thread runs the bot and manages the schedule change notification coroutine.

Source code: https://github.com/Koalko99/isei-schedule

Bot: https://t.me/isei_schedule_bot

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INVESTIGATION OF ELECTRICAL PROPERTIES AND ANTIOXIDANT ACTIVITY OF TENTOXIN

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In the present study, the electrical properties and antioxidant activity of the tetrapeptide tentoxin, derived from the phytopathogenic fungus Alternaria alternata, were investigated. Key electronic parameters of the molecule, including E_{HOMO}, E_{LUMO}, and the energy gap between the HOMO and LUMO orbitals, were analyzed. A non-empirical computational approach employing extended basis sets in an aqueous solvent environment (CAM-B3LYP/TZVP) was applied.

Keywords: electrical properties; antioxidant; Alternaria alternata; tentoxin.

Tentoxin, a phytotoxin produced by Alternaria species fungi, inhibits ATP hydrolysis in specific F_1 (CF_1) chloroplasts and induces chlorosis in susceptible plants. To calculate the initial geometry of the molecule, a non-empirical method employing extended basis sets (CAM-B3LYP/TZVP) within the Gaussian 09W software package was selected. The CAM-B3LYP functional-a long-range corrected hybrid functional-was chosen for its accuracy in modeling properties such as UV spectra. The TZVP basis set, a triple-zeta valence polarized atomic orbital set, was used to represent electron distribution within the molecule. To identify the global energy minimum and the most stable conformers, all stationary points on the molecule's potential energy surface were analyzed. Frontier molecular orbitals, including the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO), are key parameters in chemical reactivity. The HOMO and LUMO energy levels reflect the molecule's ability to donate and accept electrons, respectively.

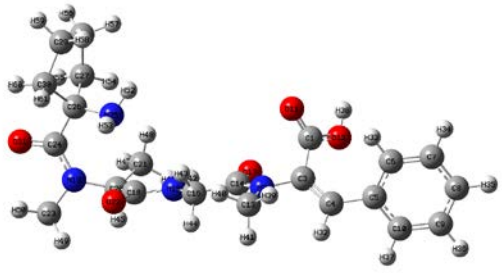

Fig.1 – 3D structure of the tentoxin

Results: Total Energy of the molecule tentoxin E (TD-HF/TD-DFT) = -1451.22.

E_{LUMO} = -0.023 eV; E_{HOMO} = -0.294 eV; E_{gap} = 0.271 eV.

Thus, the tentoxin compound exhibits notable antioxidant activity. The findings of this study highlight the potential of tetrapeptide-based compounds derived from fungal sources as promising antioxidants. Furthermore, previous

investigations have reported that tentoxin also demonstrates antibiotic activity against various antibiotic-resistant strains of microorganisms.

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IN SILICO STRUCTURAL ANALYSIS OF ABC TRANSPORTERS FROM *BREVICORYNE BRASSICAE*

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We report high-quality structural models of cabbage aphid ABC transporters, generated using AlphaFold 3. These models serve as a valuable resource for future studies aimed at elucidating resistance mechanisms, discovering new insecticide targets, and designing innovative plant protection solutions.

Keywords: Bioinformatics, structural biology, phytopathogens, resistance mechanisms.

The cabbage aphid (*Brevicoryne brassicae*) is a typical pest in Belarus, which causes damage in rapeseed and cabbage crops through direct feeding, honeydew secretion, and the transmission of plant viruses. The management of these pests relies heavily on chemical insecticides; however, their efficacy is increasingly compromised by the development of robust resistance mechanisms in aphid populations. The overexpression and polymorphism of ABC transporters, which facilitate the active efflux of toxins, is a substantial part of it. Moreover, some of their specific functional and structural characteristics remain unexamined. Therefore, studying these proteins can provide the foundation for designing new control methods [1].

Computational methods have become firmly established in biology due to their frequently high, experimentally validated predictive power, coupled with significant savings in time and resources, and often a reduced environmental footprint. Structural modeling is valuable not only in its own right by providing fundamental insights into molecular features, but also serves as a critical prerequisite for molecular docking. In such docking studies, ligands can include potential insecticides or plant metabolites, aiming to identify the most effective compounds. However, the use of computational methods requires the careful selection of tools with proven effectiveness, also the results obtained must have strong statistical support and other plausibility assessments. Therefore, for our modeling, we chose AlphaFold 3, a recently developed and already proven technology from DeepMind [2].

A structural model was generated for the consensus sequence of ABC transporters involved in Phase III insecticide detoxification in the cabbage aphid. During model construction, standard settings were used with the "auto seed" option enabled. Reliability of the obtained results was assessed using several parameters: plDDT (predicted local-distance difference test), a local confidence score for the positioning of each residue; pTM (predicted template modeling score), a global confidence score for the overall structure; and PAE (Predicted Aligned Error), a matrix representing the expected positional error (in angstroms) for each residue pair in the model..

We obtained a structural model characterized by the following high-quality parameters: The plDDT scores are distributed primarily between 70 and 90 for approximately half of the amino acid residues, indicating a confident level of support, and above 90 for the other half, reflecting a very high degree of confidence. The pTM score of 0.82 is

considered excellent. The predicted aligned error (PAE) matrix is predominantly dark green, signifying low expected positional error in those regions. The distinct squares along the diagonal can be interpreted as individual domains, with the lighter areas between them likely corresponding to flexible linkers or hinges. Visually, architecture of the model displays a cylindrical shape, consistent with the canonical structure of ABC transporters as a class of integral membrane proteins.

Overall, this high-confidence model is suitable for detailed structural analysis, characterization of protein features, and subsequent molecular docking studies.

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MOLECULAR DOCKING STUDY OF MENIN

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This study employed molecular modeling to establish theoretical models of complexes formed between DA-63788, Revumenib, Emilumenib and the protein binding structure of Menin [1](PDB ID: 6BY8).

Keywords: Molecular Docking, Menin, DA-63788, Revumenib, Emilumenib.

The structure of Menin was obtained from the RCSB Protein Data Bank (PDB ID: 6BY8). Protein structure preparation was performed using the Discovery Studio software package, involving removing the native ligand and water molecules, addition of hydrogen atoms and optimization of hydrogen bonding networks and side-chain conformations.

The three-dimensional structures of the ligands (DA-63788, Revumenib, Emilumenib) were retrieved from the PubChem database. Molecular docking simulations and visualization of results were conducted using Prankweb, Molegro Molecular Viewer and PyMOL software.

To identify the active site of the protein, we used the PrankWeb server to perform an active site prediction search. Among all the predicted pockets output by PrankWeb, the top-ranked pocket was selected as the most likely active site. This pocket is located at coordinates (x, y, z): 13.2775, 7.4366, 11.5393. This site has the highest prediction score (PrankWeb score: 5.45), ranking first among all predicted sites. Inspection of this pocket showed that it contains 14 residues . Given its highest algorithm ranking and good fit with known functional regions, this pocket was used for all subsequent ligand docking studies.

After molecular docking simulation , three stable complexes with significantly different binding properties were obtained, varying in affinity, interaction networks, and key residues involved. All detailed energy and interaction data summarized in Table.

Table

Quantitative Comparison of Molecular Docking Results of 3 Ligands with Menin complex

Ligand	DA-63788	Revumenib	Emilumenib
Energy (kcal/mol)	-8.236	-7.516	-7.450
MolDock Score	-144.433	-128.489	-142.530
H-Bond Count	2	4	4
H-Bond Residues	SER 178 , TYR 276	ASN 282, SER 155, HIS 181, GLN 260	TYR 323, TYR 323, TYR 276, SER 155
Steric interactions	SER 155, LEU 177, MET 278, LEU 177	ALA 242	TYR 323, TYR 319, CYS 241, TYR 323, ASN 282, TYR 276

Molecular docking results showed that all three ligands formed stable complexes with the Menin protein, but their binding modes and interaction characteristics differed significantly. In terms of overall binding stability, DA-63788 exhibited the best predicted binding affinity, with the highest MolDock Score (-144.433) and binding energy (-8.236 kcal/mol) among the three, suggesting it may be the most thermodynamically favorable binder. Emilumenib's MolDock Score (-142.530) was similar, but its binding energy (-7.450 kcal/mol) was slightly lower than that of DA-63788. Revumenib was the weakest in both energetic metrics.

Regarding key interactions, Revumenib and Emilumenib each formed four hydrogen bonds, surpassing DA-63788, which formed only two hydrogen bonds. However, DA-63788 likely achieves its high stability through more extensive hydrophobic interactions and steric complementarity, as evidenced by its steric interactions with multiple residues (SER 155, LEU 177, and MET 278). Notably, emilumenib forms a double hydrogen bond with residue TYR 323 and makes dense steric contacts with multiple residues, including TYR 323 and TYR 319, demonstrating a highly localized binding mode.

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IN SILICO AND DFT INVESTIGATION OF MOLECULES PREVENTING INSULIN AGGREGATION IN TYPE II DIABETES

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The purpose of this paper is to describe the results of coupling phorbol with target insulin receptor proteins.

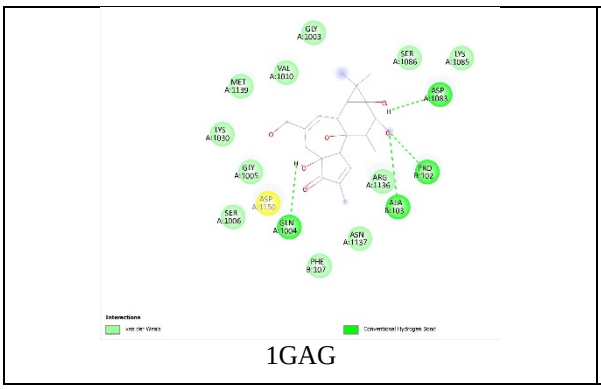
Keywords: Diabetes, docking, natural antioxidant, bioactivity, Michaelis – Menten constant.

The accumulation of insulin in amyloid fibrils poses a serious problem in the treatment of type II diabetes, reducing the effectiveness of insulin therapy. During the study, a molecular coupling of 23 prospective compounds was carried out. Important aspects were good permeability through the membrane, comparison of six physicochemical parameters for peroral bioavailability - size, polarity, lipophilicity, solubility, saturation and flexibility for structures with equivalent deviations from Lipinsky's rules [1]. The only substance that does not destroy and interact with cytochromes is phorbol.

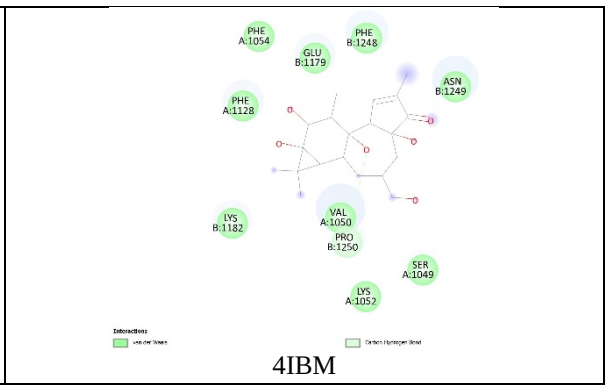
Molecular coupling of phorbol with target proteins (ID PDB: 1GAG, 4IBM, 5HHW, 1P14,) indicates that the chosen structure forms with targets thermodynamically stable complexes with Δg -8.0, -8.6, -9.0 and -9.6 kcal/mol. Constantine of Michaelis – Menten (Km), reflecting the affinity of the enzyme to the substrate for complexes equal to 1.37, 0.50, 0.25 and 9.16 10^{-5} mkM (table).

Table

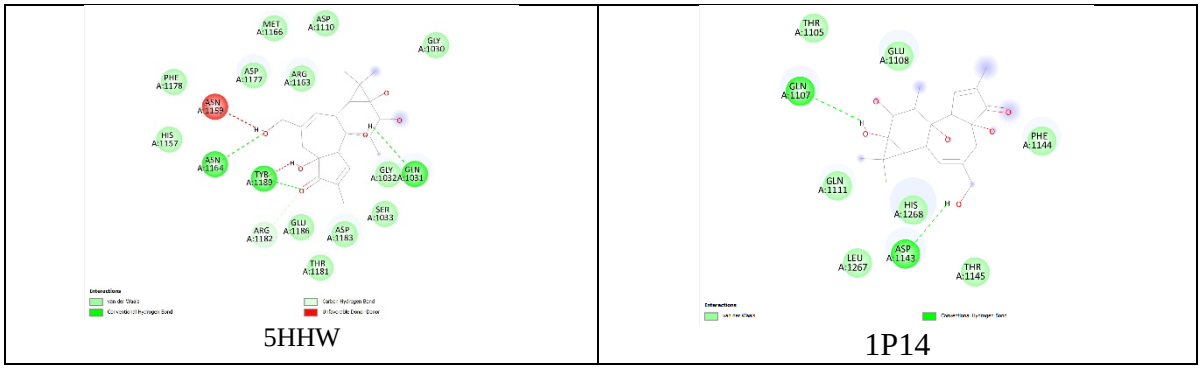
Molecular docking interactions of phorbol displaying amino acid residues with target proteins



1GAG



4IBM



Since phorbol also does not interact with any cytochrome isoform P450, we can conclude that phorbol prevents the breakdown of insulin protein and thus combat the problem of type II diabetes.

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SYNTHESIS OF 8-BROMO DERIVATIVES OF PURINE NUCLEOSIDES

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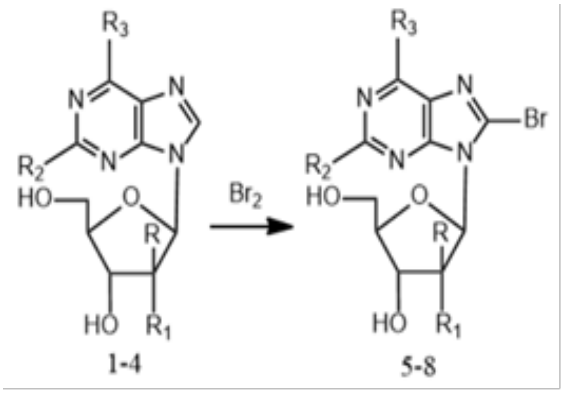
8-Bromo derivatives of purine nucleosides are used to obtain 8-substituted derivatives with diverse biological activity [1]. The most common reagents for obtaining such compounds include a solution of bromine in various solvents [2]. The aim of this research is to investigate the influence of the medium on the efficiency of the bromination reaction of adenosine **1**, guanosine **2**, arabinofuranosylguanine **3** and fludarabine **4** with a bromine solution in water using a 0.1 M solution of KH2PO4 pH 4.5 and a 0.1 M solution of H3BO3 pH 5.3 as the medium.

Keywords: Purine nucleosides, bromination reaction.

The synthesis of 8-bromo derivatives of purine nucleosides **5–8** was carried out according to the scheme shown in the figure



№	R	R_1	R_2	R_3
1, 5	H	OH	H	NH_2
2, 6	H	OH	NH_2	OH
3, 7	OH	H	NH_2	OH
4, 8	OH	H	F	NH_2

Fig. - Scheme of synthesis of 8-bromo derivatives of purine nucleosides

The progress of reactions and the content of the initial compounds **1–4** and reaction products **5–6** in the reaction medium were monitored using thin-layer chromatography on Kieselgel 60 F254 plates from Merck (Germany) in a solvent system of chloroform/methanol (4:1 v/v). Compounds on the plates were visualized by viewing them under ultraviolet light and by wetting the plate with a 0.2% solution of nafluoresorcinol in alcohol with the addition of a 20% sulfuric acid solution in a 1:1 ratio, followed by heating the plate at 80–90°C. Spots representing the reaction products and the starting compounds were colored differently.

The general technique of the bromination reaction was to obtain a suspension of 1 g of the starting compound in an appropriate solvent. During intensive stirring with a magnetic stirrer in a fume hood, a pre-obtained bromine solution in water in an amount of 1.2 equivalent to the initial nucleoside was added to the resulting suspension in portions. Each new portion of the bromine solution was added to the suspension after discoloration of the previously added bromine solution. After adding the last portion of the reagent, the resulting reaction mixture was stirred for 8 hours at room temperature in the case of guanine derivatives **2** and **3**, and for 48 hours in the case of adenine nucleosides **1** and **4**. During this period, the color of the suspension became lighter. A saturated solution of sodium bisulfite was added to the suspension to restore the excess bromine and to discolor the solvent. The precipitate from the reaction mixture was filtered in a vacuum of a water jet pump on a glass Schott filter and washed with a sodium bisulfite solution diluted and cooled in an ice bath, then cooled to 0–4°C with distilled water and acetone. The resulting precipitate was dried in air at room temperature to a constant weight. The yield of the reaction products was 30–70% based on the initial nucleoside. Preliminary results indicate a multidirectional effect of the solvent type on the yield of 8-bromine derivatives of purine nucleosides. To increase the purity of the products, they were recrystallized from a hot mixture of ethyl alcohol and water in a ratio of 1:1.

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HUMO AND LUMO ZONES OF CHALCON DERIVATIVE ANALYSIS

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Annotation. This article presents the results of quantum-chemical modeling of HOMO and LUMO zones of a chalcone derivative.

Keywords: HOMO and LUMO zones, chalcone derivatives, quantum-chemical modeling, antioxidant activity.

Chalcone derivatives and their heterocyclic analogs, such as dihydropyrimidines, are of significant interest due to their broad spectrum of biological activity, including antioxidant, anti-inflammatory, and antitumor properties [1]. The electronic structure of a molecule, particularly the energy of the highest occupied (HOMO) and lowest unoccupied (LUMO) molecular orbitals and band gap (Eg), is a key parameter determining reactivity and the mechanism of interaction with biological targets [2].

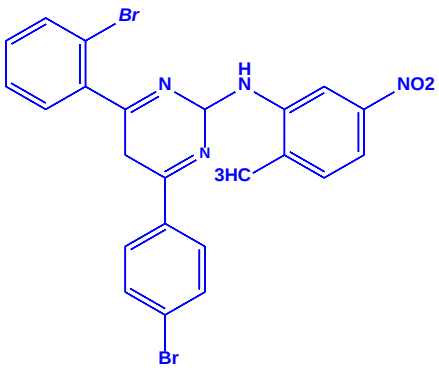

Fig. 1 4-(2-bromophenyl)-6-(4-bromophenyl)-N-(2-methyl-5-nitrophenyl)-2,5-dihydromeperidine-2-amine

For the initial investigation of the electronic properties of the derivative, the molecular modeling ChemOfficeBio 2016 software was used (Fig). The molecular geometry was optimized, after which the molecular orbital energies were calculated (Table).

Table

Structure and physical-chemical properties of the derivative

E_T, kcal/mol	E_{HOMO}, eV	E_{LUMO}, eV	E_g, eV
22.0790	-7.498	-5.178	2.320

The data obtained in the Table indicate that the band gap of the molecule is 2.320 eV, which suggests its high antioxidant activity.

Thus, the conducted study demonstrates that the synthesized chalcone derivative is a promising compound with pronounced antioxidant activity, which opens up possibilities for its further, more detailed study as a potential drug.

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MOLECULAR DOCKING OF PHE-GLY-GLY TRIPEPTIDE WITH HUMAN NICOTINIC A4B2 RECEPTOR ID:5KXI

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In this study, the interaction of the tripeptide Phe-Gly-Gly with the human nicotinic α4β2 receptor (PDB ID: 5KXI) was investigated using molecular docking. The binding energy was calculated and the main interactions in the receptor's active site were characterized. The obtained data define the studied peptide as a promising object for further research aimed at creating new pharmacological approaches to the treatment of nicotine addiction.

Keywords: molecular docking, nicotine addiction, tripeptide, α4β2-nAChR.

Developing new, effective treatments for nicotine addiction is a key challenge in modern pharmacology. Current medications, such as varenicline, have limited efficacy and are associated with side effects. In this regard, the search for new peptide ligands targeting α4β2-nicotinic acetylcholine receptors (nAChRs) is relevant.

Molecular docking was performed with the tripeptide Phe-Gly-Gly (figure) and the crystal structure of human α4β2-nAChR (PDB ID: 5KXI) [1].

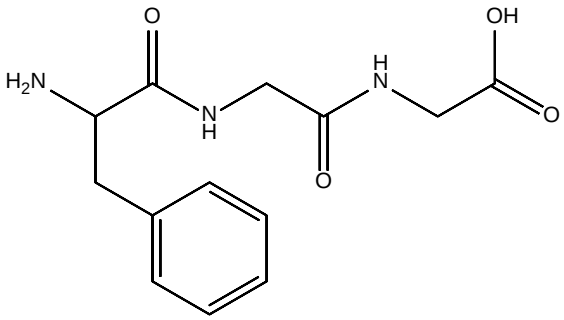

Fig. – 2D-Structural formula of a tripeptide Phe-Gly-Gly

The Score value for the tripeptide was -7.3, which is lower than that of nicotine (-5.7) and indicates the likelihood of forming a thermodynamically stable complex [2]. The total energy of the peptide-receptor complex is -79.302 kcal/mol. The tripeptide forms stable interactions with amino acid residues Ser 272, Lys 53, Thr 273, Gln 55, and Tyr 212 of the receptor's active site, including the key residue Glu 1770, which ensures selectivity and binding strength.

The tripeptide Phe-Gly-Gly exhibits high affinity for α4β2-nAChR, with a binding energy superior to that of nicotine. These results suggest this peptide may be a promising candidate for developing a new, effective treatment for nicotine addiction.

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COMPARATIVE ANALYSIS OF PHASE II GENES OF THE PROCESS OF BIOTRANSFORMATION OF XENOBIOTICS IN THE GENOMES OF APHIDS WITH DIFFERENT FOOD SPECIALIZATION

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In this study, a comparative analysis of phase II detoxification system genes in monophagous, oligophagous, and polyphagous aphids. The analysis of the total number of detoxification genes did not show a statistically significant increase in the number of UGT and GST genes in polyphagous species compared to oligophagous ones. The positive correlation for UGT2B33 and high intragroup variability suggest that resistance to xenobiotics is determined by the functional differentiation of gene families.

Keywords: aphids, detoxification systems, UGT genes, GST genes, monophages, oligophages, polyphages

Aphids (Aphididae) are agricultural pests and vectors of plant viral infections. The primary method for their control is the use of insecticides; however, aphids rapidly develop resistance. A key mechanism of this resistance is associated with UDP-glucuronosyltransferase (UGT) and glutathione S-transferase (GST) enzymes, which are involved in the phase II detoxification of xenobiotics. According to one model, aphid resistance to insecticides is explained by gene copy number variation: polyphagous species have a higher number of detoxification gene copies than monophagous species.

For the comparative analysis, genomic data on the number of UGT and GST genes from 6 aphid species, obtained by the staff of the Student Research Laboratory of Animal Bioinformatics and Molecular Evolution, were used. Additionally, data for 6 aphid species were extracted from the NCBI RefSeq database. The aphids were then classified into three trophic groups: polyphages (*Aphis gossypii* (GCF_020184175.1), *Myzus persica*e, *A. craccivora*), oligophages (*Acyrthosiphon pisum* (GCF_005508785.1), *Diuraphis noxia* (GCF_001186385.1), *Melanaphis sacchari* (GCF_002803265.2), *Macrosiphum rosae*, *Brevicoryne brassicae*, *A. glycines*, *Sipha flava* (GCF_003268045.1), *Rhopalosiphum maidis* (GCF_003676215.2)), and monophages (*M. albifrons*).

Due to the presence of outliers, asymmetric data distribution, and the limited sample size (n = 3 for polyphages, n = 8 for oligophages, n = 1 for monophages), non-parametric tests were used: the Kruskal – Wallis test and the Mann – Whitney U test. For UGT genes, the distribution across subfamilies was analyzed; for GST genes, the total number of genes was analyzed since the data from the genetic database were not annotated at the subfamily level. The presence of a correlation was tested using Spearman's coefficient (ρ). The level of statistical significance for all tests was set at $p < 0,05$.

Statistical analysis did not reveal significant differences in the total number of UGT genes between polyphages and oligophages ($H = 0,129$; $p = 0,719$). Polyphages had on average (M ± SD) 64,0 ± 2,65 UGT genes, while oligophages had 58,63 ± 14,11. At the level of individual subfamilies, a significant difference and a strong positive correlation were found only for UGT2B33 ($\rho = 0,8091$; $p = 0,0014$). For GST genes, no significant differences (M ± SD) were found between polyphages (13,00 ± 7,26) and oligophages (11,50 ± 5,10) ($H = 0,011$; $p = 0,918$). Quantitative analysis of the

single monophagous representative (*M. albifrons*) showed values of 79 UGT genes and 14 GST genes, which exceed the average values for both polyphages and oligophages.

Thus, there are no differences in the total number of UGT and GST genes between polyphages and oligophages, which may indicate more universal functions of the UGT and GST gene families. However, a significant positive correlation was identified between feeding specialization and the number of genes in the UGT2B33 subfamily, which may indicate a potential role of this family in adaptation to a wide range of host plants and insecticides through an increase in gene copy number. It can be assumed that the key role in the adaptation of aphids to a wide range of host plants and the detoxification of xenobiotics is played by the functional specialization of specific subfamilies, rather than the total number of genes.

REGULATORY REGIONS MAPPING IN THE GENOME OF PRIMARY ENDOSYMBIONT OF *MACROSIPHUM ROSAE – BUCHNERA APHIDICOLA*

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The upstream regions in the genome of *Buchnera aphidicola*, an obligate intracellular symbiont of aphids, were analysed. The results for two loci (*mdlB, yheI*) include a list of operators with their coordinates and localisation on DNA strands, which allows us to form a sample of potential binding sites for transcription factors in the genome of *B. aphidicola*.

Keywords: transcription factor binding sites, Buchnera aphidicola, Escherichia coli

Buchnera aphidicola is an obligate intracellular symbiont that may contribute to more efficient transformation of substances in the aphid organism, which entails increased resistance to currently used insecticides. The proteins *mdlB* and *yheI* belong to the ABC-transporter superfamily and are potentially involved in the detoxification of xenobiotics by aphid endosymbionts [1].

The previously assembled *B. aphidicola* genome of the *M. rosae* lineage was annotated for the present study. Operator sites of transcription factors known in Enterobacteriaceae to be key regulators of stress response and multidrug resistance were searched. The study included the operator sites *ArcA, BaeR, CpxR, FNR, LexA, MarA, Rob and SoxS*, which provide within *E. coli* regulatory networks a link between metabolic status, stress signalling and activation of genes that play a key role in the formation of multidrug resistance. Ready-made position-weighted matrices from the RegulonDB database, constructed for E. coli as the closest of the detailed characterised relatives of *B. aphidicola*, were used to search for operator sites. A script was written in the Python programming language, using Biopython modules and the pandas library, to extract fixed upstream regions by coordinates from the annotation file (the reverse complementary sequence was obtained for the minus chain). Upstream sequences were scanned using the FIMO utility. For each motif, a single position with minimal q-value was retained, since prioritisation by q-value reduces redundancy and generates a reliable set of candidates for subsequent experimental validation. The final list of unique operators was generated for each gene under study (Table).

Table

Regulatory sites of analyzed genes

Gene	Motif identifier	Start	End	Strand	Q-value	Matched sequence
mdlB	*ArcA*	29370	29385	+	0.00107	TTAAAAAATTTATTAC
yheI	*ArcA*	31156	31171	-	0.00257	TTAGCATTTTTTTTAC
	BaeR	31178	31195	+	0.0219	TTTTTTTTTCCATGGTAT
	FNR	30994	31010	+	0.00324	TTTGAAAATAATTAAAA
	LexA	31013	31032	+	0.00926	AACTGCTAATATTTGCAGCA
	Rob	31194	31210	+	0.0311	ATTGCATAAATTATTAA

During the analysis of the upstream regions of the *mdlB* and *yheI* genes in the *B. aphidicola* lineage of *M. rosae*, unique operator regions were identified that correspond to potential binding sites for transcription factors of stress response regulatory genes and multidrug resistance genes. The obtained results indicate the presence of conservative elements of the regulatory system in *B. aphidicola*, potentially involved in the control of the expression of the genes under study. This suggests that *B. aphidicola* may contribute to the development of aphid resistance to insecticides by regulating active transport systems. This approach demonstrates the effectiveness of using positional weight matrices of transcription factors from model bacterial species for annotating regulatory elements in endosymbiont

PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF METFORMIN

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In this study quantum-chemical modeling of metformin, electronic properties of molecules such as E_{HOMO}, E_{LUMO} and energy gap between LUMO and HOMO have been investigated. A preliminary quantum-chemical simulation of a drug of the biguanide class was carried out using the MM^+ method of molecular mechanics.

Keywords: metformin, molecular modeling, antioxidant activity, diabetes mellitus.

Metformin [Fig.] is a synthetic analogue of guanidine due to its ability to reduce glucose levels by reducing gluconeogenesis and insulin resistance [1]. Metformin is a first-line therapy for type 2 diabetes mellitus. In addition to its antihyperglycemic properties, metformin has many health benefits. For example, the benefits of metformin therapy for weight loss have been proven. This mechanism helps protect cells from damage caused by oxidative stress and improves endothelial function, reducing the risk of vascular complications in diabetes mellitus.

When calculating the initial geometry of a molecule, the method of molecular mechanics (MM^+) of the ChemOffice 2016 software package was chosen. The choice of the MM^+ method is justified by the fact that it was developed for organic molecules, takes into account the potential fields formed by all atoms of the calculation system, and allows you to flexibly change the calculation parameters depending on the specific task. To find the global minimum energy and the most stable conformers, all fixed points on the surface of the potential energy of the molecules were analyzed. Boundary molecular orbitals, including HOMO and LUMO orbitals are important parameters in chemical reactions. The energies of HOMO and LUMO illustrate the ability to give an electron and receive an electron, respectively [2].

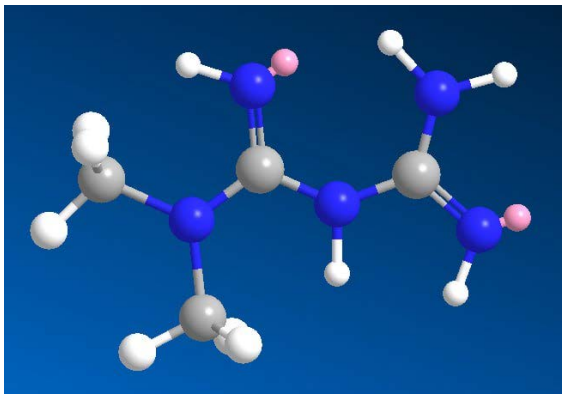

Fig. – Computer model of metformin

Results: total energy of the compound 6.8208 kcal/mol; E_{LUMO} = 8,000 eV; E_{HOMO} = -9,963 eV.

The data obtained as a result of the study opens up wide opportunities for improving metformin treatment methods.

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VIRTUAL SCREENING OF MURA INHIBITORS BY MOLECULAR DOCKING

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This article describes the discovery of novel inhibitors targeting MurA through molecular docking-based virtual screening.

Keywords: MurA, Virtual screening, Molecular Docking.

In recent years, the widespread emergence of drug-resistant bacterial strains due to antibiotic abuse has become a major threat to human health, making the development of antibacterial drugs with novel mechanisms of action urgently needed. MurA enzyme is indispensable for bacterial cell wall synthesis, serving as a promising target for new antibiotic discovery. Fosfomycin, an inhibitor of MurA enzyme, exerts targeted inhibition by forming an interaction with the active site of MurA [1]. We conducted virtual screening of fosfomycin analogs for MurA inhibition to identify molecules with potential enhanced inhibitory activity.

The 100-molecules with structures similar to fosfomycin were collected from the ZINC database and processed using the Prepare or Filter Ligand module in Discovery Studio 2019 (DS). MurA (PDB ID: 1UAE) was downloaded from the PDB Bank and subsequently processed using the Prepare Protein module in DS. After processing, a spherical active pocket was generated at Cys115 using the Define Binding Site function in the Receptor-Ligand Interactions module. Molecular docking was performed using the LibDock module in DS. The results are presented in Table and Figure. Compound 33 (SMILE: CC1[NH]C(=O)C(NCC2NC3CCCCC3O2)CC1[C@@H](C)O), with the highest LibDock score, was selected for comparison with fosfomycin.

Table

Molecular docking results

Compound	Absolute energy / (kJ · mol⁻¹)	Relative energy / (kJ · mol⁻¹)	LibDock score
Compound 33	65.6	9.6	112.2
Fosfomycin	1.59	1.72	63.3

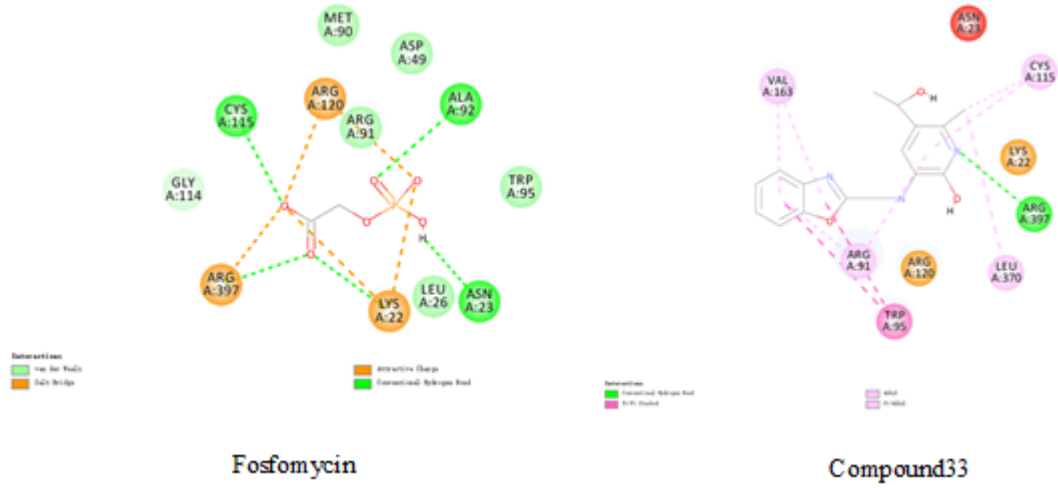

Fig. 1 - Molecular Docking 2D Image

Molecular docking results showed that Compound 33 formed hydrogen bonds with ARG397 and hydrophobic interactions with TRP95, VAL163, and CYS115. In contrast, fosfomycin formed hydrogen bonds with CYS115 and ASN23, van der Waals forces with MET90 and TRP95, and salt bridges with ARG (120, 397) and LYS 22. Although

Compound 33 exhibited higher absolute and relative free energies (indicating lower stability) compared to fosfomycin, it formed more binding interactions and achieved a higher score, which is beneficial for binding.

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APPLICATIONS AND ADVANCES OF DEEP LEARNING IN DRUG DISCOVERY

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This article discusses the research progress of deep learning in drug discovery, mainly covering molecular generation, conformation prediction, and binding affinity evaluation.

Keywords: Deep Learning, Drug Discovery, Artificial Intelligence

Artificial intelligence(AI) is profoundly transforming the field of drug discovery, serving as a key solution to the high cost and long cycle of traditional small-molecule targeted drug discovery. As a subset of AI, deep learning(DL) is a technology that analyzes and learns from large volumes of data through multi-layer processing units. It exhibits remarkable advantages in molecular generation, conformation prediction, binding affinity evaluation, paving new paths for drug design[1].

In the field of molecular generation, the chemical space of organic molecules is enormous, making traditional methods inefficient. Generative DL models (RNNs and GANs) generate new structures by learning the distribution of molecular data; early models were trained with SMILES strings as input, but their applicability is limited due to the lack of permutation invariance and 3D information. Molecular graph representation is more advantageous models,like Pocket2Mol and LiGAN can generate molecules within protein binding pockets, intuitively demonstrating interactions, though their performance relies on high-quality training data[2].

3D molecular conformation is one of the crucial features determining many physical, chemical, and biological properties of molecules. Traditional methods exhibit poor performance in terms of accuracy and computational efficiency. DL have been introduced into conformation generation to address this issue . ClofNet can directly manipulate molecular conformations and has been applied in AlphaFold. In the prediction of complex conformations, models such as DeepDock and EquiBind achieve rapid and accurate generation of protein-ligand binding conformations through geometric learning and other approaches, thereby improving the efficiency of virtual screening[3-5].

Binding affinity prediction is a crucial step in drug research and development. Traditional methods such as molecular docking and pharmacokinetic simulation have high computational costs, which limit the efficiency and speed of drug discovery. DL have been applied in the field of drug-target binding affinity prediction. Initially, AtomNet predicted molecular binding using Convolutional Neural Networks (CNNs)[6]. Pafnucy, another CNN model, predicted the binding affinity between proteins and ligands through 3D CNNs, but it had problems such as high computational cost and direction sensitivity. Graph convolutional networks proposed by Gomes and Lim have achieved better performance in prediction[7].

Nowadays, DL has become an indispensable tool in drug discovery, with significantly improved speed and efficiency that enhance the accuracy of drug-related predictions, optimize virtual screening, and expand applications to aid in discovering new drug targets.

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STRUCTURAL MODELING OF AN ABC TRANSPORTER IN *MYZUS PERSICAE*

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Here we report the structural modeling of an ABC transporter protein based on a consensus amino acid sequence from the aphid Myzus persicae.

Keywords: detoxification system, aphids, protein modeling.

The green peach aphid, Myzus persicae, is a widespread pest that feeds on numerous plants, including fruit trees and agricultural crops. It is known that M. persicae possesses high adaptability to environmental changes and chemical exposure.

One method of controlling insect pests relies on the use of pesticides; however, as a result of evolutionary adaptations, insects have developed resistance to chemical compounds. One mechanism of adaptation to insecticides is the altered expression of ABC transporter proteins, which are responsible for expelling toxins from cells during the third phase of xenobiotic detoxification.

A dataset of 49 amino acid sequences of ABC transporters from a Belarusian M. persicae population was compiled from whole-genome sequencing data generated by the Laboratory of Bioinformatics and Molecular Evolution of Animals. A consensus protein sequence was then constructed. Three-dimensional structural modeling of this consensus ABC transporter was performed using AlphaFold v2.3.2 on the Google Colab Pro platform with GPU acceleration. Multiple sequence alignments were generated with the UniRef90 and BFD databases. Modeling was carried out in the standard AlphaFold mode with three relaxation cycles and the high-accuracy option enabled. Model quality was evaluated using the built-in metrics pLDDT (predicted Local Distance Difference Test) and PAE (predicted Aligned Error). The pLDDT color scale indicates prediction confidence: blue and cyan regions correspond to high and very high confidence, whereas yellow, orange, and red regions indicate lower reliability.

The resulting structural model exhibits a cylindrical architecture typical of the ABC transporter family. The nucleotide-binding domains, composed of small β-sheets and conserved motifs (Walker-A, Walker-B, LSGGQ), are predominantly blue, reflecting high confidence in their spatial organization. The transmembrane domains consist of two types of α-helices: the first form a cylindrical channel and are colored blue and cyan, while the second group, rendered in yellow and red, suggests structural variability and reduced confidence. The pLDDT profile shows a decline in confidence after residue 250, likely corresponding to a flexible linker region that acts as a hinge, undergoing conformational changes during ATP binding or hydrolysis. Overall, the consensus M. persicae ABC transporter model demonstrates strong statistical support and offers a reliable structural framework for downstream applications, including molecular docking and functional analyses.

QUANTUM-CHEMICAL MODELING OF THUJOL FROM *ARTEMISIA ABSINTHIUM* L. ESSENTIAL OIL BY THE SEMI-EMERIC METHOD PM6

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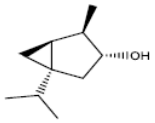
Artemisia Absinthium L. essential oil contains 15–25% thujol. Thujol is a monoterpene alcohol with antiseptic activity.

The aim of this study was to optimize the structure of thujol and obtain its thermodynamic parameters and UV spectral characteristics [1].

Keywords: Artemisia absinthium, tuyol, quantum chemical modeling, PM6 method.

Table

Structural formula and thermodynamic parameters of thujol calculated by the PM6 method

Structural formula of thujol	$E_{(THERMAL)}$ kcal/mol	CV Cal/Mol-kelvin	S Cal/Mol-kelvin
	158,539	48,496	110,209

The PM6 method was used to optimize and determine the thermodynamic parameters of thujol. The following results were obtained: thermal energy = 158.539 kcal/mol, heat capacity at constant volume = 48.496 cal/mol-Kelvin, and entropy = 110.209 cal/mol-Kelvin (table).

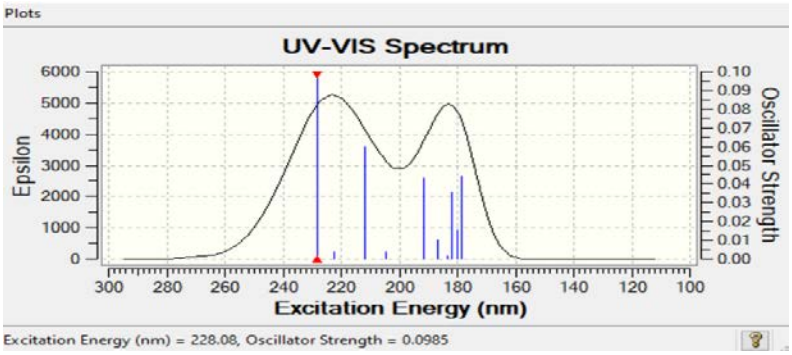


Fig. – Visualization of the UV spectrum of thujol

Gaussian View 15 was also used to visualize the UV spectrum of thujol. In this case, the most strength excitation energy of the molecule was 228.08 nm, and the oscillator strength = 0.0985 (Figure).

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PHYSICOCHEMICAL PARAMETERS AND ANTIOXIDANT ACTIVITY STUDY OF ARTEMETIN FROM THE MEDICINAL PLANT ARTEMISIA ABSINTHIUM L. BY IN SILICO METHOD

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The search for plants with a large number of secondary metabolites and a broad spectrum of pharmacological properties is a pressing issue. One such plant is *Artemisia absinthium* L., which synthesizes biologically active substances that are of great interest for experimental and clinical research.

The aim of this work was to study the physicochemical parameters and antioxidant activity of the flavonoid artemetin in *Arhemisia absinthium* L. using the *in silico* method [1].

Keywords: Artemisia absinthium, antioxidant properties, artemetin, chemical modeling, MM2.

During the study, we created a 3D model of the chemical compound artemetin, and used the Compute Properties method and the MM2 method (Figure).

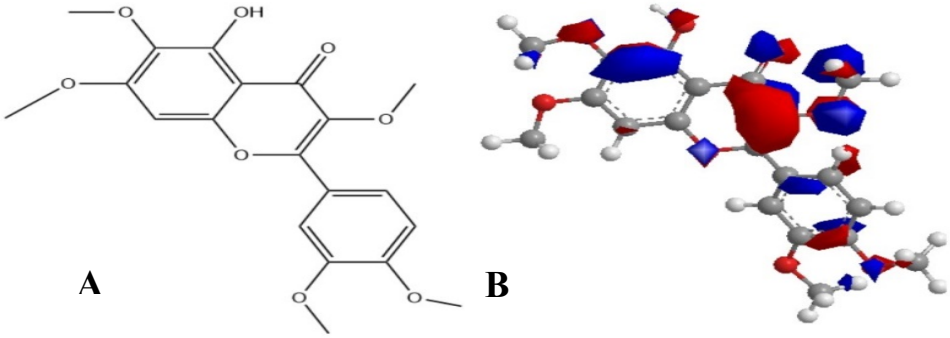

Fig. – Structural formula of artemetin (A) and 3D model with visualization of electron clouds (B)

The Compute Properties method showed the following values for artemetin: molecular formula C20H20O8, molecular weight = 388.37 Da, boiling point = 785.132 K, melting point = 792.22 K, critical temperature = 970.85 K, critical pressure = 196.458 bar, Gibbs free energy = -527.08 kJ/mol, number of single bonds 6.

Using the MM2 method, we found that the total energy (ETOTAL) = 55.7830 kcal/mol, the energy of the highest occupied molecular orbital (EHOMO) = 9.990 eV, the energy of the lowest unoccupied molecular orbital (ELUMO) = 3.989 eV, and the band gap width of artemetin was 6.052 eV, which allows it to be classified as a strong antioxidant.

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DOCKING OF C-MET PROTEIN WITH CABOZANTINIB ZGWATINIB AND TIVANTINIB

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This study employed molecular modeling to establish theoretical models of complexes formed between Cabozantinib, Zgwatinib,Tivantinib and the crystal structure of c-Met (PDB: 3CD8).

Keywords: Molecular Docking, c-Met,Cabozantinib, Zgwatinib,Tivantinib

The structure of c-Met was obtained from the RCSB Protein Data Bank. Protein structure preparation was performed using the Discovery Studio software package, involving removing the native ligand and water molecules, addition of hydrogen atoms and optimization of hydrogen bonding networks and side-chain conformations.

We used the PrankWeb server to perform an active site prediction search. Among all the predicted pockets output by PrankWeb, the top-ranked pocket was selected as the most likely active site. This pocket is located at coordinates x, y, z = 20.9361, 11.3708, 57.0817. This site has the highest prediction score (PrankWeb score: 12.29), ranking first among all predicted sites. Inspection of this pocket showed that it contains 18 residues.

To identify the probable ligands that can be docking to c-Met we used the Prankweb and PubChem server to search for the structure of inhibitor or inducer ligands (Cabozantinib, Zgwatinib [1], Tivantinib), then perform molecular docking and display the results the table below.

Table

Quantitative Comparison of Molecular Docking Results of Ligands with c-Met

Ligand	Cabozantinib	Zgwatinib	Tivantinib
ΔG (kcal/mol)	-8.803	-10.593	-10.927
MolDock Score	-132.495	-142.971	-137.920
H-Bond Count	1	0	1
H-Bond Residues	Asp1222		Arg1086
Steric Contacts	Gly1163, Tyr1230, Ang1208	IIe1084, Tyr1230, Arg1208 Met1211, Asp1222, Asn1209, Cys1210	Arg1208, Asp1164, Asn1167

The docking results demonstrate that all three ligands form stable complexes within the ATP-binding pocket of c-Met, yet exhibit significant differences in their binding modes. Tivantinib displayed the strongest predicted binding affinity (-10.927 kcal/mol) but the stability of the combination (-137.920) is not as strong as Zgwatinnib, followed by Zgeatinib (-10.593 kcal/mol) and the most favorable MolDock Score (-142.971). Also it doesn't have H-Bonds. This indicates that it is the thermodynamically most unstable adhesive among the three ligands. This was followed by the natural inhibitor Cabozantinib (-8.803 kcal/mol), MolDock Score (-132.495) is also the lowest.

In MolDock Score Zgwatinib has the highest value and is the ligand with the most stable contact points with c-Met, but in has only 7 steric contacts with the protein. Tivantinib is the ligand with the strongest binding affinity. Cabozantinib also has hydrogen bonding networks that can bind to protein, but their strength is relatively weaker than Tivantinib.

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BIOLOGICAL ACTIVITY OF THE OF DEHYDROCOSTUS LACTONE COMPOUND

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In this work, the biological activity of the compound of Dehydrocostus lactone (DL) was investigated using the semi-empirical method PM6 of Gaussian 09 W software package [1]. DL is a sesquiterpene lactone found in plants of the genus *Saussurea* and has various biological activities, including antibacterial and antioxidant properties. The electrical properties of a molecule in a vacuum environment have been calculated.

Dehydrocostus lactone (DL) is an organic compound belonging to the class of Guaiane-type sesquiterpene lactones and found in *Saussurea Costus,* which is the most well-known species of the genus *Saussurea* [2]. The 2D image and optimized molecular structure of MM2 DL are presented in Figure 1 and 2, respectively.

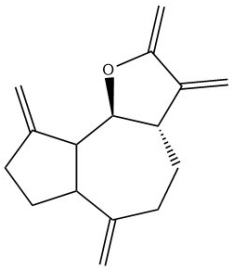

Fig. 1. 2D DL image

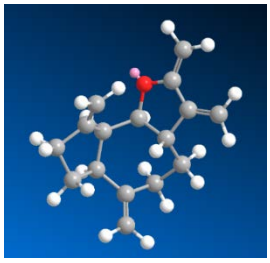

Fig. 2. Optimized DL structure

The molecule was further optimized using the semi-empirical PM6 method of the Gaussian 09W software package until the global minimum of the total energy of the system under study was reached. To study the biological activity, the energies of the highest occupied (HOMO) and lowest unoccupied (LUMO) molecular orbitals were calculated, as well as the forbidden gap width (E_g=E_{LUMO}-E_{HOMO}) to assess the presence or absence of biological activity.

Table

Electrical properties of DL molecule

E_T, kcal/mol	E_{LUMO}, eV	E_{HOMO}, eV	E_g, eV
197,843	0,00975	- 0,33176	0,34151

The forbidden band width of the compound, 0.34714 eV, indicates that the DL compound has high biological activity, including antioxidant activity (table).

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COMPARATIVE ANALYSIS OF THE NUCLEOTIDE COMPOSITION IN THE MITOCHONDRIAL GENOMES OF *ACYRTHOSIPHON CARAGANAE* AND *BREVICORYNE BRASSICAE*

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This article presents the results of calculating the nucleotide composition of the mitochondrial genomes of *Acyrthosiphon caraganae* and *Brevicoryne brassicae*.

Keywords: mitochondrial genome, nucleotide composition, aphids.

Representatives of the Aphid superfamily (Aphidoidea) are widespread pests of agricultural and ornamental crops on the territory of the Republic of Belarus [1]. Mitochondrial genomes are important objects in evolutionary research, which can potentially be a source of information for developing measures for quick identification and prevention of pest invasions.

The mitochondrial genomes of *Acyrthosiphon* caraganae [MW724715] and *Brevicoryne brassicae* [MW267824] were extracted, assembled, and annotated by the authors and collaborators of the SSRL of Bioinformatics and Molecular Evolution of Animals. The nucleotide composition was calculated using the MEGAX program [2].

The nucleotide composition in the mitochondrial genomes of *A. caraganae* and *B. brassicae* is typical for the mitochondrial genomes of aphids. This is expressed in the ratio (A + T)/(G + C) > 80/20, and the richest with A+T bases are considered to be non-coding regions – the repeat region and the D-loop formation region.

Calculation of the nucleotide composition showed that the content of adenine-thymine bases in the complete mitochondrial DNA of *A. caraganae* reaches 83.6 %. The repeat region in the mitochondrial genome of *A. caraganae* is quite long for this region – 1002 bp. Analysis of the nucleotide composition also confirms that the repeat region is the most saturated with adenine-thymine bases in the mitochondrial genome (86.8 %). The D-loop formation region in the mitochondrial genome of *A. caraganae* is slightly shorter than the typical size of aphids and consists of 447 bp, but the A+T composition in this region is characteristically high (85.2 %). The results of the analysis of the nucleotide composition of the mitochondrial genome of *B.brassicae* showed that the content of adenine-thymine bases in this mitochondrial genome reaches 84.0 %. In the mitochondrial genome of *B. brassicae*, the length of the repeat region was 578 bp, and it consists of 3 large pairs (195, 195, and 123 bp) of tandem repeats. The region is saturated with adenine-thymine bases (86.5 %). The D-loop formation region in the mitochondrial genome of *B. brassicae* consists of 675 bp, the content of adenine-thymine bases was 86.7 %.

The A+T content of individual protein-coding and tRNA genes was also calculated. It was found that the content of A+T in all mitochondrial genomes varies significantly depending on the functional region. Among the protein-coding regions, the *Cox1* gene has the least amount of A and T – 76.24 % in *A. caraganae* and 76.99 % in *B. brassicae*. On average, all subunits of mitochondrial cytochromes had a lower level of A+T content than in the genes encoding the ATP synthase and NADH subunits. The highest number of A+T nucleotides was found in the protein-coding gene *Atp8* in both mitochondrial genomes of aphids (88.05 % in *A. caraganae* and 92.67 % in *B. brassicae*). Generally, the control region (D-loop) and especially the repeat region in insect mitochondrial genomes are generally considered to be the richest in A+T. However, the content of A+T in these functional parts in mtDNA was lower than the average content in the *Atp8* gene and several tRNA genes, such as *tRNA*, *trnC*, *trnE*, *trnG*, *trnH*, *trnL* (past NADH1), *trnP*, *tRNS* (past trnN), *trnT*, *trnW*, *trnV* and *trnF*. The mitochondrial genomes *of A. caraganae* and *B. brassicae* have a negative GC deviation in almost all regions, except for the region of protein-coding genes from the minor chain, which indicates a significant content of C compared to G in the main mtDNA chain of these species.

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COMPARATIVE ANALYSIS OF THE GEOMETRIC PARAMETERS OF THEOBROMINE AND CAFFEINE MOLECULES

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This article presents the results of a comparative analysis of the geometric parameters of theobromine and caffeine molecules, performed using the ChemOffice 2015 software package.

Keywords: quantum chemical modeling, theobromine, caffeine, molecular geometry

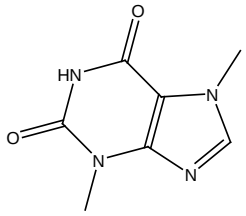
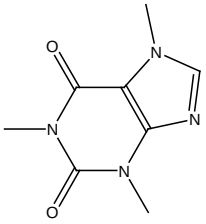
Theobromine (C7H8N4O2) and caffeine ($C_8H_{10}N_4O_2$) are natural alkaloids that are purine derivatives. The substances are structurally similar and both are methylxanthines from a pharmacological point of view, which makes it appropriate to compare the geometry of the molecules in order to evaluate their properties [1].

Analysis of the geometric parameters of a molecule can provide information about its reactivity, thermodynamic stability, polarity, and biological activity, which is important for assessing the prospects for using the substance in a particular direction [2].

Table 1 shows the information obtained during the study on the geometry of theobromine and caffeine molecules.

Table

Results of analysis

Parameter	Theobromine	Coffeein
Structure	E_T=25.7101 kcal/mol 	E_T=26.4446 kcal/mol 
Number of methyl groups	2	3
C-N1 bond length	1.343	1.450
C=O bond length	1.208	1.208
N-C-N angle (degrees)	126.000	126.000

Based on the analysis results, it can be suggested that the presence of a methyl group in the caffeine molecule, distinguishing it from the theobromine molecule, only slightly alters its geometric structure. However, in certain cases, the methyl group may hinder caffeine's binding with substances that theobromine can interact with, as it "overlaps" the reactive center located at the nitrogen atom.

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THE EFFECT OF VITAMIN B12 DEFICIENCY ON THE HUMAN BODY

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This article reviews current scientific understanding of vitamin B12 deficiency – a condition often unrecognized in its early stages yet capable of causing severe hematological and neurological consequences. Vitamin B12, or cobalamin, plays a pivotal role in DNA synthesis, homocysteine metabolism, and the maintenance of myelin sheath integrity in nerve fibers. Deficiency may result from inadequate dietary intake (e.g., strict vegan diets) or impaired absorption due to autoimmune gastritis, gastric resection, or medication use [1].

Keywords: vitamin B12, deficiency, megaloblastic anemia, neurological disorders

The most well-known clinical manifestation of vitamin B12 deficiency is megaloblastic anemia. Vitamin B12 and folate act as interdependent partners in several biochemical reactions and jointly participate in erythropoiesis. Together, they ensure proper nuclear maturation and division of erythroid precursor cells in hematopoietic tissue, a process characterized by decreased hemoglobin levels, increased mean corpuscular volume of erythrocytes, and the presence of megaloblasts in the bone marrow.

Beyond megaloblastic anemia, cobalamin deficiency leads to nervous system involvement in approximately one-third of patients. Primary neurological manifestations include spinal cord lesions (subacute combined degeneration of the lateral and posterior columns, or funicular myelosis), cerebral dysfunction (dementia), optic nerve damage, and peripheral nerve involvement resulting in distal sensory polyneuropathy. Combined central and peripheral nervous system impairment is also possible [2].

The immediate pathophysiological mechanisms underlying these neurological disturbances include impaired methionine synthesis, reduced oxidation of odd-chain fatty acids, and accumulation of methylmalonate – a neurotoxic metabolite that induces neuronal lipid degeneration and demyelination of nerve fibers.

Current evidence confirms the role of B-group vitamins, particularly vitamin B12, in human cognitive function. A 10-year longitudinal study at the University of Oxford (UK) evaluated cognitive performance in 1,648 participants across various age groups. Low serum vitamin B12 levels, coupled with elevated methylmalonic acid concentrations, were associated with accelerated cognitive decline [3].

Recent studies indicate that serum vitamin B12 levels do not always reflect true body stores. More sensitive markers – elevated methylmalonic acid (MMA) and homocysteine – can detect functional deficiency even when serum B12 concentrations appear normal. This is especially critical in elderly patients, in whom deficiency is frequently misattributed to age-related cognitive changes [4].

Thus, vitamin B12 deficiency remains a significant issue in clinical practice, demanding heightened awareness among physicians across specialties. Timely diagnosis and appropriate replacement therapy – via intramuscular injections or high-dose oral cobalamin formulations – can prevent not only anemia but also irreversible neurological damage. Future research should focus on standardizing diagnostic criteria and identifying at-risk populations for targeted screening.

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BIOLOGICAL ACTIVITY OF PHENAZINE-1-CARBOXYLIC ACID

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A promising compound considered as an active component in potential anticancer drugs is a phenazine isolated from the bacterium *Pseudomonas chlororaphis* subsp. *aurantiaca* strain B-162 [1]. The main active component of this compound is phenazine-1-carboxylic acid (Figure). To investigate its biological activity, theoretical calculations of electronic parameters were performed using the B3LYP/STO-3G method.

Keywords: phenazine-1-carboxylic acid, biological activity, B3LYP/STO-3G method.

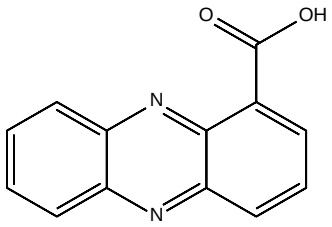

Fig. – phenazine-1-carboxylic acid

The chemical properties of phenazine-1-carboxylic acid were determined using the ChemDraw 2.0 software package and are summarized in Table 1. Preliminary quantum-chemical modeling was performed using the molecular mechanics (MM2) method as implemented in the Chem3D suite.

Table 1

Chemical properties of phenazine-1-carboxylic acid

Compound	Boiling point, K	Melting point, K	Gibbs free energy, kJ/mol
phenazine-1-carboxylic acid	824,55	656,31	175,22

The electronic properties of the molecule were determined using the Gaussian 09W software package. The non-empirical method B3LYP/STO-3G was chosen for the calculations. Visualization and analysis of the results were carried out using GaussView 6.0.

As a result, the following molecular parameters were obtained: E_{HOMO}, E_{LUMO}, band gap (E_g), ionization potential (IP), electron affinity (EA), global hardness (η), electronegativity (μ) and chemical softness (S). The calculated data are summarized in Table 2.

Table 2

Electronic properties of phenazine-1-carboxylic acid

Compound	E_{HOMO}, eV	E_{LUMO}, eV	E_g, eV	IP, eV	EA, eV	η, eV	μ, eV	S, eV^{-1}
phenazine-1-carboxylic acid	-0,15070	-0,02350	0,1272	0,15070	0,02350	0,0636	-0,0636	7,862

Based on the obtained data, phenazine-1-carboxylic acid was found to exhibit high antioxidant activity, which is associated with its low band gap value ($E_g < 7$) [2].

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NEGATIVE EFFECTS OF SILVER NANOPARTICLES ON HUMAN HEALTH

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Silver nanoparticles (AgNPs) are widely used in the development of pharmaceuticals and cosmetics due to their enhanced antimicrobial and virucidal properties. However, alongside their beneficial effects, AgNPs also exhibit significant toxicological risks.

Keywords: Silver nanoparticles, nanotechnology.

Due to its potent bactericidal, fungicidal, and virucidal properties, silver has become a convenient and effective agent in medicine-serving as a natural alternative to antibiotics-and in cosmetology, where it is used as a therapeutic and preventive additive in various cosmetic formulations.

Upon transitioning to the nanoscale, silver particles acquire the ability to penetrate cellular membranes more efficiently and disseminate throughout the organism via systemic circulation. Beyond their intrinsic cytotoxicity, silver nanoparticles (AgNPs) can disrupt key cellular processes and have been shown to induce apoptosis through oxidative and molecular stress pathways [1].

Common side effects associated with prolonged consumption of nanosilver colloids (NCS) include conditions such as argyria-characterized by near-irreversible skin pigmentation-argyrosis, involving silver deposition in ocular tissues,

and both acute and chronic nephropathy. Some researchers hypothesize that these manifestations may represent a physiological detoxification mechanism, whereby silver is sequestered in tissues in the form of relatively inert protein complexes or silver sulfides.

Researchers Seung-Heon et al. [2] and Shin et al. [3] demonstrated that nanosilver colloids (NCS) exert significant cytotoxic effects by impairing cell division and altering cytokine expression in peripheral blood mononuclear cells.

In his study, Senjin demonstrated that the consumption of colloidal silver-a suspension containing silver in micro- or nanoparticulate form-may lead to a range of adverse effects, including neurological and gastrointestinal disorders, renal dysfunction, sleep disturbances, headaches, and hyperpigmentation. In certain cases, a decline in night vision was also observed [4].

It is well established [1] that nanosilver colloids (NCS) can induce oxidative stress, a process that damages key cellular components-including lipids, proteins, and DNA-and may contribute to the onset of various pathologies, including carcinogenesis. Therefore, it can be concluded that despite the widespread use of NCS-based products, their excessive or uncontrolled application poses serious health risks. Moreover, given the tendency of silver to accumulate in renal and osseous tissues, individuals with kidney or skeletal disorders are strongly advised to avoid the use of nano-silver-containing medications and personal care products.

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ANALYSIS OF THE STRUCTURE OF CYTOCHROME P450 GENES OF APHIDS *MACROSIPHUM ROSAE*

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Cytochrome P450s constitute a large superfamily of enzymes that play a key role in the insect detoxification system, participating in the oxidation and biotransformation of a wide range of insecticides and other xenobiotics. This study presents the results of an analysis of the exon–intron structure of the obtained cytochrome P450 models in the aphid Macrosiphum rosae.

Keywords: aphid; detoxification system; exon–intron structure; cytochrome P450.

The rose aphid, Macrosiphum rosae (Linnaeus, 1758), is a cosmopolitan species widely distributed due to rose cultivation. M. rosae is one of the most important pests of plants in the genus Rosa worldwide and causes significant economic damage. The rose aphid spoils the aesthetic appearance of rose bushes by deforming flowers and foliage. In addition, it contributes to the formation of sticky honeydew, which provides a surface for the development of sooty molds.

Cytochrome P450 enzymes are the first to interact with toxic secondary plant metabolites and insecticides within the detoxification system. It is known that due to their genetic diversity and broad substrate specificity, P450s play a crucial role both in the metabolism of endogenous compounds and in the detoxification of xenobiotics, leading to the development of resistance to synthetic insecticides and facilitating insect adaptation to phytochemicals.

The structural analysis of the studied genes was performed using the online tool Gene Structure Display Server. Previously annotated sequences were uploaded to the website in .gff format, which enabled the visualization of their

exon–intron organization. Information on the total gene length as well as exon and intron sizes was obtained using a custom script written in the Bash programming language.

The average gene length was 3059 base pairs. It was found that genes of the CYP6 family contain from 1 to 7 exons, with most comprising approximately 3–4 exons. Cytochromes of the CYP4 and CYP380 families show greater diversity, containing from 3 to 12 exons (on average, 3–7). Some genes, such as CYP6CZ1, CYP6DD1, and CYP6DA1, exhibit relatively simple structures with few exons and long introns, while others, such as CYP4CJ2 and CYP4CJ14, are characterized by more complex organizations including numerous short exons. The length of exons and introns varies significantly, which may be related to regulatory features and the evolutionary origin of these genes. The mosaic nature of the exon–intron structure is a characteristic feature of cytochrome P450 genes in insects, reflecting their functional diversity and important role in detoxification mechanisms.

The exon–intron structure of M. rosae cytochrome P450 genes demonstrates substantial structural variability, reflecting the functional and evolutionary diversity of this superfamily. Differences in exon number may be associated with specific regulatory mechanisms of gene expression and adaptive responses contributing to insect resistance to xenobiotics. Such structural mosaicism indicates the key role of P450 genes in providing flexibility in detoxification metabolic pathways and in adaptation to changing environmental conditions. The data obtained serve as a foundation for further functional studies aimed at understanding the mechanisms of M. rosae resistance to insecticides.

ANALYSIS OF ORTHOLOGOUS AND PARALOGOUS CYTOCHROME P450 GENES IN DIFFERENT APHID SPECIES

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Cytochrome P450s constitute a large and diverse superfamily of enzymes that play a key role in the detoxification system of insects. They participate in the oxidation and transformation of a wide range of xenobiotics, facilitating their elimination from the organism. This study presents the results of evolutionary analysis of the dN/dS and dS parameters for cytochrome P450 genes in various aphid species.

Keywords: aphids; detoxification system; evolutionary analysis; cytochrome P450.

The analysis utilized cytochrome P450 gene sequences from seven currently available aphid genomes in RefSeq – *Acyrtosiphon pisum* (GCF_005508785.1), *Aphis gossypii* (GCF_020184175.1), *Diuraphis noxia* (GCF_001186385.1), *Myzus persicae* (GCF_001856785.1), *Melanaphis sacchari* (GCF_002803265.2), *Rhopalosiphum maidis* (GCF_003676215.2), and *Sipha flava* (GCF_003268045.1) – as well as the genomes of *Aphis craccivora* and *Macrosiphum rosae*, which were assembled and annotated by the Bioinformatics and Molecular Evolution of Animals Research Group.

Based on phylogenetic data, 38 orthogroups of cytochrome P450 genes belonging to the CYP4 and CYP6 families, known to be actively involved in detoxification processes, were selected for evolutionary analysis. A Python script was employed to identify paralogs within these orthogroups. The script performed multiple sequence alignment using MAFFT, calculated pairwise evolutionary distances, and visualized them in two-dimensional space via multidimensional scaling (MDS). Paralogs were defined as sequences that were most distant from the cluster center.

For each orthologous and paralogous sequence, two evolutionary parameters were calculated – dN/dS (the ratio of nonsynonymous to synonymous substitutions) and dS (the number of synonymous substitutions per site) – using the *yn00* program from the PAML package, which implements the Yang and Nielsen method. For orthologs, the calculations were performed relative to an outgroup species (*Bemisia tabaci*, GenBank: GCF_001854935.1), while for paralogs they were performed relative to the putative ortholog.

To assess differences between groups, the normality of data distributions was tested using the Shapiro–Wilk test, which showed that the datasets deviated from normality ($p < 0.05$). Therefore, the non-parametric Mann–Whitney U

test was applied for subsequent analysis. The statistical results demonstrated significant differences between orthologs and paralogs for both parameters – dN/dS and dS ($p < 0.05$).

A comparison of the obtained values revealed that paralogs exhibited lower dS values, indicating fewer accumulated synonymous substitutions and thus a more recent evolutionary origin, most likely associated with recent gene duplication events. Orthologs, in contrast, showed higher dS values, reflecting longer evolutionary divergence times. Moreover, the dN/dS ratios were higher in paralogs than in orthologs, suggesting differences in selective pressure between these gene groups. This indicates that paralogs undergo adaptive changes following duplication, whereas orthologs tend to retain their ancestral functions.

The most conserved orthogroup was identified as *CYP4G51*, which exhibited minimal dN/dS values (0.0146–0.0151). This points to strong purifying selection and high functional importance of this gene. Such evolutionary stability can be explained by the critical role of *CYP4G51* in aphid desiccation resistance through its participation in the biosynthesis of cuticular hydrocarbons. The low level of evolutionary change maintained in this gene over long evolutionary timescales suggests that even minor amino acid substitutions could negatively affect insect viability.

In contrast, two paralogs – *CYP380C35* and *CYP6CY6* – demonstrated the highest dN/dS values (0.5228 and 0.5055, respectively) combined with low dS values (0.0174 and 0.0285). This indicates a recent duplication origin of these genes and their potential involvement in adaptive processes related to xenobiotic metabolism. Elevated dN/dS ratios imply accelerated evolution, possibly linked to the development of insecticide resistance mechanisms.

STUDY OF ANTIOXIDANT PROPERTIES OF QUERCETIN IN THE MEDICINAL PLANT *CATHARANTHUS ROSEUS* (L.) G. DON BY THE *IN SILICO* METHOD

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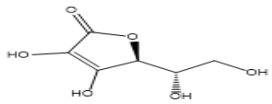
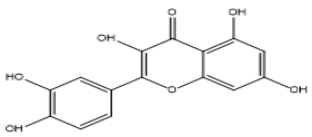
Catharanthus roseus (L.) G. Don is a valuable medicinal plant due to its content of secondary metabolites: alkaloids, phenols, anthocyanins. These biologically active compounds have anticancer, anti-inflammatory, antiviral and hepatoprotective properties which makes it possible to use them for therapeutic purposes [1].

The aim of this work was to study the antioxidant activity of quercetin contained in the plant *Catharantus roseus* (L.) G. Don using the *in silico* method and to compare its antioxidant activity with ascorbic acid [2].

Keywords: *Catharantus roseus*, antioxidant properties, quercetin, chemical modeling.

Table

Structure and physicochemical properties of ascorbic acid and quercetin calculated by the MM2 method

Name of biologically active substance	Structure	E_T, kcal/mol	E_{HOMO}, eV	E_{LUMO}, eV	Eg, eV
Ascorbic acid		5,3921	-10,585	-1,404	9,181
Quercetin		15,0487	-10,086	-3,902	6,184

During the study, calculations were made using the MM2 molecular modeling method, namely the total energy (E_{TOTAL}), the energy of the highest occupied molecular orbital (E_{HOMO}) and the lowest unoccupied molecular orbital (E_{LUMO}), as well as the width of the forbidden zone of the studied biologically active substances to confirm the antioxidant activity of quercetin in the medicinal plant *Catharanthus roseus* (L.) G. Don.

The data obtained in the table indicate that the band gap of the quercetin molecule is 6,184 eV while that of the ascorbic acid molecule is 9,181 eV.

Thus, our results indeed confirm that quercetin found in the secondary metabolites of the medicinal plant *Catharanthus roseus* (L.) G. Don, is a more powerful antioxidant than ascorbic acid.

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MOLECULAR DOCKING STUDY OF AZALOMYCIN, GELDANAMYCIN AND SNX-2112 WITH HSP90α

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This study employed molecular modeling to establish theoretical models of complexes formed between Azalomycin, Geldanamycin, SNX-2112 and the crystal structure of HSP90α (PDB: 4EGK).

Keywords: Molecular Docking, HSP90α, Azalomycin, Geldanamycin, SNX-2112.

The structure of HSP90α was obtained from the RCSB Protein Data Bank [1]. Protein structure preparation was performed using the Discovery Studio software package, involving removing the native ligand and water molecules, addition of hydrogen atoms and optimization of hydrogen bonding networks and side-chain conformations.

The three-dimensional structures of the ligands (Azalomycin, Geldanamycin, SNX-2112) were retrieved from the PubChem database. Molecular docking simulations and visualization of results were conducted using PrankWeb, Molegro Molecular Viewer and PyMOL software.

PrankWeb analysis identified one main binding site with a score of 43.93 and a probability of 0.968. The pocket centered on x, y, z = 8.5994, -6.7430, 18.2885 and formed by 34 amino acids residues includes key interaction residues confirmed by docking (e.g. Asn51, Asp93).

Three stable complexes with significantly different binding properties were obtained, varying in affinity, interaction networks, and key residues involved. All detailed energy and interaction data summarized in Table.

Table

Quantitative Comparison of Molecular Docking Results of Ligands with HSP90α

Ligand	SNX-2112	Geldanamycin	Azalomycin
ΔG (kcal/mol)	-8.87	-7.84	-7.17
MolDock Score	-135.967	-108.707	-111.662
H-Bond Count	5	3	6
H-Bond Residues	Thr 184, Asn 106, Lys 112, Asp 54, Asn 51	Asn 106, Lys 112, Asn 51	Asn 51, Thr 184, Asp 93, Ser 52, Asn 106, Lys 112
Steric Contacts	Asp 93, Ile 96, Gly 97	Asn 106, Gly 97, Asp 102	Thr 184, Asn 106, Phe 138, Val1 86

The docking results demonstrate that all three ligands form stable complexes within the ATP-binding pocket of HSP90α, yet exhibit significant differences in their binding modes. The synthetic inhibitor SNX-2112 displayed the strongest predicted binding affinity (-8.87 kcal/mol) and the most favorable MolDock Score (-135.967), indicating it is the most thermodynamically favorable binder. This was followed by the natural inhibitor Geldanamycin (-7.84

kcal/mol), while Azalomycin had the relatively least favorable binding energy (-7.17 kcal/mol), though its MolDock Score (-111.662) was comparable to Geldanamycin, suggesting considerable binding stability.

Azalomycin formed the most extensive hydrogen-bonding network (interacting with 6 key residues), featuring bonds of notable quality, such as Asn51 (strength: -2.46 kcal/mol) and Thr184 (strength: -2.0 kcal/mol). Although SNX-2112 formed fewer hydrogen bonds (5), it possessed the strongest set of interactions, including two high-strength bonds (-2.5 kcal/mol each), explaining its superior binding affinity. Geldanamycin exhibited fewer (3) and generally weaker hydrogen bonds, suggesting its stability may rely more heavily on steric complementarity within the pocket.

Conclusions: Quantitative docking results indicate that SNX-2112 possesses the optimal binding affinity, while Azalomycin, despite a slightly weaker binding energy, forms the most extensive and qualitatively significant hydrogen-bonding network. The three ligands achieve stable binding through distinct interaction strategies: SNX-2112 relies on high-strength hydrogen bonds, Geldanamycin on classical shape complementarity, and Azalomycin exhibits a broad-spectrum interaction profile (hydrogen bons and steric interactions). The unique interaction spectrum of the natural product Azalomycin identifies it as a valuable novel scaffold for HSP90 inhibition.

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