



SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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该地区行业基于风险的方法

RISK-BASED APPROACH IN THE REGION'S INDUSTRY

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注解。通过在该地区的生产区使用国家监督和控制的手段和工具，实现该地区工业部门运作风险最小化的需要；在某些情况下实施的控制措施的强度取决于企业的活动（IE）或企业所有者用来确保其活动的工业设施属于一种或另一种风险。应用基于风险的方法主要旨在减少工业事故的数量，以及降低工伤和工伤事故的水平。这适用于使用该方法的所有领域，并且控制强度（检查频率及其覆盖范围）与特定生产现场的安全水平成反比。从而合理分配相关资源，并在必要时采取措施。

关键词：区域经济，风险导向，风险管理，区域工业部门

Annotation. *The need to minimize risks in the functioning of the industrial sector of the region is realized through the use of means and tools of state supervision and control in the production areas of the region; the intensity of the control measures implemented in certain cases depends on whether the activity of the enterprise (IE) or industrial facilities used by the owners of the enterprise to ensure their activities belongs to one or another category of risks. The application of a risk-based approach is primarily aimed at reducing the number of industrial accidents, as well as reducing the level of occupational injuries and accidents at work. This applies to all areas of use of this approach, and the intensity of control (both the frequency of inspections and their coverage) is inversely proportional to the level of safety of a particular production site. Thus, the relevant resources are allocated rationally, and measures are taken exactly where it is necessary.*

Keywords: *regional economy, risk-oriented approach, risk management, industrial sector of the region*

In relation to the electric power industry, the key principles of the risk-based approach are set out in the provisions of the government Decree "On Amendments to the Regulations on the Implementation of Federal State Energy Supervision" developed with the participation of leading Rostekhnadzor employees. According

to the specified act, a dynamic model should be used for risk management, which is based on the analysis of the statistics of violations that were detected at the facilities subject to supervision. At the same time, the risk category, in accordance with the severity of such violations, can be changed; supervisory structures, based on this, get the opportunity, to prevent negative consequences, to direct their control resources, first of all, to objects belonging to the highest categories [1]. The most significant indicator of the probability of risks is the power indicator. The activities of industry entities, heating grid and heat supply enterprises (and individual industrial facilities), as well as end consumers of electricity, within the framework of using a risk-oriented approach in state supervision activities, should thus, according to the current rules and criteria, be assigned to a certain risk category.

Russian legislation highlights a number of aspects of the risk-based approach, with the main focus on control and supervisory activities carried out by state supervisory and regulatory authorities. Thus, the Federal Law "On the Protection of the Rights of Legal Entities in the Exercise of State Control" defines that in order to increase the efficiency of the use of all types of resources involved in the implementation of the procedure of state supervision and control, optimizing the costs of legal entities and individual entrepreneurs and ensuring high efficiency of the work performed, state control bodies should be guided by a risk-oriented approach when conducting the procedure of state control and supervision. At the same time, the risk-oriented approach is a way of preparing and executing the procedure of state supervision and control, in which the intensity, duration of control measures, as well as the form in which they are carried out, directly depend on which risk category (or hazard class) the activity of an enterprise or individual entrepreneur belongs to. When the so-called risk-oriented management system is introduced at a manufacturing enterprise, a number of goals are achieved [2]:

- 1) making thoughtful and adequate decisions, taking into account the level of risk;
- 2) ensuring the possibility of free circulation of information about risks and their characteristics (with vertical movement of information flows, and in both directions - from management to staff and from staff to management); the ability to take timely measures to manage risks, including their prevention;
- 3) conducting an audit of those areas of activity that are associated with maximum risks (including in "real time" mode).

The basis of the entire management system of an economic entity should be based on thoughtful management decisions and correct goal setting; it is necessary to make such decisions solely based on the results of a comprehensive analysis of negative factors that can affect the activities of the entity. To do this, the risk management system should be an integral part of the enterprise management system. The definition of a particular risk category for a particular supervised entity is car-

ried out according to the severity of the possible consequences of non-compliance with legislative requirements in the field of safety of the electric power industry, as well as the likelihood of their violation.

It should be noted that when operating production facilities of various power levels or with different network capacity by supervised energy enterprises, the risk category is assigned to this subject according to the value of these indicators that corresponds to the maximum hazard class. In addition, the risk category increases if the object subject to supervision is the only source of heat or electricity that provides the activities of the enterprise operating this object (Table 1) [3].

Table 1.

Criteria for assigning electric power industry entities, heat supply organizations, heating grid organizations and consumers of electric energy to a certain risk category

Features of attribution of organizations of owners of energy facilities, energy receiving devices to risk categories	Категория риска				
	I	II	III	IV	V
	High risk category	Significant risk category	Medium risk category	Moderate risk category	Low risk category
Electric power plants	Installed capacity from 500 MW and above	Installed capacity from 150 to 500 MW	Installed capacity from 50 to 150 MW	Installed capacity from 1 to 50 MW	Installed capacity less than 1 MW
Electric grid facilities	Capacity of the electric network from 500 MW	Capacity of the electric network from 100 to 500 MW	Capacity of the electric network from 5 to 100 MW	Capacity of the electric network from 0.15 to 100 MW	Capacity of the electric network less than 0.15 MW
Electrical installations of consumers	Maximum power from 500 MW and above	Maximum power from 100 to 500 MW	Maximum power from 5 to 100 MW	Maximum power from 0.15 to 5 MW	Maximum power less than 0.15 MW (consumers of the 1st and 2nd categories of power supply)

Thermal installations and networks			Installed capacity from 10 MW and above	Installed capacity from 0.15 to 10 MW	Installed capacity less than 0.15 MW
Subjects of operational dispatch management in the electric power industry	Medium risk category				

Dynamic model

When taking into account the evaluation of the specified model [4,5]:

1) entities operating in the electric power industry are classified according to risk categories as follows: high risk, significant, medium and moderate; it is necessary to revise the procedure for assigning to all categories except the first, and introduce certain rules for assigning these categories:

- for at least 5 years immediately before the assignment of the category, there must be no judicial acts (which have entered into force) issued for violation of safety requirements, as a result of which an accident and /or a fatal accident occurred at work, in relation to the enterprise (IE), as well as individual officials and / or other employees of this enterprise;

- for at least 3 years immediately before the assignment of the category, there should be no resolutions (which have entered into force) on bringing the subject to administrative responsibility due to the commission of offenses provided for by certain provisions of the Administrative Code (articles 9.7 to 9.9, as well as 9.11 and 9.18);

2) entities operating in the areas of heating networks and heat supply, as well as electricity consumers, are classified according to risk categories as follows: high risk, significant, medium and moderate; it is necessary to revise the procedure for assigning to all categories except the first, and introduce certain rules for assigning these categories:

- for at least 5 years immediately before the assignment of the category, there must be no judicial acts (which have entered into force) issued for violation of safety requirements, as a result of which an accident and /or a fatal accident occurred at work, in relation to the enterprise (IE), as well as individual officials and / or other employees of this enterprise;

- according to the results of the latest inspection, there should be no resolutions (which have entered into force) on bringing the subject to administrative responsibility due to the commission of offenses provided for by certain provisions of the Administrative Code (articles 9.9 to 9.11);

3) a supervised entity may be assigned a category of significant, medium, moderate or low risk in the following cases:

- over the past 5 years, immediately before the assignment of the category, there has been at least one judicial act (which has entered into legal force) issued for violation of safety requirements, as a result of which an accident and /or a fatal accident occurred at work, in relation to the enterprise (IE), as well as individual officials and /or other employees of this enterprise;

- over the past 3 years, immediately before the assignment of the category, there has been at least one resolution (which entered into force) on bringing the subject to administrative responsibility due to the commission of offences provided for by certain provisions of the Administrative Code (1st part of Article 19.5);

Attribution authority (Fig 1) [6]

In relation to the level of risk, the activities of supervised entities belong to one or another category:

- when determining a high, significant, medium risk – in accordance with the decision of the head (or deputy). head) of the state supervisory authority;

- when determining moderate, low risk – in accordance with the decision of the management of the relevant territorial subdivision of state supervisory authorities.

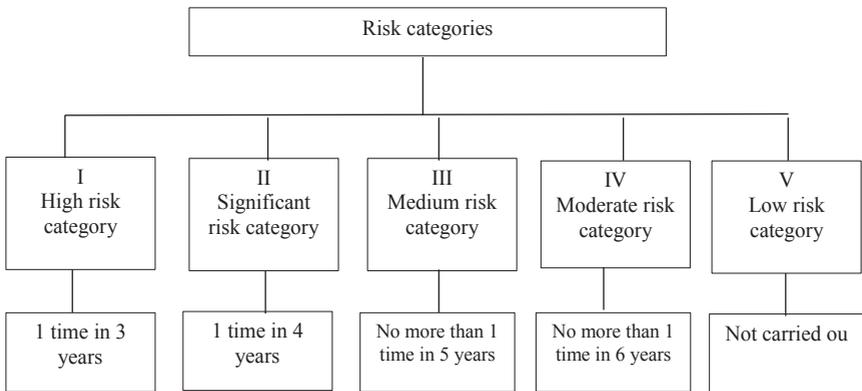


Figure 1. Frequency of scheduled inspections depending on the assigned risk category

The decision to assign a particular risk category to a supervised entity in the case of the presence of several such entities in the relevant territory is made by the management (deputy head) of the supervisory authorities. In turn, the decision concerning the promotion of this category is made by an official with the appropriate authority.; if such a decision concerns the reduction of a category, it should be made by the same official who was charged with making a decision on assigning

a certain risk category (or hazard class), and at the same time, both the decision on the reduction of the category in writing and its documentary grounds should be sent to the authorized body. If there is no corresponding decision at all, the activity of the supervised entity automatically belongs to the low-risk group.

Scheduled inspections

The following figure shows the regulatory frequency of planned supervisory inspections of electric power industry enterprises in accordance with risk categories (hazard classes); it should be borne in mind that subjects classified as low risk are not subject to planned control (Fig 2) [4, 7].

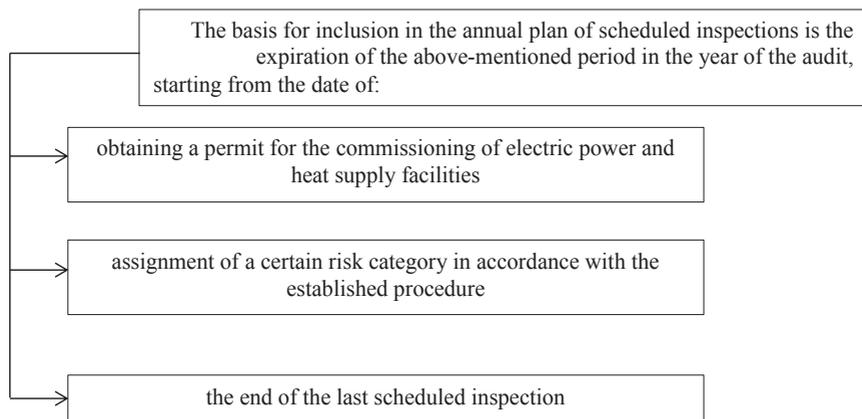


Figure 2. *The basis for inclusion in the annual plan of scheduled inspections*

A planned audit of an enterprise (IE) is included in the corresponding annual plan on the general basis that in the period for which the plan is drawn up, the validity period of the previous audit expires; at the same time, the countdown begins from the date:

- obtaining (in accordance with the procedure provided for by the provisions of the legislation on urban development) a permit to put electric power and heat supply facilities belonging to heating grid enterprises into operation;
- assignment of a certain risk category to a supervised entity (also in accordance with the procedure established by law);
- completion of the last scheduled inspection.

Lists of subjects of supervision

Supervised entities belonging to certain risk categories are included in special lists compiled by state supervisory structures; the following data are entered into such lists [8]:

- the name (full) of the relevant enterprise or the passport data of the sole proprietor;
- OGRN and INN;
- the legal address of the company (or the residential address of the sole proprietor);
- the actual address at which the company conducts its main activities;
- the risk category (hazard class), the details of the document according to which it was assigned, the documentary grounds for assigning the specified category.

Information about supervised entities classified, in accordance with the nature of their activities, into high and significant risk categories should be posted on the official Internet pages of the relevant state supervisory structures, as well as, if necessary, updated; such information includes:

- the name (full) of the relevant enterprise or the passport data of the sole proprietor;
- OGRN and INN;
- the legal address of the company (or the residential address of the sole proprietor);
- the actual address at which the company conducts its main activities;
- the risk category assigned to the subject, as well as the date of the relevant decision by the authorized body.

When posting this information on the international Internet, the current provisions of the legislation concerning the preservation of state secrets of the Russian Federation must be observed. Supervisory authorities that, according to the Rules on Assigning Risk Categories to Enterprises, Sole Proprietors and Their Industrial Facilities, have decided to assign a supervised entity to a particular risk category, in accordance with the request of this entity, must provide data on the assignment of the entity's activities to a particular category, as well as the grounds for the decision. In accordance with the procedure provided for by the above-mentioned Rules, the supervised entity has the right to submit an application to the state supervisory authorities for a change in the risk category to which its activities were assigned by the decision of the authorized bodies.

Problem areas of regions in the Russian Federation

The so-called problem zones are territories of various sizes, within which certain anomalies operate. In particular, this refers to territories that have been negatively affected by the consequences of various kinds of accidents and catastrophes (both man-made and natural origin), military conflicts, socio-political upheavals, etc., which ultimately led to the displacement of significant masses of the local population (forced migration), as well as a decrease in the economic potential of the region as a result of a sharp drop in production and, as a consequence, the qual-

ity of life of citizens. In Russia at the moment, such territories, for the regulation of which special techniques should be used, can be classified, based on typological features formulated according to the results of research, as follows: underdeveloped or lagging regions; depressed regions; regions in a state of crisis [9]. The first of these categories can be attributed to federal subjects whose economy is in a state of stagnation and whose economic potential is many times inferior to the national average due to the influence of various factors – both historical and socio-economic; social infrastructure is insufficiently developed in the territories of such regions, and local industry is poorly diversified (Altai, the North Caucasus, most joint-stock companies, except those in which the oil and gas industry prevails, etc.). The development of such regions should be stimulated through state support measures, as well as the use of existing advantages; it should be noted that this requires significant costs, including temporary ones. The depressed regions of Russia, characterized by a steady and deep decline in economic activity and a sharp decline in the standard of living of the population, include local zones of old-industrial, agricultural -industrial and some mining regions of the European Center, the Urals, southern Siberia and the Far East. The group of problem regions also includes a significant part of the northern territories, where typical negative factors (unfavorable climate and high cost of living, increased production and transport costs, environmental vulnerability, etc.) are currently not compensated by strong competitive advantages in the form of the richest resources (oil and gas, diamonds, precious and non-ferrous metals, etc.). The plight of a number of regions of the Far North (the curtailment of basic and service industries, significant unemployment, low incomes, difficulties with the import of fuel and food) require special measures of state assistance. The situation of a number of depressed regions may improve if Russia's position in the global arms markets, aerospace equipment, nuclear industry and other high-tech industries is restored and strengthened. For most depressed regions, the path to sustainable economic growth can be achieved on their own by diversifying, converting, modernizing production, stimulating the development of small businesses, improving the local investment climate, searching for new markets, etc. However, a number of regions with a particularly deep degree of depression should become objects of targeted state support. According to the results of the period "January-August" 2021, the volume of industrial production amounted to 37.2% compared to the same period of the previous year, which amounted to 55,019,000 million rubles. What do the indicators of industrial production demonstrate (Fig 3) [10]

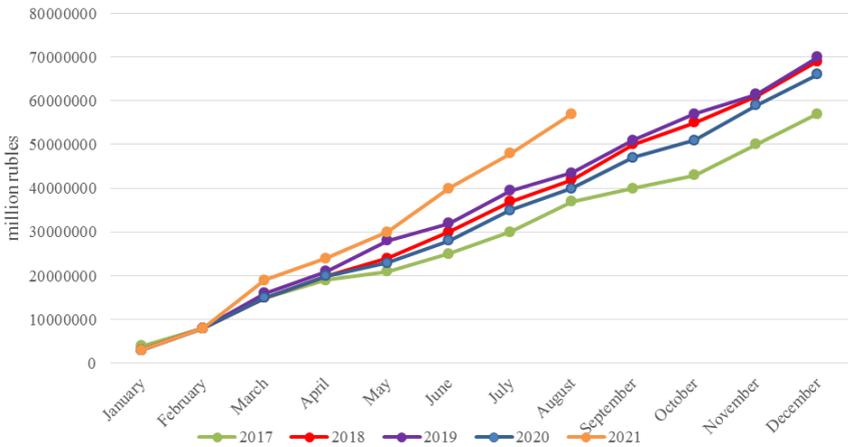


Figure 3. industrial production indicators 2017-2021 (aug)

Moscow (7,619,691 million rubles), the Tyumen Region (6,877,904 million rubles), as well as the Khanty-Mansi Autonomous Okrug (3,481,258 million rubles) were among the leaders in terms of shipped goods of their own production, works and services performed in the country, while the highest industrial production indices were in the Republic of North Ossetia (133%), Primorsky Krai (133.4%) and the Republic of Sakha (Yakutia) (125.7%). Among the lagging regions are the Republic of Altai (5,542 million rubles), the Republic of Kalmykia (2,841 million rubles), and the Republic of Ingushetia (2,394 million rubles), the lowest industrial production indices were recorded in the Republic of Ingushetia (93.3%), Sakhalin Oblast (87.8%). Thus, the use of a risk-based approach for industrial enterprises is associated not only with control and audit activities, but also with the main activities of enterprises, including:

- production,
- financial,
- investment activities.

The risk-oriented approach is part of the enterprise management process, includes a specific strategy, tactics and operational implementation. The risk management system includes not only analysis and impact procedures, but also mechanisms for periodic review and ranking of risk management measures and tools. The full application of a risk-based approach in the management of an industrial enterprise means the introduction of a risk management system, including the integration of components of this system into the main business processes and activities.

References

1. Andreev, V.D. *Complex risk-oriented audit of energy enterprises Textbook / V.D. Andreev. - M.: Master, 2019.*
2. Armashova-Telnik G.S. *Competitive market space in the context of the need to increase the competitiveness of the Russian economic system. Vestnik VGUIT [Proceedings of VSUET]. 2021. vol. 83. no. 2. pp. 259– 264. (in Russian). doi:10.20914/2310-1202-2021-2-259-264 © 2021,*
3. Aralbayeva, F. Z. *Innovation-oriented approach in ensuring socio-economic development of the region / F.Z. Aralbayeva. - M.: Bibkom, 2020.*
4. Doronin, S. N. *Public procurement. Legislative framework, implementation mechanisms, risk-oriented management technology / S.N. Doronin, N.A. Rykhtikova, A.O. Vasiliev. - M.: Forum, 2020.*
5. Armashova-Telnik G. S. *On the issue of digital economy tools //Bulletin of the Voronezh State University of Engineering Technologies. - 2020. - T. 82. – №. 2 (84).*
6. Inza, Shparrer *Introduction to the risk-oriented approach and systemic structural arrangements / Shparrer Inza. - M.: Institute of Consulting and System Solutions, 2019.*
7. Filimonov S. V. *Risk-oriented approach as an element of tactical analysis of the company //Economy. Business. Banks. – 2020. – №. 4. – Pp. 100-108.*
8. Skorokhodova Yu. N., Shirokova D. N. *RISK-ORIENTED APPROACH IN CONTROL AND SUPERVISORY ACTIVITIES //Arctic: modern approaches to industrial and environmental safety in the oil and gas sector. - 2020. - pp. 149-151.*
9. Timoshenko K. A. *Risk-oriented approach to the management of state programs of the Russian Federation: a meaningful aspect //Audit statements. - 2020. - No. 4. - pp. 43-50.*
10. Pochivalova G. P. *Modern directions of transformation of the business climate in the Russian economy in the context of regional development //Moscow Economic Journal. - 2020. - No. 12.*

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COVID-19 背景下现代国家创新系统的特点
SPECIFICS OF MODERN NATIONAL INNOVATION SYSTEMS
IN COVID-19 CONDITIONS

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Belgorod State Technological University named after V. G. Shoukhov

摘要。 文章考虑了全球大流行对国家创新体系发展的影响的后果。突出显示了受创新活动影响最大的领域。研究了大流行对创新系统的负面和正面影响。

关键词： 大流行，COVID-19，创新活动

Abstract. *The article considers the consequences of the impact of the global pandemic on the development of national innovation systems. The most affected areas of innovation activity are highlighted. The negative and positive effects of the pandemic on the innovation system are studied.*

Keywords: *pandemic, COVID-19, innovation activity*

The COVID-19 pandemic and its aftermath are having an extremely dire impact on the global economy as a whole. In the pessimistic scenario presented by the OECD in 2020, global economic growth will contract by 2-3% in 2021, global unemployment will increase further, and corporate investment will remain very weak.

This crisis represents the worst recession since World War II. Growth has slowed and continues to decline in most developing countries and markets, the first time negative growth has occurred in at least 50 years.

The business sector has been hit hard by the crisis, with government lockdowns, supply chain disruptions and falling demand that have led to a sharp rise in bankruptcies. Small and medium-sized enterprises (SMEs) have been hit by the global pandemic even more than large businesses, as SMEs are mainly represented in sectors such as wholesale and retail trade, accommodation and catering services, real estate, professional services, etc.

The COVID-19 crisis also affected business research and innovation. Many innovative companies have curtailed innovation in the midst of isolation. According to a survey of innovative companies conducted in April 2020 by the German

Federal Ministry for Economic Affairs and Energy, 54% of companies have suspended ongoing research and innovation projects.

An international survey and follow-up interviews with more than 200 industry leaders conducted by McKinsey in April 2020 showed that the focus on innovation as a top business priority has declined in many industries, with the exception of the pharmaceutical and medical sectors (McKinsey, 2020).

The sharp decline in demand during the first wave of isolation and limited access to research infrastructure influenced innovation. As elsewhere, isolation measures have led to the closure of most innovation and testing centers, laboratories and science parks. This has had a direct impact on the ability of many firms to make progress in their planned research, product development and commercialization as outlined in business plans and investor agreements.

Comparing the trends in the filing of patent applications under the Patent Cooperation Treaty (PCT) before the pandemic and after, the average slowdown in filing of patent applications can be noted after the outbreak of COVID-19.

COVID-19 has also impacted venture capital firms as the main source of funding for innovative startups. According to Ipsos MORI's analysis, the number of venture capital deals globally declined between January and August 2020, reaching its lowest level since February 2013 (Ipsos MORI, 2020).

A survey of 1,000 institutional and corporate venture capitalists, mostly based in the US, also showed that they slowed their investment rate (71% of normal) in the first half of 2020.

Universities are facing financial problems caused by the pandemic. Some students have abandoned their plans to enroll in higher education programs in 2020/21, including international students. All this led to a reduction in the income of universities from educational activities. It can also affect research spending, as teaching income often cross-subsidizes research activities. About 60% of OECD countries have increased their education budget in response to the pandemic. How these additional funds are spent varies greatly from country to country: for example, additional teacher salaries to cover small classes and additional, corrective training; providing students with digital tools for online learning; additional scholarships or loan waiver for university students.

Severe travel restrictions imposed by isolation measures have interrupted the mobility of human resources in innovation and research (e.g. visiting researchers, exchanging employees with industry). In the early months of the pandemic, many scientific events and conferences were postponed or canceled. Instead, some of these conferences and events (including large flagship conferences) are increasingly being organized digitally, sometimes with very high attendance. The move highlighted the benefits of digital conferencing, especially in terms of improved accessibility, reach a more diverse audience, and lower costs. However, virtual ex-

changes are not an ideal substitute for face-to-face conferences, which often lead to collaborations and long-term relationships of trust, as well as an opportunity for aspiring researchers to find work and increase the visibility of their work.

An important change brought about by the pandemic is the faster publication rate of scientific research results, highlighting the role of open science. Many journals have accelerated the peer review process to ensure rapid distribution. Based on data from 669 articles published in 14 medical journals during and before the current pandemic, the study found that publication times decreased by an average of 49%, from 117 days to 60 days (Horbach, 2020).

Preprints became more common in the medical research field over a period of several weeks. Their rapid adoption is also supported by the high proportion of published documents with open access: an analysis of medical publications by the OECD shows that the share of open access studies on COVID-19 was 76% (compared, for example, with 43% for diabetes).

Another phenomenon observed in the early months of the pandemic was the rapid development of frugal innovations to fill shortages in medical equipment and other emergency supplies (Harris, 2020). For example, in mid-March 2020, an Italian start-up remodeled a 3D-printed version of a respirator valve and delivered 100 such valves to Chiari Hospital in a few days.

Some companies in the automotive, aviation, or consumer goods industries have repurposed (partially) their production lines to produce urgently needed medical equipment such as ventilators and respirators, face masks and hand sanitizers.

Thus, COVID-19 has accelerated the development of already incipient trends by opening up access to scientific publications, increasing the use of digital tools, improving international cooperation in research and innovation, stimulating various partnerships between the public and private sectors.

Overall, the pandemic continues to pose serious challenges to national innovation systems, jeopardizing key manufacturing and innovation capabilities. Policy responses to the crisis have focused on securing funding for research and innovation related to COVID-19, with governments, foundations and industry raising several billion dollars to fund new vaccines and therapies.

In the short term, governments should continue to support research and innovation to develop solutions to combat and mitigate the pandemic, while paying attention to the uneven distribution of the impact of COVID-19.

References

1. Technology and Innovation Report 2021 // UNCTAD Review 2021 - Access Mode: https://unctad.org/system/files/official-document/tir2020overview_ru.pdf

2. *On the effects of the pandemic on science, technology and innovation in the OECD review* - Access mode: <https://issek.hse.ru/news/435594846.html>

3. *OECD forecast for science, technology and innovation for 2021. Times of Crisis and Opportunity* - Access Mode: <https://www.oecd.org/sti/oecd-science-technology-and-innovation-outlook-25186167.htm>

4. *OECD Education Innovation Report: Schools and Education Systems Not Ready to Realize the Potential of New Technologies* - Access Mode: <https://www.csee-etuice.org/ru/news/archive/1748-oecd-report-on-innovation-in-education-schools-and-education-systems-are-not-yet-ready-to-realise-technology-s-potential-2>

后COVID时代年轻人的福祉和教育前景
**WELL-BEING OF YOUNG PEOPLE AND PROSPECTS OF
EDUCATION IN THE POST COVID ERA**

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注解。 本文致力于分析 COVID-19 大流行时代年轻人的福祉以及 COVID-19 后高等教育的前景。 该研究基于官方来源的数据和外国学生调查（联合国儿童基金会、联合国、国际劳工组织等），以及阿比莱汗哈萨克国际关系大学科学小组自己进行的研究哈萨克斯坦共和国 1000 名学生中的世界语言。 这个想法被证实，大流行不是根源，而是年轻人世界观中深度价值转变过程的催化剂。 提出了科学家对高等教育未来的思考和桥梁般的教育趋势。

关键词：教育哲学、流行病、青年福祉、青少年时期、全球教育危机。

Annotation. *This article is devoted to the analysis of the well-being of young people in the era of the COVID-19 pandemic and the prospects of post-COVID higher education. The study was based on data from official sources and foreign surveys of students (UNICEF, UN, International Labor Organization, etc.), as well as on the basis of its own research conducted by the scientific group of Abylai Khan Kazakh University of International Relations and World Languages among 1000 students of the Republic of Kazakhstan. The idea is substantiated that the pandemic was not a source, but a catalyst for deep value-transformation processes in the worldview of young people. The thoughts of scientists about the future of higher education and bridge-like educational trends are presented.*

Keywords: *philosophy of education, pandemic, well-being of youth, post-teen age, global educational crisis.*

The coronavirus pandemic, which spread widely around the world at the beginning of 2020, has seriously affected the education sector. It has led to the almost complete paralysis of schools, colleges and universities. Already in mid-April, according to UNESCO, schools were closed in 191 countries of the world, and more than 1.5 billion students switched to distance education [1]. This process, which, only at first glance, seems temporary, in fact causes serious concerns of the academic community with deep socio-economic consequences and a new round of the global educational crisis. It is believed that the main negative factors of the pandemic are failures in the work of educational institutions, poor technical equipment, interruptions in the Internet, limited access to educational products, poor digital training of teachers and students, growing unemployment in education, rising student debts, etc. [2]. But all this is just the tip of the iceberg.

The COVID-19 pandemic has exposed the education system. The crisis in which the entire world education was previously in a hidden, latent form, today it has made itself felt in the most impressive dimensions. Narrow pragmatism instead of the fundamentalization of education, technization instead of humanization, consumerization at the expense of ecologization, and finally, education as a commodity instead of education as an end in itself: the substitution of the value foundations of the education system is more obvious than ever today.

With the pandemic came a clear realization that universities do not teach young people to cope with life's problems. Having become a part of market relations, serving the consumer society with its increasing imaginary needs, education has become far removed from the basics and has ceased to perform its main functions - socialization and social control.

Ankit Gupta, a researcher from India, believes that the entire education system concentrates on teaching students purely professional skills with economic value. "How to do" instead of the questions "What to do" or "Why something should be done" [3]. The education system does not prepare students for life, does not help them cope with problems and difficulties that arise outside their profession. As a result, modern students are disoriented, worried, lose their purpose and understanding of the events taking place.

Thus, according to a UNICEF survey on the impact of COVID on the mental health of adolescents and young people, conducted in 9 countries and covering more than 8 thousand respondents, one in three said that they feel anxious (27%) and another 15% experience depression. 43% of girls and 31% of boys are pessimistic about the future [4].

According to the report of the International Labor Organization "Youth and the COVID-19 pandemic: impact on jobs, education, rights and psychological state", 50% of young people may potentially experience anxiety or depression, and another 17% are likely to have already encountered these problems [5].

In Canada, every fourth respondent student noted that his stress level is above critical thresholds [6].

The results of a survey conducted by Goodwin Simon Strategic Research in 2020 among 1,305 young people in the United States showed that students in the United States today show less clarity about their goals and ideas for future work or career, many respondents are not sure whether they should continue studying at university, most have changed their educational plans [7].

In the UK, the average life satisfaction score among students has decreased: it has become much lower than that of the adult population (5.8 vs. 7 out of 10) [8].

In Australia, the majority of students are unsure about their financial future (64%) and postpone achieving their main life goals due to the Covid-19 pandemic (69%). The majority of young people stated that they are unlikely to retire before the age of 65, find their dream home or a job that is not only related to paying bills [9].

In Russia, 57.2% of student respondents stated that they lose control of the situation and their lives, feel the loss of goals, lack of plans and uncertainty [10].

As for Kazakhstan, according to a study conducted by Abylai Khan KazUIR&WL research group in April-May 2021, among 1000 students of the Republic of Kazakhstan, almost every fifth student in Kazakhstan (18%) experiences negative feelings: the state of unbalance, anxiety, depression, indifference, fear, fatigue, loneliness, etc. Among the main concerns, students noted the fear of not realizing themselves (54%), problems with employment (11.4%), fear of being left without means of livelihood (11.2%), health problems (10.3%), problems with marital status (8.5%) [11].

As we can see, the pandemic is seriously affecting the mental and psychological health of young people. All over the world, including Kazakhstan, the level of stress and anxiety of young people is growing.

Most education theorists see a way out of the situation in the value transformation of university education, in the return of its essential qualities to the education system: fundamentalization, humanization and environmentalization.

The pandemic gives a chance to turn our universities not into a gathering place for "intellectual technicians", but into a place where "people of thought trained to think essentially, holistically, transdisciplinarily" will gather [12].

"Impact on the planet" should become an integral part of disciplinary knowledge," R. Gorur believes, "not as a six-week course in the first semester, but as the fundamental basis of any discipline. The orientation of each discipline towards understanding how decisions in this area affect society, with case studies assessing past contributions and effects, will justify and bring to life the abstract missions and visions that universities support"[13].

In addition to rethinking each individual discipline and its impact on the devel-

opment of mankind, scientists consider it necessary to fundamentally rethink the role of the university in society. If in the era of the pandemic it became possible to have rare museum collections, library archives, articles, etc. in the public domain, then why can't this be after the pandemic, in normal times? "Universities should seriously think about making all their research open after COVID, giving priority to society. This is another way for them to demonstrate their commitment to the principles of justice and the health of the planet," R. Gorur believes [13].

Thus, the main trends and prospects of the education of the future are seen:

- in moving away from market relations and commercialization in favor of education for people based on empathy, social ethics, integrity and interdisciplinarity,
- in the openness of education and its wide access for all, in the democratization of higher education,
- in the emergence of distance (or mixed) education as an alternative to the classroom-based system with active student involvement and high interactivity,
- in the transformation of the education system as an end in itself and self-worth.

The pandemic has undoubtedly exposed the education system around the world, it has clearly shown its sick and weak points, pointed to vulnerable places. The urgent transformation of education and the transition to online, which were considered exclusively as temporary measures, can be the beginning for the formation of higher-order education and thinking. A pandemic is a gap after which education can no longer be the same. Today, more than ever before, it has become clear that the value of education is not equivalent to its market value. Education should become something more - the basis, the cornerstone in the formation of personality, the main value guideline of young people. Only in this way it is possible to overcome the negative consequences of the pandemic and the global educational crisis that followed it.

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References

1. *A deep "digital divide" in distance learning. UNESCO report. - [Electronic resource] URL: <https://ru.unesco.org/news/glubokiy-cifrovoy-razryv-v-distancionnom-obuchenii> (accessed: December 15, 2020).*

2. *Education in the era of COVID-19 and beyond. The UN Concept Note for August 2020 - [Electronic resource]. URL: https://www.un.org/sites/un2.un.org/files/policy_brief_-_education_during_covid-19_and_beyond_russian.pdf (accessed: December 20, 2020).*
3. Gupta Ankit (2020) *Value education in higher education". https://www.researchgate.net/publication/340755942_Value_education_in_higher_education. - DOI 10.13140/RG.2.2.16787.84005*
4. UNICEF study. *The impact of COVID-19 on the mental health of adolescents and youth.. - [Electronic resource] URL: <https://www.unicef.org/lac/en/impact-covid-19-mental-health-adolescents-and-youth> (accessed: July 15, 2021).*
5. *Due to the COVID-19 pandemic, more than 70 percent of young people cannot study properly. - [Electronic resource] URL: https://www.ilo.org/moscow/news/WCMS_753125/lang--ru/index.htm (accessed: July 15, 2021).*
6. Schwartz K., Exner-Cortens D., etc. (2021) *COVID-19 and Student Well-Being: Stress and Mental Health during Return-to-School. – Canadian Journal of School Psychology: 36 (2). <https://doi.org/10.1177/08295735211001653>*
7. *How COVID-19 and Other Events are Shaping Young People’s Perceptions of the Future. Equitable Futures National Youth Poll 2020-2021. – [Electronic resource] URL: <https://www.equitablefutures.org/covid19/> (accessed: July 15, 2021).*
8. *Coronavirus and higher education students: England, 4 to 12 May 2021. - [Electronic resource] URL: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandhighereducationstudents/england4to12may2021> (accessed: July 15, 2021).*
9. *Young Australians delaying life goals due to pandemic and feel pessimistic about future. – [Electronic resource]. URL: <https://www.theguardian.com/business/2020/nov/05/young-australians-delaying-life-goals-due-to-pandemic-and-feel-pessimistic-about-future> (accessed: July 15, 2021).*
10. *Young people have pandemic fears. [Electronic resource] URL: <https://urfu.ru/ru/news/35209/> (accessed: July 15, 2021).*
11. *Ashilova M.S., Begalinov A.S., Begalinova K.K. Kazakh higher education. Review. - Almaty, 2021. - 240 p.*
12. *Gibbs P. (2020). Transdisciplinary possibilities after the pandemic // Reimagining the new pedagogical possibilities for universities post-Covid-19. - Educational Philosophy and Theory: 52. - DOI: 10.1080/00131857.2020.1777655.*
13. *Gorur R. (2020). Course correction: Disciplines in the post-COVID world // Reimagining the new pedagogical possibilities for universities post-Covid-19. - Educational Philosophy and Theory: 52. – 2020. DOI: 10.1080/00131857.2020.1777655.*

以西伯利亚联邦大学（俄罗斯克拉斯诺亚尔斯克）的学生为例，通过电子学习进行生态教育

**ECOLOGICAL EDUCATION BY MEANS OF E-LEARNING
EXEMPLIFIED BY THE STUDENTS OF SIBERIAN FEDERAL
UNIVERSITY
(KRASNOYARSK, RUSSIA)**

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注解。 本文对西伯利亚联邦大学学生准备接受“生态与环境管理”方向的教育的结果进行了分析，使用距离方法。 结果表明，学生认为混合学习更有效。

关键词：电子学习例证，问卷调查，远程学习

Annotation. *The article presents an analysis of the results of the study students of Siberian Federal University readiness to receive education in the direction of «ecology and environmental management» using distance methods. It is shown that students consider mixed learning to be more effective.*

Keywords: *e-learning exemplified, анкетирование, distance learning*

The rapid pace of information growth in the modern society demands the life-long learning for any specialist. In recent years, "life-long education" concept is associated with the necessity to search for new approaches related to knowledge and learning technology transfer.

E-learning is a combination of technologies assigned for delivery of the base amount of the materials studied, interactive activities and self-studying during the course (Andreev, 2013).

This type of education is actively developing worldwide (Marks et al., 2005; Arbaugh, Benbunan-Fich, 2007; Peltier et al., 2007; Huda et al., 2018). E-learning

offers many advantages to students like availability to all groups of people including physically disabled ones, blended study and individual training.

Education in Russia implemented with e-learning tools is considered to be a form of learning process arrangement but it is not a form of getting education (Weindorf-Sysoeva, Shitova, 2013). Educational organizations are eligible to apply distance learning technologies while fulfilling the educational programs of any levels and forms of receiving education (their combination) as well as while running different types of academic, laboratory and practical classes and training (except for the work experience internships), ongoing follow-up, intermediate performance evaluation.

Distance learning in the system of Russian education will be developing and advancing substantially with Internet technologies progress and e-learning tools update (Burlaka et al., 2018). The following development of e-learning systems requires the highest level of their interactivity. At the same time, heavy workload for courses development, a lack of teaching experience among academic staff and weak system of student control and identification are appeared to be basic issues of distance learning (Andreev, 2013; Magomedova, 2013; Ivanov et al., 2017).

The School of Ecology and Geography in Siberian Federal University (Krasnoyarsk, Russia) has elaborated electronic educational resources (e-courses) within the framework of the project called “Lifelong Learning for Sustainable Development SUSDEV 574056-EPP-1-2016-1-PL-EPPKA2-CBHE-SP” which allow students to gain «green skills». They include optional courses and compulsory ones.

Many disciplines have blended format when realizing «ecology and environmental management» training program i.e. partially by means of e-courses. However, some part of the disciplines is arranged traditionally.

Taking into consideration the relative novelty of blended type of learning that combines methods of classroom teaching and e-learning platform usage, the research is committed to evaluate how the Siberian Federal University students of «ecology and environmental management» training program are prepared to receive education through e-learning methods.

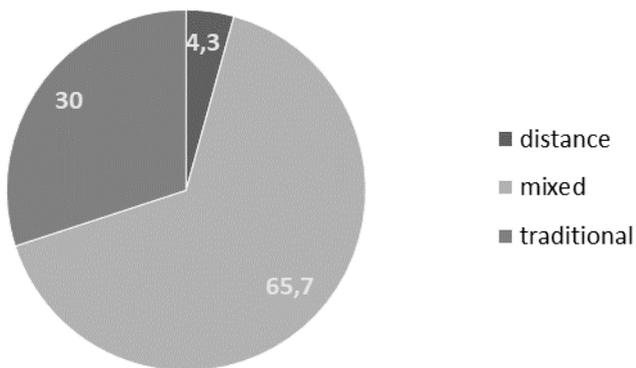
Research Methods

The main research tool applied is a questionnaire survey. The questionnaire with 15 questions has been specifically created. The survey is aimed at tracking students’ feedback on e-learning quality and efficiency in terms of ecological disciplines realization as well as knowledge level received during e-learning process. 70 BSc respondents from 1st to 4th year of study took part in the survey.

Results

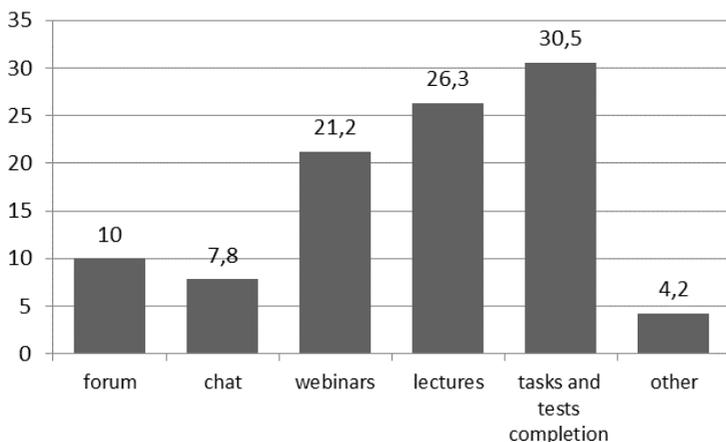
The survey showed that almost all the interviewees know what distance learning means. 66 % of respondents indicated that the most effective form of learning

is blended one with traditional and distance methods combined whereas only 4 % voted for distance learning as the most effective one (Picture 1).



Picture 1. Proportion of responses to a question «What form of learning do you think is the most effective?» (%)

The students outlined the main types of distance learning used by academic staff during e-courses: tasks and tests completion – 46 %, lectures - 34 %. The lowest percentage belonged to forums and chats – 15 and 5 % respectively.

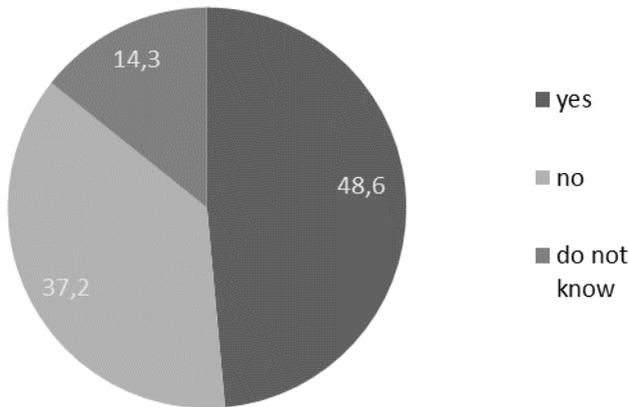


Picture 2. Efficiency of specific types of distance learning according to respondents (%)

The students defined the most effective types of e-course learning: tasks and tests completion (30 %), lectures (26 %) and webinars (21 %). Forum and chat summed up with 18 % that might be explained by their low usage from the part of academic staff.

The next question in the survey related to understanding the quality level of the disciplines realized with e-course as opposed to the disciplines realized traditionally. It should be noted that interviewees' opinion has been almost equally distributed as 40 % of respondents think that e-learning tools improves the quality of disciplines whereas 34 % have a reverse point of view. The others couldn't decide upon the response (option reply «I don't know»).

51 % of students report that e-learning methods do not make the disciplines studied more complicated in comparison with traditional ones. At the same time, 36 % of responses confirm that the distance disciplines add the complexity to learning process while 13 % couldn't reply on this question.



Picture 3. Proportion of responses to a question «Do e-learning methods enable to get clear understanding of key issues (aspects) of the discipline studied?»

Almost half of the respondents said «yes» for the question «Do e-learning methods enable to get clear understanding of key issues (aspects) of the discipline studied?» (Picture 3). Sufficiently large amount of the students (37 %) think that e-learning doesn't help them at all. The group of respondents who found it difficult to answer the question ended up with 14 %.

Another essential question collected the answers that reflect the importance for students to get a feedback in the «tutor-student» system. The survey showed that performance evaluation during the e-course is valuable for the most part of the respondents (61 %). So far, 26 % of students chose answer «no» as the evaluation

is not critical for them and the rest ones 13 % couldn't decide upon the response and chose answer «I don't know».

The students were also recommended to express their opinion about digitalization of all the disciplines (Table 1). One third of students responded that it would help them to manage time, less amount of students believe that it would make their learning more complicated and equally the other respondents left were negative about e-courses tasks.

The results of the survey to track how the students-ecologists are prepared to switch to the distance learning. More than a half of respondents (63 %) are ready to e-learn only certain disciplines like optional courses but not the base disciplines. Previous answers demonstrated that the students are more attached to traditional learning methods (classroom lectures and workshops). Only 16 % of respondents are ready to be fully engaged with e-learning in case the higher education diploma is guaranteed upon completion. In the meantime, 21 % of interviewees reported their negative attitude about distance learning and answered «no» in the questionnaire.

Table 1.
Student opinion about digitalization of all the disciplines studied

Question	Suggested answers	%
What would you think of digitalization of all the disciplines?	That would be great, I would be able to manage my time	30,8
	It would make my learning more complicated	27,2
	I don't like accomplishing tasks at the e-course at all	27,2
	It makes no difference to me	7,4
	Other	7,4

The survey analysis generally revealed that the students of «ecology and environmental management» training program consider blended learning to be more efficient education format when teacher combines traditional learning methods (classroom lectures and workshops) and e-course assignments like tasks and tests. It should be noted that the majority of students needs feedback from the teacher in the form of assessment and comments while accomplishing tasks. Consequently, the courses developed within the framework of the project are positively qualified by the students and they would contribute greatly to «green skills» acquisition in the field of ecology and environmental management.



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Erasmus+: Higher Education - International Capacity Building

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References

1. Andreev A.A. (2013) *E-learning and Distance Learning Technologies // Open education, №.5.p.40-46.*
2. Arbaugh J. B., Benbunan-Fich R. (2007) *The importance of participant interaction in online environments // Decision support systems, V.43.№.3, p.853-865.*
3. Burlaka S.D., Dvadenko M.V., Privalova N.M. (2018) *Use of the Moodle electronic-educational resource for improving the efficiency and quality of training in the higher educational institutions // Uchenye zapiski universiteta imeni P.F. Lesgafta, №.6(160).*
4. Huda, M., Maselena, A., Atmotiyoso, P., Siregar, M., Ahmad, R., Jasmi, K., & Muhamad, N. (2018). *Big data emerging technology: insights into innovative environment for online learning resources. //International Journal of Emerging Technologies in Learning (iJET), 13(1), 23-36.*
5. Ivanov S. V., Ivanov I. S., Tsukanov A. V., Zhabin S. N. (2017) *Distance methods of education quality control // Education process: search for effective forms and mechanisms, p. 253.*
6. Korneev D. N., Korneeva N. Yu. (2018) *Realization of distance learning technologies in professional education // Chief Editor: Krasnova N.A., Reviewer: Kanaeva Yu. O.*
7. Magomedova R.M. (2013) *Organizational Conditions of Formation of Professional Competences of the Teacher of Higher Education Institution in the Course of Postgraduate Training // Tomsk State Pedagogical University Bulletin, №.1(129).*
8. Marks R. B., Sibley S. D., Arbaugh J. B. (2005) *A structural equation model of predictors for effective online learning //Journal of management education, V.29. №.4, p.531-563.*

9. Peltier J. W., Schibrowsky J. A., Drago W. (2007) *The interdependence of the factors influencing the perceived quality of the online learning experience: A causal model* // *Journal of Marketing Education*, V.29. №.2, p.140-153.

10. Vaindorf-Sysoeva M.E., Shitova V.A. (2013) *About the models of e-learning technologies applied in contemporary higher educational institution*// *Pedagogics and Education Psychology*, №.4.

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地方大学汉语学习（以下诺夫哥罗德国立大学为例）

**THE STUDY OF CHINESE AT A REGIONAL UNIVERSITY (ON THE
EXAMPLE OF NIZHNY NOVGOROD STATE UNIVERSITY)**

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注解。文章考察和描述了下诺夫哥罗德罗巴切夫斯基国立大学（UNN）培养人文学科专家的主要阶段，揭示了学生对汉语学习兴趣的系统增长。作为研究的结果，作者得出的结论是，世界现状、古城对旅游业发展的定位、现代一代学生的价值观、UNN积累的经验扩大和完善地方高校汉语人才培养体系。作者认为，访谈学生的方法有助于快速识别学生对新变量和可选学科（例如中文）的兴趣，并在教育过程中使用获得的数据以改进兴趣。

关键词：俄罗斯东方学，学生语言训练，汉语。

Annotation. *The article examines and describes the main stages of training humanities specialists at the Lobachevsky State University of Nizhny Novgorod (UNN), a systematic growth of students' interest in the study of the Chinese language was revealed. As a result of the study, the authors come to the conclusion that the current situation in the world, the orientation of ancient cities towards the development of the tourism business, the values of the modern generation of students, the accumulated experience of UNN make it possible to expand and improve the system of training graduates with knowledge of the Chinese language in regional universities. The authors believe that the methodology of interviewing students contributes to the rapid identification of students' interests in new variable and optional disciplines (for example, to the Chinese language) and the use of the obtained data in the educational process in order to improve it.*

Keywords: *Russian oriental studies, linguistic training of students, Chinese language.*

Over the past decades, the pace of global integration has become much higher thanks to unprecedented advances in technology, communications, science, transport, and industry. An increasingly important role in this process is played by the People's Republic of China, which has managed to integrate a lot of the experience of Western civilization into the national culture and at the same time has retained the view of the world tested over the centuries, its system of principles and priorities [12]. In addition, there is no dialogue of cultures without a language of communication [9], and knowledge of the Chinese language - one of the most ancient living languages on the planet - opens up wide opportunities for immersion in the world of the mysterious and unique culture of the Far Eastern civilization, for opening new ways of mutual understanding and communication. Knowledge of the language is necessary for businessmen to be able to negotiate with partners directly without intermediaries, to understand them better, and to find mutually acceptable solutions faster. Secondly, more and more guests from the PRC come to our country, so qualified guides, tourism managers, tour guides are in demand. Foreign tourists visit many Russian cities with an ancient history, including Nizhny Novgorod. The reverse process is also gaining momentum. Residents of the Russian Federation are showing greater interest in the PRC, its history, culture, and language. Therefore, the question of the need to expand the system of linguistic training, especially in regional universities, remains controversial and is of great interest to both teachers and students. [2, 4].

The beginning of the purposeful process of training orientalists in Russia was laid by the decrees of Peter the Great of June 18, 1700 and April 16, 1702 [8, p. 42]. The first decree dealt with issues of caravan trade and missionary activities of the Orthodox clergy in Siberia and the Qing Empire [13], which was impossible without high-quality language training. Therefore, the consequence of this act was the appointment of Metropolitan Dmitry to Tobolsk, and in 1702 - Filofei Leshchinsky (in the monasticism of Theodore), who sent students from Tobolsk to Urga from Tobolsk to prepare the ground for missionary activity in Mongolia to study the basics of the Mongolian language [1, p. 115]. The second decree, the original of which has not survived, but its content is given in another later document, concerned the creation of a school for teaching the Japanese language [6, p. 4-5]. Thus, it was precisely with the study of the Far Eastern languages during the time of Peter the Great that the purposeful training of orientalists began in Russia.

During the XVIII-XIX centuries. members of the Russian Spiritual Orthodox Mission in Beijing made a huge contribution to the study of the Chinese and Manchu languages and to Russian Sinology. The teaching of the Chinese language in Russia is also associated with their names. The first department of the Chinese language and Chinese literature in the Russian Empire was established in 1837 at Kazan University. Subsequently, the Chinese language could be taught primarily

in the capital's universities. They also retained the privileges of teaching oriental languages in Soviet times. However, with the development of the Russian education system, the expansion of ties with the countries and peoples of Asia, such an opportunity in the twentieth century. received and regional universities, in particular the Lobachevsky State University of Nizhny Novgorod (UNN; until 1991 - Gorkovskiy).

Two stages can be distinguished in the history of training specialists who speak Chinese at UNN. First - 1990s - 2008

Until the 1990s. the language training of GSU students, who specialized in studying the problems of countries and Asia and Africa, was not carried out, which was explained both by the shortage of oriental specialists in the provincial city, and by the fact that the opportunities to get them were limited. The country needed school teachers: under the conditions of the Iron Curtain, there were enough Orientalists who were trained in the capital's universities. The memoirs of graduates contain interesting information that the head of the Department of General History, Doctor of Historical Sciences N.P. Sokolov did not very much welcome the students' enthusiasm for the history of Asian and African high-quality graduation work [7, c. 92].

Only in the 1990s, when the city of Gorky was opened, the restrictions on travel abroad were lifted, the Nizhny Novgorod students had opportunities for language internships, there was a qualitative breakthrough in the study of the Chinese language in the Nizhny Novgorod region..

One of the first to realize the importance of studying oriental languages in a regional university was O. Kolobov [10, p. 173], who strongly supported the opening of paid two-year Chinese language courses for students in 1988–1990, through which 69 people passed.

In the 1990s, O. Kolobov set the task of expanding the range of specialties and areas of training, involving deeper and more diverse linguistic training. Since 1995, at the Faculty of History, which became known as the Faculty of History, Social Sciences and International Relations, and then the Faculty of International Relations, the training of international specialists, political scientists, and somewhat later - regional studies began, whose educational programs included the Chinese language.

The beginning of the second modern stage in the history of training specialists with knowledge of oriental languages at UNN is associated with the opening in January 2008 of the Department of Oriental Languages and Cultural Linguistics. Despite the difficulties encountered in teaching the Chinese language [3, p. 90–91], UNN provides an in-depth course, its study for four years and allows you to ensure a decent level of language training for graduates, master the skills of speech activity in everyday, professional, socio-political, administrative, legal,

socio-cultural spheres of communication, learn the linguistic situation and peculiarities of linguistic processes in the studied region, master the skills of oral and written speech [14, p. 156]. Language training is supported by regional studies and a block of disciplines aimed at a deep and comprehensive study of the PRC.

Currently, opportunities for studying the Chinese language are provided to students in the bachelor's programs "International Relations", "Foreign Regional Studies" and the master's programs "Foreign Regional Studies" (master's program "Studies of Regions and Countries of Asia and Africa"). Students have the opportunity to test their knowledge during language internships, as the department actively cooperates with Beijing (PRC), Kainan and Tomkan (Taiwan) and other universities.

In recent years, Chinese has been in first place in popularity among the oriental languages studied at the university, ahead of Arabic, Korean, Turkish and Armenian. In the 2021-2022 academic year, 71 students or 23.5% of the total number of 2-4 year undergraduate students in the areas of International Relations and Foreign Regional Studies are studying Chinese as a second foreign language at UNN, and 6 or 12% of these undergraduates the same areas of training.

Thus, the Chinese language has firmly entered the curriculum of a number of training areas. However, our survey of students of 1-3 courses in the direction of training "History", whose curriculum includes only European languages, showed that the time has come for the introduction of the Chinese language into their curricula.

In order to find out the interest of modern youth in the study of oriental languages, we conducted a survey in which 94 people took part. Among the proposed options were European and Oriental languages. The leaders were English and Chinese.

Students associate the need for knowledge of the Chinese language (Figure 1) primarily with study and work. More than a third of the respondents spoke in favor of the need to raise their cultural level.

Для чего вы хотели бы изучить выбранные языки?

94 ответа

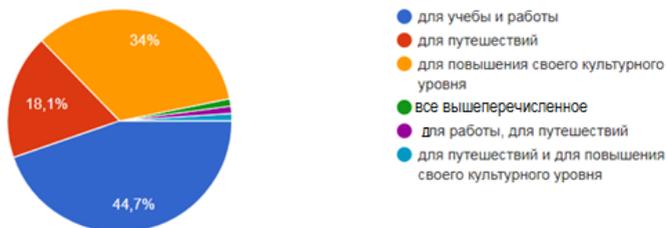


Figure 1.

Answers to the last question - "Where and how, in your opinion, should the teaching of oriental languages be organized?" - showed that the majority of students are not ready to study them at a serious level. The overwhelming majority supported the study of oriental languages at the university as an elective (Figure 2).

Где и как, на ваш взгляд, должно быть организовано обучение восточным языкам?

94 ответа

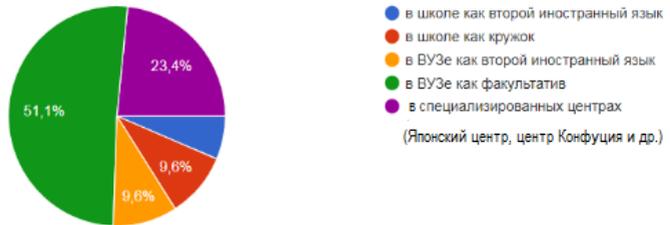


Figure 2.

The preferences of students in favor of such a form of education as an elective is associated both with the practical application of these languages, and with the common values of the modern generation of students. On the one hand, graduates of the humanitarian areas of universities are increasingly forced to work outside their specialty, therefore they do not see the need for deep mastering of a number of disciplines. On the other hand, one should not forget about the peculiarities of this generation of students: they are consumers of information culture [5], i.e. have the ability to quickly process visual rather than verbal information, are absent-minded and hyperactive, while their active vocabulary is often limited. Today's young people understand that the demand for specialists with knowledge of the Chinese language has increased these days, therefore they are showing an interest in learning it. However, they are aware of the peculiarities and complexities of Chinese phonetics, grammar, vocabulary, spelling, understand that Chinese is not at all similar to European languages [11], therefore they choose electives that allow them to get some idea of this language, to try their hand and abilities. open the mind.

Thus, the objective processes of social development and the peculiarities of the historical path of Russia require further expansion of the range of areas of training, educational programs of which would provide for the study of the Chinese language. This will allow graduates not only to become more erudite, to significantly expand the field of activity by attracting historical sources in the original languages, scientific literature, the development of communicative competencies, but also to become more in demand in the labor market.

References

1. *Andrievich V.K. Historical sketch of Siberia: in 6 volumes. Irkutsk, 1886. Vol. II.*
2. *Arefiev A.L. Chinese language in Russian higher education: history and modernity // Foreign languages in higher education. 2011. No. 1. P. 94-105.*
3. *Guruleva T.L., Makarov A.V. Higher language education in Russia: problems of training sinologists // Higher education in Russia. 2013. No. 8-9. P. 88–94.*
4. *Gusevskaya N.Yu. Problems of professional language training for the development of international cooperation // Uchenye zapiski ZabGU, 2015. No. 5 (64). P. 76–80.*
5. *Zvereva E.A. Features of media consumption "generation Y" and "generation Z" // Social and humanitarian knowledge. 2018. No. 8, pp. 205–216.*
6. *Ivanov P. Orders of Peter the Great on teaching the Japanese language in Russia // Bulletin of the Imperial Russian Geographical Society, 1853. Part 8. Depart. 8, pp. 4-5.*
7. *Faculty of History through the eyes of graduates and employees N. Novgorod, Nizhny Novgorod Humanitarian Center, 2004.*
8. *History of Russian Oriental Studies until the middle of the 19th century. M.: Science. Main edition of oriental literature, 1990.*
9. *Kabakhidze E.L., Mamedov N.M. Communicative barriers to globalization // Communicology. 2015. No. 4. P. 92–105.*
10. *Kolobov O.A. Fundamental historical science higher education in Russia. Selected Works. Arzamas / Nizhny Novgorod: RIOAGPI, IF NNSU, 2000.*
11. *Malaya A.G., Klochkova N.V., Korotysheva Yu.N., Voronyuk Yu.S., Li Zhong Min. New pedagogical conditions for teaching the Chinese language // Bulletin of Science and Education. 2017. Vol. 1. No. 7 (31). P. 59–65.*
12. *Mosyakov D.V. East in the modern global system // South-East Asia: topical development problems. Issue 26, 2015, pp. 11–17.*
13. *Decree of Tsar Peter I on the issues of caravan trade and missionary activities of the Orthodox clergy in Siberia and the Qing Empire. 1700. Access mode: http://www.vostlit.info/Texts/Dokumenty/China/XVIII/1700-1720/Russ_kit_otn_18_v_I/1-20/5.htm*
14. *Faculty of International Relations, NNSU named after N.I. Lobachevsky in 2008-2009 school. year. Curricula, curriculum of academic disciplines, reference materials. Issue 3. Nizhny Novgorod: UNN, 2008.*

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具有抗寄生虫作用的消毒剂
DISINFECTANTS WITH ANTIPARASITIC EFFECT

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抽象的。介绍了基于阳离子表面活性剂（CS）、氧活性化合物和卤素的消毒剂消毒特性研究的文献来源分析和自己的研究。已经确定，它们的最大消毒活性是由碘配合物所具有。过氧化氢对蛔虫卵等抗性寄生物体无活性。还确定，作为研究药物抗寄生虫特性的结果，对于每组消毒剂，确定了消毒效果最显著的消毒剂。在基于CS的药物中，这些是“B-des”和“Brovadez-plus”，氧活性药物 - “二氧化氯”，氯活性药物 - “Glavchlor Extra”和“DP-2T”，以及碘 - 活性药物 - “聚维酮碘”和“Pharmadez”。

关键词：消毒剂，阳离子表面活性剂，含氧化合物，卤素，土蠕虫病，杀卵作用。

Abstract. *An analysis of literature sources and own research devoted to the study of disinfection properties of disinfectants based on cationic surfactants (CS), oxygen-active compounds, and halogens is presented. It has been established that the greatest disinfection activity of them is possessed by iodine complex compounds. Hydrogen peroxide is inactive against such resistant parasitic objects as ascarid eggs.*

It was also established that, as a result of studying the antiparasitic properties of drugs, for each group of disinfectants, disinfectants with the most pronounced disinfection effect were determined. Of the drugs based on CS, these are "B-des" and "Brovadez-plus", of oxygen-active drugs - "Chlorine Dioxide", of chloractive drugs - "Glavchlor Extra" and "DP-2T", and of iodine-active drugs - "Povidone-iodine" and "Pharmadez".

Keywords: *disinfectants, cationic surfactants, oxygenated compounds, halogens, geohelminthiasis, ovicidal effect.*

Parasitic diseases are widespread in the world. According to the WHO, every fourth inhabitant of the Earth is a carrier of this or that parasite. Intestinal helminthiasis are considered to be the most dangerous diseases, it is believed that they occupy the 4th place in damage to human health, in comparison with other pathologies. More than 2 billion people in the world are affected by geohelminthiasis [1-3].

According to various sources, on the territory of Russia and the countries of the Near Abroad, from 60 to 70 species of helminths have been found, of which about 20-30 species are most common. In the country, 2 million patients are detected annually, however, taking into account the correction factors, the true number of them may exceed 20 million [4, 5]. Of helminthiasis, in terms of the frequency of registration among the population of Russia, enterobiasis is in the first place, and 90-95% of the patients are children. Significant circulation of the causative agent of this disease occurs in preschool, school and health care institutions. The second place is occupied by ascariasis [6-8]. The problem of toxocariasis deserves serious attention, especially in megacities. The spread of this disease is associated with an increase in the number of dogs in cities and non-observance of the rules for keeping them in the absence of measures for excrement disinfection [6-10].

The constant detection of parasitic pathogens in the environment indicates the insufficient effectiveness of disinfection measures [6, 11, 12]. In the complex of measures for disinfestation of objects of the external environment, the use of chemical agents plays an important role. However, today the range of such products is very small. Of the huge variety of disinfectants known today, only a small part is suitable for disinfestation. In addition, not all of them have such properties as a wide spectrum of action, ease of preparation, reliability of the disinfecting effect. Therefore, the search and development of new drugs with a strong antiparasitic effect remains a very important direction in the protection of the environment from contamination with invasive material and the prevention of parasitic diseases [13-17].

According to literary sources and our own research, a comparison was made of the antiparasitic activity of 28 disinfectants.

The purpose of the work is to study the physicochemical, antimicrobial, antiparasitic and disinfecting properties of various disinfecting compositions from literary sources.

1 Antiparasitic activity of disinfectants based on cationic surfactants (CS)

The most important representatives of CS are quaternary ammonium compounds (QAC), guanidine derivatives and tertiary amines. Table 1 shows the

ovicidal efficacy of 6 disinfectants based on these compounds against the eggs of 8 types of helminths. Of these, 7 are representatives of the Roundworm type, suborders Ascaridata (*Neoascaris vitulorum*, *Ascaris suum*, *Parascaris equorum*, *Ascaridia galli*, *Toxocara canis*, *Toxocara cati*) and Strongylata (family Trichostrongylidae, *Nematodirus* sp.), and 1 – is a representative of the Flatworm type, class Cestodes (*Taenia* sp.). Analyzing the indicators of ovicidal action, we can say that preparations based on QAC are not very active against ascarid eggs. They show a pronounced effect in concentrations of at least 10% with prolonged exposure of 12-24 hours [2, 3]. The drug "GABO" showed in our experiment a strong effect (ovicidal efficiency 100%) with a shorter exposure of 4 hours, but in a high concentration of 25%. On the example of the action of the drug "Aminocid" there is a noticeable difference in the sensitivity of the test objects to the action of disinfectants. This preparation, with an exposure time of 12-24 hours, was effective against *Trichonema* sp. (family Trichonematidae, suborder Strongylata) at a concentration of 5-10%, caused the death of eggs of *Toxocara cati* at a concentration of 10% and had no effect on the eggs of *Taenia* sp. (class Cestoda) [4].

Table 1.
Antiparasitic activity of CS-based disinfectants

Drug, composition of the drug	Test-object	Exposure time	Drug concentration	Disinfection efficiency	Source of information
Samarovka: Alkyldimethylbenzylammonium chloride; Alkyldimethylethylbenzylammonium chloride	<i>Neoascaris vitulorum</i> , <i>Ascaris suum</i> , <i>Parascaris equorum</i> , <i>Ascaridia galli</i>	24 hours	10 %	60-80 %	2
Ecosan: Alkyldimethylbenzylammonium chloride; Alkyldimethylethylbenzylammonium chloride	<i>Toxocara canis</i>	24 hours	10 %	60 %	3
Encke Mod: Quaternary ammonium compounds, own research	<i>Ascaris suum</i>	4 hours	25 %	100 %	OR
		24 hours	12 %	90 %	
Septa: Alkyldimethylbenzylammonium chloride; Didecyldimethyl ammonium chloride	<i>Ascaris suum</i>	4 hours	100 %	11 %	OR
		24 hours	100 %	99 %	

Aminocide: Alkyldimethylbenzylammonium chloride; N, N-bis (3aminopril) dodecylamine; Didecyldimethyl ammonium chloride	Trichonema sp.	12-24 hours	5-10 %	100 %	4
	Toxocara cati	12-24 hours	10 %	100 %	
	Taenia sp.	12-24 hours	10 %	Absent	
Brovadez: Dimethyldialkyl ammonium chloride; Didecyldimethyl ammonium chloride; EDTA	Ascaris suum	1 hour	1,5 %	92 %	6
	Trichuris suis	1 hour	1,5 %	78 %	
Bi-des: Dodecyldipropylene triamine; Polyhexamethylene guanidine (PGMG-x); Cocoamidopropyl Betaine (surfactant); Glutamic acid	Toxocara canis	1 hour	0,3 %	61 %	5
			1 %	95 %	
	Ascaris suum	1 hour	1 %	98 %	6
	Trichuris suis	1 hour	1 %	79 %	

These data indicate a relatively higher chemical sensitivity of *Trichonema* eggs compared to *Toxocara* eggs and a higher resistance of cestode eggs compared to these species. Of all the considered CS-based disinfectants, the "B-des" and "Brovadez-plus" preparations showed the highest ovicidal activity. The composition of the preparation "Bi-des" includes such representatives of CS as triamine and a guanidine derivative as the main components. In relation to eggs of a fairly stable species *Toxocara canis*, this drug showed a pronounced effect at a concentration of 0.3% at exposure time

1 hour [5]. It is interesting to compare the effect of the drug "Bi-des" in the same experimental conditions (1%; 1 hour) on the eggs of 3 species of nematodes. The effect of the drug on ascaridate eggs (*Ascaris suum* and *Toxocara canis* is approximately the same (the death of eggs is 98% and 95%, respectively), and the eggs of the whipworm (*Trichuris suis*) were more resistant (79%) [5, 6]. "Brovadez-plus" in addition to two representatives [2, 3] QAC includes EDTA, a representative of chelating agents that form strong intracomplex compounds (chelates) with metal ions. At a concentration of 1% with an exposure time of 1 hour, its ovicidal efficacy against *Ascaris suum* and *Trichuris suis* eggs was 85% and 77%, respectively [6].

2 Antiparasitic activity of disinfectants based on oxygen-active compounds

Table 2 shows data on the effect on helminth eggs of such oxygen-active compounds as hydrogen peroxide, potassium permanganate, chlorine dioxide, as well as three disinfectants based on hydrogen peroxide and other peroxide compounds.

Table 2.
Antiparasitic activity of disinfectants based on oxygen-active compounds

Drug, composition of the drug	Test-object	Exposure time	Drug concentration	Disinfection efficiency	Source of information
Hydrogen peroxide	Toxocara canis	60 minutes	30 %	Absent	3
		20 days	6 %	Absent	7
	Ascaris suum	4 hours	33 %	Absent	OR
		24 hours	33 %	73 %	
Peroxam Ultra: Hydrogen peroxide	Ascaris suum	24 hours	100 %	100 %	OR
			50 %	11 %	
Desolex: Hydrogen peroxide	Ascaris suum	24 hours	100 %	100 %	OR
			50 %	35 %	
Manganese-sour potassium	Toxocara canis	1 hour	30 %	Absent	3
Virkon: Potassium peroxomonosulfate; Surfactant; organic acids)	Trichonema sp.	12-24 hours	5-10 %	100%	4
	Toxocara cati	12-24 hours	10 %	100%	
	Taenia sp.	12-24 hours	10 %	Absent	
Chlorine dioxide	Ascaris suum	4 hours	0,25 %	90 %	OR
		24 hours	0,06 %	100 %	

First of all, it should be noted the low efficiency of hydrogen peroxide against helminth eggs. At a concentration of 6%, usually destructive for microbiological objects, peroxide did not affect the development of eggs of *Toxocara canis* at all. On the 9th day, larvae formed in them, which did not lose their viability until the end of the experiment for 20 days [7]. Even in a concentrated state (30%), hydrogen peroxide does not act on eggs of *Toxocara canis* at an exposure time of 1 hour [3]. In our experiments, hydrogen peroxide at a concentration of 33% did not have a detrimental effect on the eggs of *Ascaris suum* at an exposure time of 4 hours and showed a pronounced effect on the eggs of this object only after an exposure of 24 hours (73%). Preparations based on hydrogen peroxide "Peroxam Ultra" and "Dezolex" in undiluted form with an exposure time of 24 hours had a strong ovicidal effect on *Ascaris suum* eggs (OE 100%), but after dilution by 2 times their effect became weak (OE 11-35 %). The preparation "Virkon" with an exposure time of 12-24 hours was effective against eggs of *Trichonema sp.* at a concentration of 5-10%, against eggs of *Toxocara cati* - at a concentration

of 10% and is ineffective against eggs of *Taenia* sp. at this concentration [4]. Potassium permanganate at a concentration of 40% after 1-hour exposure did not affect the further development of *Toxocara canis* eggs [3]. Chlorine dioxide has the strongest ovicidal effect of the considered oxygen-active compounds. In our experiments, it was active against *Ascaris suum* eggs at a concentration of 0.25% at an exposure time of 4 hours (90%) and caused the death of 100% of the eggs at a concentration of 0.06% at an exposure time of 24 hours.

3 Antiparasitic activity of disinfectants based on chloroactive compounds

Table 3 shows the data on the ovicidal activity of chloroactive disinfectants made on the basis of sodium hypochlorite, trichloroisocyanuric acid (TCA) and sodium salt of DCCA. According to the available literature data, *Toxocara canis* eggs died from the action of a hypochlorite solution with an active chlorine (ACh) content of 9-16% within 30 minutes [3]. At the same time, when testing commercial drugs such as "Comet" gel ("Double effect"), "Bleach" and "Domestos", it took much longer to achieve a similar effect - from 15 to 48 hours [8]. Of all the considered disinfectants based on sodium hypochlorite, the most active drug is "Glavkhlor Extra". As our studies have shown, from its action at a concentration of 0.45% (hereinafter, the concentration is given as active chlorine (ACh), complete elimination of *Ascaris suum* eggs occurred within 2 hours. Comparison of the ovicidal effect of sodium hypochlorite disinfectants suggests that it is not directly related to the ACh level in the preparations. The same conclusion can be reached by comparing the effectiveness of drugs based on isocyanuric acids and their derivatives. The ovicidal effect of disinfectants varies widely, although the reported ACh levels are approximately the same. Thus, our studies of the ovicidal activity of 4 preparations based on the sodium salt of DCCA showed the following. There is no activity of "Aster" (43% ACh content) tested at a concentration of 3% with an exposure time of 4 days against *Ascaris suum* eggs. In relation to the same object, the effectiveness of the drug "Pharmachlor" (ACh content 41%) at a concentration of 8% with an exposure time of 1 day was only 17%. The ovicidal efficacy of "Nika Chlor" (ACh content 45.5%) and "Nika Chlor Lux" (ACh content 42%) against *Toxocara canis* eggs tested at a concentration of 10% at an exposure time of 1 day was quite high and amounted to respectively, 92% and 85%. According to literary sources, the preparation "Javel Absolute" (sodium salt of TCA, content of ACh 43%) in 12-24 hours caused destruction and death of eggs of nematodes of the genus *Trichonema* at a concentration of 5-10%, as well as eggs of *Toxocara canis* and *Taenia* sp. - at a concentration of 10% [4]. The drug "DP-2T" based on TCA (32% ACh) is very active against the eggs of parasitic nematodes. It causes death of *Toxocara canis* eggs at a concentration of 5% (according to the preparation) with an exposure time of 24 hours [9], and *Nematodirus* sp. - at a concentration of 0.06% in 30 minutes [10].

Table 3

Antiparasitic activity of disinfectants based on chloroactive compounds

Drug, composition of the drug	Test-object	Exposure time	Drug concentration	Disinfection efficiency	Source of information
Sodium hypochlorite	Toxocara canis	30 minutes	9-16 % by ACh	100 %	3
Bleach: Sodium hypochlorite; Sodium hydroxide; Surfactant	Toxocara canis invasive eggs	48 hours	4,8-14,3 % by ACh	100 %	8
	Gel "Comet Double Effect": Chlorinol; Formic acid; Phosphoric acid	15-24 hours	100 % by drug	100 %	
	Domestos: Sodium hypochlorite; Surfactant	48 hours	4,8 % by ACh	100 %	
Glavklor Extra: Sodium hypochlorite	Ascaris suum	1 hour	0,45 % by ACh	95 %	OR
		2 hours	0,45 % by ACh	100 %	
Astera: Dichloroisocyanuric acid sodium salt	Ascaris suum	4 days	3 % by ACh	Absent	OR
Farmahlor: Dichloroisocyanuric acid sodium salt	Ascaris suum	24 hours	8 % by ACh	16 %	OR
Nika Chlor: Dichloroisocyanuric acid sodium salt	Toxocara canis	23 hours	10 % by ACh	91 %	OR
Nika Chlor Lux: Dichloroisocyanuric acid sodium salt; Surfactant	Toxocara canis	23 hours	10 % by ACh	87 %	OR
Javel Absolute: Dichloroisocyanuric acid sodium salt	Trichonema sp.	12-24 hours	2- 4,3 % by ACh	100 %	4
	Toxocara cati	12-24 hours	4,3 % by ACh	100 %	
	Taenia sp.	12-24 hours	4,3 % on ACh	100 %	
DP- 2T: Trichloroisocyanuric acid; Surfactant (sulfonol)	Nemato-dirus sp.	30 minutes	0,06 % by ACh	100 %	10

4 Antiparasitic activity of disinfectants based on iodine active compounds

The antiparasitic activity data shown in Table 4 indicate the high efficacy of iodine-based preparations. So the preparations "Cystodesis" and "Paradesil" containing crystalline iodine, at a concentration of 3-4%, destroy 94-100% of Buxtonella sulcata cysts within 2 hours. The drug "Paradizel" also works in relation to oocysts of Eimeria sp., And in relation to eggs of Ascaris suum, the same level of its effectiveness is achieved after exposure for 24 hours [11, 12]. The disinfection activity of disinfectants based on iodine complex compounds is even higher. The preparations "Pharmayod and" S-280 "at concentrations of 1-5% (by drug) cause the death of 100% of the eggs of such a stable object as Ascaris suum within 1-3 hours [13]. The drug "Pharmades", which includes pharmaco, is highly effective against all pathogens of parasitic diseases and is recommended as the main disinfectant for disinfecting contaminated objects [14]. In our experiments, "Pharmadez" caused the death of 100% of pork roundworm eggs at a concentration of 0.03% for active iodine (hereinafter I) within 2 hours, and within 24 hours - at a concentration of 0.002%. The drug "Povidone-iodine" was even more active. Its ovicidal efficiency at a concentration of 0.005% according to AI with an exposure time of 2 hours was 64%, and at a concentration of 0.0006% with an exposure time of 24 hours - 100%.

*Table 4.
Antiparasitic activity of disinfectants based on iodine active compounds*

Drug, composition of the drug	Test-object	Exposure time	Drug concentration	Disinfection efficiency	Source of information
Cystodesis: Crystalline iodine; Glutaraldehyde; Ethanol%; Potassium iodide; PEG-400	Buxtonella sulcata	2 hours	3 % by drug	98 %	11
			4 % by drug	100 %	
Paradesil: Crystalline iodine; Potassium iodide; Glutaraldehyde; PEG-400; Ethanol	Ascaris suum	24 hours	3 % by drug	94 %	12
			4 % by drug	100 %	
	Buxtonella sulcata	2 hours	3 % by drug	94 %	
	Eimeria sp.	2 hours	3 % by drug	93 %	
Pharmayod: Iodophor	Ascaris suum	3 hours	1 % by drug	100 %	13
S-280: Iodophor	Ascaris suum	1 hour	5 % by drug	100 %	13

Pharmades: Pharmayod; Sodium lauryl sulfate; Syntanol;	Ascaris suum	1 hour	0,03% by DV (5% for the drug)	100%	14
		2 hours	0,03% by DV	100%	OR
			0,008% by DV	96%	
		4 hours	0,002% by DV	73%	
	24 hours	0,002% by DV	100%		
Povidone iodine: Povidone iodine; Glyc- erol; Nonoxynol; citric acid, etc.	Ascaris suum	2 hours	0,0005- 0,005% by DV	64%	OR
		24 hours	0,0006% by DV	100%	

Conclusion

From literary sources, the disinfection properties of disinfectants based on CS, oxygen-active compounds, and halogens have been established. Complex compounds of iodine have the greatest disinfection activity of them. As a result of studying the antiparasitic properties of drugs, for each group of disinfectants, disinfectants with the most pronounced disinfection effect were determined. Of the drugs based on CS, such are "B-des" and "Brovadez-plus", of oxygen-active drugs – "Chlorine Dioxide", of chlorine-active drugs – "Glavchlor Extra" and "DP-2T", and of iodine-active drugs – "Povidone-iodine" and "Pharmades", from drugs that include aldehydes - "Cystodes-ultra", "DZPT-1" and "DZPT-2".

References

1. MUK 4.2.2661-10. *Methods of sanitary and parasitological research: approved by the Chief State Doctor of the Russian Federation on July 23, 2010: introduced instead of MUK 4.2.796-99*
2. Dolbin, D.A. *Analysis of the effectiveness of the use of modern means for disinvasion / D.A. Dolbin, R.Z. Khairullin // Bulletin of the Kazan Technological University. – 2015. – V.18, №1 6. – P. 314-315.*
3. Masalkova, Yu.Yu. *Disinfection activity of chemicals and drugs in relation to eggs Toxocara canis // Veterinary medicine. – 2016. – № 3. – P. 30-33.*

4. Neprimerova, T.A. Ovocidal and larvocidal properties of some disinfectants / T.A. Neprimerova, T.N. Sivkova // *Materials of reports of the international scientific conference "Theory and practice of combating parasitic diseases"*. – Moscow, 2012. – Iss. 13. – P. 277-280.

5. Stibel, V.V. Influence of the disinfectant "Bi-des" on the embryogenesis of *Toxocara canis* / V.V. Stibel, O.B. Priyma, N.N. Danko, O.A. Svarchevsky // *Scientific Bulletin of LNUVMB im. S.Z. Gzhitsky*. – 2016. – V. 18, № 1 (65), part 1. – P. 177-181.

6. Yuskiv, I. D. The effectiveness of using various test cultures of helminth eggs to establish the disinvasive properties of chemical agents // *Bulletin of the Poltava State Agrarian Academy*. – 2015. – № 4.

7. Pautova, E.F. Effect of disinfectants on *Toxocara canis* eggs (results of experimental studies) / E.F. Pautova, A.S. Dovgalev, L. D. Shchuchinova, L.V. Alyautdin // *Med. parasitol.* – 2013. – № 4. – P. 27-29.

8. Shchuchinova, L. D. Effect of household chemicals on the invasive eggs of *Toxocara canis* / L.D. Shchuchinova, E.A. Pautova, A.S. Dovgalev // *Med. parasitol.* – 2013. – № 4. – P. 30-32.

9. Pautova E.A. Epizootological, epidemic and ecological aspects of toxocarosis in the Altai Republic: specialty 03.02.11 "Parasitology": dissertation for the degree of candidate of biological sciences / Elena Anatolyevna Pautova; Gorno-Altai State University. – Gorno-Altaysk, 2016. – 179 P.

10. Lutfullin, M.Kh. Ovocidal effect of chemotherapy on eggs of nematodes of the Strongylata suborder / M.Kh. Lutfullin, N.A. Lutfullin, D.A. Dolbin // *Scientific Notes of the N.E. Bauman Kazan State Academy of Veterinary Medicine*. – 2015. – V. 224, № 4. – P. 122-125.

11. Safiullin, R.T. Disinfection of environmental objects against cysts of parasitic protozoa (*Buxtonella sulcata*) of cattle / R.T. Safiullin, S.K. Shibitov // *Russian parasitological journal*. – 2019. – V. 13, Iss. 1. – P. 64-74.

12. Patent № 2727519 Russian Federation, IPC A61L 2/18, A01N 25/02, A01N 59/12, A61L 101/06, A61L 101/36. Means for disinfection of objects of the external environment: № 2020107067: apl. 16.02.2020: pub. 22.07.2020 / Shibitov S.K.; patentee of Scientific Center for Veterinary Parasitology and Therapy LLC.

13. Novikov, N.L. Development of means and methods for disinfecting livestock buildings from pathogens of invasive and infectious diseases: specialty 03.00.19 "Parasitology": dissertation for the degree of candidate of veterinary sciences / Novikov Nikolai Leonidovich; All-Russian Scientific Research Institute of Helminthology named after K.I. Scriabin. – Moscow, 2004. – 145 P.

14. SP 1.3.2322-08. Sanitary and Epidemiological Rules. Safety of work with microorganisms of III-IV groups of pathogenicity (danger) and pathogens of parasitic diseases. approved and put into effect from May 1, 2008 by the Decree of the Chief State Doctor of the Russian Federation of January 28, 2008 № 4.

15. Patent № 2748168 Russian Federation, IPCA01N 25/02, A01N 33/04, A01N 35/02. Means for disinfection of objects of the external environment: № 2020129699: apl. 09.09.2020: pub. 20.05.2021 / Safiullin R.T., Arisov M.V., Shubitov S.K.; patentee FSBSI FSC AIEV RAS.

16. Dakhno, I.S. Screening of preparations for disinfection of environmental objects / I.S. Dakhno, Yu.V. Negreba, G.F. Dakhno // Materials of reports of the international scientific conference "Theory and practice of combating parasitic diseases". – Moscow, 2010. – Iss. 11. – P. 144-147.

17. Dolbin, D.A. Resistance of helminth eggs to unfavorable physical, chemical and biological factors of the environment (literature review) / D.A. Dolbin, R.Z. Khairullin // Russian Journal of Parasitology. – 2017. – V. 39, Iss. 1. – P. 14-19.

人工晶状体植入术后免疫反应特点
**CHARACTERISTICS OF IMMUNE RESPONSE AFTER
INTRAOCULAR LENS IMPLANTATION**

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抽象的。目的: 研究一些实验室标志物(抗DNA抗体、细胞粘附分子、新蝶呤)对人工晶状体手术后渗出性炎症患者的预后价值。材料与方法: 21例术后虹膜睫状体炎和眼内炎住院患者。测定进行两次: 入院后和出院前。随访时间为6个月。结果。初步数据显示, 高血清水平的 sVCAM、sICAM 和抗 DNA 抗体以及极低水平的抗 DNA 抗体似乎与这些患者的不良预后有关(摘除术、失明、晶状体摘除术)。结论。小队列不允许我们对这些实验室标志物的预后价值做出严格的结论。应该继续研究。

关键词: 人工晶状体, 眼内炎, 粘附分子, 抗DNA抗体, 新蝶呤

Abstract. *Aim: To study prognostic value of some laboratory markers (anti-DNA antibodies, cell adhesive molecules, neopterin) in patients with exudative inflammation after intraocular lens surgery. Materials and methods: 21 in-patients with postoperative iridocyclitis and endophthalmitis were included. The assays were taken twice: after admission and before discharging. The follow-up period was 6 months. Results. Preliminary data show that high serum levels of sVCAM, sICAM and anti-DNA antibodies, as well as very low levels of anti-DNA antibodies seems to be associated with poor outcomes in those patients (enucleation, blindness, lens extraction). Conclusion. Small cohort doesn't allow us to make strict conclusion about prognostic value of these laboratory markers. The study should be continued.*

Keywords: *intraocular lens, endophthalmitis, adhesion molecules, anti-DNA antibodies, neopterin*

According to the WHO, there are 45 million blind and 135 million visually impaired in the world, while 20 million have blindness due to clouding of the lens. In the structure of eye diseases, the proportion of cataracts is 42%, and the overwhelming majority of cases (about 90%) are age-related (senile, senile) cat-

aracts in persons over 60 years of age. As life expectancy in developed countries increases, the number of patients with cataracts is steadily increasing. Despite the introduction of minimally invasive surgical technologies, the use of modern biocompatible materials and drugs, the problem of exudative-inflammatory reactions (EVR) of the eye that occur after the implantation of intraocular lenses (IOLs) is still relevant. Their frequency ranges from 3.1% to 13%[1]. There are infectious EVR, which are caused by different microorganisms, and non-infectious, caused by the reaction of tissues to the surgical trauma itself, IOLs or consumables. The timing of the development of EVR ranges from several days to a month or more after the operation. The most severe manifestation is endophthalmitis, which can result in the removal of the eye [3]. It is rather difficult to predict the course and outcome of EVR, therefore, the search for laboratory markers that allow this to be done seems to be quite relevant. Potential candidates include various markers of inflammation, as well as autoantibodies [2,4,5].

The aim of this study was to identify laboratory markers characteristic of various variants of EVR in pseudophakia.

Material and methods

The study included 21 patients (9 men and 12 women) aged 17 to 69 years with EVR, which developed after phacoemulsification followed by IOL implantation. Laboratory studies were performed upon admission to the hospital and before discharge and included bacterial cultures from the conjunctival cavities of both eyes, determination of the level of neopterin, antibodies to double-stranded DNA (antibodies to nDNA), soluble adhesion molecules (sICAM-1, sVCAM-1). Subsequently, the patients were followed up for 6 months. We used test systems from IBL (Austria), Orgentec (Germany), Bender MedSystems (Austria)

Results

EVR occurred in all patients at different times after surgery (from 2 to 14 days). According to the severity of EVR, the distribution was as follows: II degree - 8 patients (38.1%), III degree - 11 patients (52.3%), IV degree - 3 patients (14.3%).

Visiometric examination revealed that visual acuity before treatment was reduced and, on average, was 0.09 ± 0.03 .

The absence of microbial growth in both the patient and the healthy eye was noted with approximately the same frequency (16.7 and 20%, respectively). In the overwhelming majority of cases, the microflora was represented by coagulase-negative staphylococci (*S. haemolyticus*, *S. epidermidis*, *Staph. Spp.*). There were isolated cases of isolation of *S. aureus* and *Enterobacter*. Group D streptococci were inoculated from a healthy eye in 2 patients. It should be noted that the growth of microorganisms in samples from the operated eye in all cases was presented in monoculture, in samples from a healthy eye, monoculture was inoculated

in 77.8%, and in 13.2% - in two-component associations.

All patients had IgG to HSV, EBV, CMV, 2 - IgG to Varicella zoster, their level did not change over time.

When determining the content of antibodies to nDNA, sICAM, sVCAM, neopterin, there was no correlation with the age of patients, significant individual fluctuations were noted

The baseline level of anti-nDNA antibodies was increased in 12 (57.1%) patients, neopterin - in 9 (42.8%), sICAM-1 - in 3 (14.3%), sVCAM-1 - in 5 (23, eight%). No reliable correlations with the timing of the development of EVR and its severity were obtained. There were large individual fluctuations in indicators.

In the study of these indicators in dynamics, it was found that the normalization of the content of antibodies to nDNA occurred in 6 patients, in another 5 it significantly decreased compared to the initial level. At the same time, in 1 patient with severe postoperative endophthalmitis, this indicator increased even more, which can be explained by the intensification of apoptosis processes.

Normalization of the level of neopterin occurred in 6 patients, in 2 it remained elevated. At the same time, in 1 patient, this indicator before discharge from the hospital significantly increased compared to the initial normal value, although the course of the disease was favorable and no complications or relapses were noted in the future.

Observation of the patients showed the following. One patient with endophthalmitis had the most unfavorable outcome - removal of the eye. At the same time, he also had the highest baseline level of sVCAM-1 (3472 ng / ml) and a high level of neopterin (20.6 nmol / L), both of which increased rapidly. The second patient with endophthalmitis had an initially high level of anti-nDNA antibodies; before discharge, it increased almost 5 times, but the rest of the indicators practically did not exceed normal values. The course of the disease was protracted, but in the end, the outcome was favorable. Finally, on admission, the third patient had rather high levels of anti-nDNA antibodies (93.5 U / ml) and neopterin (27.7 ng / ml), but by the end of treatment they had normalized, which coincided with positive clinical dynamics. In the future, no relapses were noted.

Vision loss as an outcome of acute uveitis was associated with high levels of sICAM-1 (610 ng / ml), moderate increases in neopterin and anti-nDNA antibodies upon admission. At the same time, a moderate increase in the level of sVCAM-1 was noted in the dynamics. Also noteworthy is the case when a patient with acute uveitis, normal and favorable course of the postoperative period after 1.5 months. severe endophthalmitis developed, requiring repeated hospitalization and long-term conservative therapy.

Conclusion

Thus, anti-nDNA antibodies, sICAM-1, sVCAM-1, and neopterin are promising laboratory markers for predicting the course of EVR that arise after IOL implantation. High baseline sVCAM-1 and neopterin levels and their rise during treatment may be predictive markers of poor outcomes. With a sluggish exudative-inflammatory reaction, a very low content of antibodies to nDNA is noted (<4 U / ml). At the same time, due to the small number of observations, it is not possible to make an unambiguous conclusion about the predictive value of the studied indicators.

References

1. Belousova N.Ju. *Exudative-inflammatory reaction of the eye in cataract surgery: a modern view of the problem. Modern technology in medicine. 2011, 3, 134-141.*
2. Krichevskaya G.I., Likhvantseva V.I., Angelov V.O. *The value of autoimmune reactions in the development of postoperative uveitis in patients with artifakia. Bulletin of Ophthalmology. 1996, 5, 27-29.*
3. Arijeet D. *Endophthalmitis after cataract surgery. Ophthalmology. 2010, 117(4), 853-859.*
4. Kooij B., Rothava A., Rijkers G., deGroot Mijness J.D. *Distinct cytokine and chemokine profiles in the aqueous of patients with uveitis and cystoid macular edema. AM. J. Ophthalmol. 2006, 142(1), 192-194.*
5. Lawson C., Wolf S. *ICAM-1 signaling in endothelial cells. Pharmacol. Rep. 2009, 61, 22-32.*

急性重型颅脑外伤合并收缩压对儿童昼夜节律的影响
**EFFECT OF SYSTOLIC BLOOD PRESSURE IN ACUTE SEVERE
CONCOMITANT TRAUMATIC BRAIN INJURY ON CIRCADIAN
RHYTHM IN CHILDREN**

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抽象的。第一天,第三组儿童的 SBP 昼夜节律中枢比第一组高 13 mmHg,第二组高 - 9 mmHg。患者病情的严重程度主要由脑损伤的严重程度决定。在意识障碍 10 ± 0.4 分的情况下,根据PTS的创伤严重程度为 4 ± 0.2 分,机械通气时间最长为 2 ± 0.9 天,ICU治疗时间最长为 7.7 ± 1.7 天。CTBI 导致的病情严重程度表现为在前 9 天出现动脉高血压的趋势,这是由于高动力型血液循环的代偿性质,旨在恢复受损的原发性和继发性脑损伤的氧合。

关键词: 昼夜节律, 收缩压, 严重伴随的创伤性脑损伤, 儿童。

Abstract. *On the first day, the SBP circadian rhythm mesors in children of the 3rd group turned out to be higher than in the first one by 13 mmHg and in the second by - 9 mmHg. The severity of the patients' condition was mainly determined by the severity of the brain injury. In case of impaired consciousness 10 ± 0.4 points, the severity of trauma according to PTS 4 ± 0.2 points, the duration of mechanical ventilation was up to 2 ± 0.9 days and the duration of treatment in the ICU was up to 7.7 ± 1.7 days. The severity of the condition caused by CTBI was expressed in a tendency to arterial hypertension in the first 9 days, which was due to the compensatory nature of the hyperdynamic type of blood circulation, aimed at restoring oxygenation of the damaged primary and secondary brain damage.*

Keywords: *circadian rhythm, systolic pressure, severe concomitant traumatic brain injury, children.*

Relevance

The combination of TBI with damage to other organs and systems exacerbates the severity of brain damage. On the one hand, this is due to the inadequacy of systemic compensatory reactions in the shock period, and on the other hand, to direct or indirect damage to various organs or systems. Intensive therapy aimed

at compensating for multisystem disorders may conflict with the regularities of the course of sanogenic and reparative processes in the CNS. According to many authors, a moderate increase in mean arterial pressure should be maintained in patients with acute brain injury. The use of controlled hyperdynamia in TBI is widely practiced but remains controversial.

Lack of information on the topic prompted us to study one of the priority tasks of intensive care (severe concomitant traumatic brain injury) of SCTBI in the acute period.

Purpose of the work

To study and assess the circadian rhythm of systolic blood pressure in the acute period of severe concomitant traumatic brain injury in children over 7 years old

Material and research methods

We studied the indicators of a comprehensive examination of 18 school-age patients (7-18 years old) with severe concomitant traumatic brain injury (SCTBI) admitted to the intensive care unit (ICU) of the neurosurgical department of the Republican Scientific Center for Emergency Medical Aid (RSCEMA) in the first hours after road traffic accident (RTA) - 15, catatrauma - 3 patients. Continuous hourly monitoring of systolic blood pressure (SBP), as well as other hemodynamic parameters was performed within 30 days after CSTBI. According to the indications, the patients were started on admission to the invasive mechanical respiratory support (MRS). Mechanical respiratory support was started in mechanical ventilation (CMV) mode for an extended period of time, followed by transfer to SIMV. The severity of the condition was assessed using scoring methods for assessing the severity of concomitant injuries - the PTS (PediatricTraumaScore) scale (Tepas J.J. et al. 1985), the assessment of the severity of injuries on the ISS scale, the severity of acute cerebral failure according to the Glasgow coma scale. On admission, impaired consciousness in 14 injured patients was assessed on the Glasgow Coma Scale (GS) 8 points or less. Patients were considered in three groups according to the duration of intensive care in the ICU. Group 1 (tab. 1) with the duration of intensive therapy (7.7 ± 1.7 days) included 4 children aged 11.5 ± 3 years, 2 - with the duration of stay in the ICU 14.8 ± 2 days consisted of 6 patients of average age 10.6 ± 0.9 years, 3 - 8 patients 12.7 ± 2.8 years, the duration of treatment in the ICU from 21 to 30 days (2 patients were in the intensive care unit for 55 and 84 days). Complex intensive care consisted in identifying and timely correction of deviations: MRS, after removing from shock anesthetic, anti-inflammatory, hemostatic, antibacterial, infusion therapy, correction of protein, water-electrolyte balance disorders, surgical, as far as possible, early correction, stress-limiting, cytoprotective therapy. According to the PTS classification, the interpretation was: if the total score on a scale of 9-12 points is a minor injury, 6-8 points is a potential threat to life, 0-5 points is a life-threatening condition, 0 points

is a fatal situation. The probability of death according to PTS (<8) requires hospitalization from a specialized department, 4 points - the probability of death is 50%, with <1 the probability of death is >98%. The use of the scale for assessing the severity of injuries ISS allowed for a more differentiated assessment of the severity of injuries. ISS scale analysis: 1-9 points - mild injury; 10-15 points - moderate severity; 16-24 points - heavy; over 24 is extremely heavy. Mortality at 16-24 points - 5-7%; > 24 points — over 30%. Duration of hospital stay: 1-9 points — about 4 days; 10-15 points - 6-7 days; 16-24 points - 8-10 days; > 24 points - over 12 days. The introduction of the scales made it possible to clearly delineate the severity of the shock and, depending on this, to determine the further tactics of action.

Results and discussion

The need for specialized care for admission in an extremely serious condition was associated with a combination of STBI, severe cerebral contusion (SCC), closed severe traumatic brain injury (CSTBI), open severe traumatic brain injury (OSTBI), subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH) with injuries of other organs, fractures of the ribs, limbs, facial bone skeleton (tab. 2).

Table 1.

Characteristics of patients with severe concomitant traumatic brain injury over 7 years old

Groups	1	2	3
Num. of patients	4	6	7
Days at the ICU	7.7±1.7	14.8±2.2	34.6±14.1
Age, years	11.5±3	10.6±0.9	12.7±2.8
GS, points	10±0.4	8.2±0.9	7.8±0.7
ALV, days	2±0.9	10.7±2.6	22.2±4.5
PTS, points	4±0.2	1±0.3	1±0.25
ISS, points	52±8	60±13	47.8±8.5

Table 2.

Types of traumatic injuries

Damage types	Group 1 (4)	Group 2 (5)	Group 3 (8)
CSTBI	50% (2)	-	75% (6)
SCC	75% (3)	80% (4)	62% (5)
Light CC	25% (1)	-	25% (2)
OSTBI	50% (2)	100% (5)	25% (2)
SAH	50% (2)	80% (4)	62% (5)

Imbibed by the blood of the brain	50% (2)	25% (1)	37% (3)
Intracerebral hematoma	50% (2)	25% (1)	37% (3)
Subdural hematoma	25% (1)	-	25% (2)
IVH	25% (1)	-	25% (2)
Dislocation syndrome	25% (1)	-	37% (3)
Facial bone fracture	50% (2)	75% (3)	25% (2)
Fracture of the pelvic bones	-	25% (1)	25% (2)
Fracture of the humerus, femur, shin bones	-	80% (4)	37% (3)
Lung contusion	50% (2)	50% (2)	-
Pneumothorax	25% (1)	25% (1)	-
Crushing injury of the liver	25% (1)	-	-
Ruptured kidney	25% (1)	-	-
Hemoperitoneum	25% (1)	-	-
Retroperitoneal hematoma	25% (1)	-	12% (1)
Laceration of the thigh	25% (1)	25% (1)	12,5% (1)

The severity of the patients' condition was determined mainly by the severity of the brain damage (tab. 1). In case of impaired consciousness 10 ± 0.4 points, the severity of trauma according to PTS 4 ± 0.2 points reduced the duration of ALV to 2 ± 0.9 days and the duration of treatment in the ICU to 7.7 ± 1.7 days (tab. 1).

With a comparatively less pronounced traumatic effect on the brain, timely etiopathogenetically determined measures were able to bring patients out of the state of severe traumatic shock in a fairly short time, timely surgical correction of bone fractures, effective intensive therapy of bruises of parenchymal organs, and compensation of blood loss (tab. 2).

The efficacy of treatment for severe cerebral contusion (CC) was more favorable with open TBI, as evidenced by shorter recovery times in group 1 7.7 ± 1.7 days, in group 2 14.8 ± 2.2 days, ALV duration in 1 group 2 ± 0.9 , in group 2 10.7 ± 2.6 days than with CSTBI (tab. 1). While the duration of intensive therapy in group 3 patients was significantly longer and amounted to 34.6 ± 14.1 days ($p < 0.05$), ALV 22.2 ± 4.5 days ($p < 0.05$) (tab. 1).

It is known that the initial severity of the condition is in direct proportion to the volume of traumatic injuries that cause more severe stress mobilization of defense systems. One of them is the response of the circadian rhythms of the body's hemodynamic parameters. In this regard, an attempt was made to study and assess

the dynamics of the circadian rhythm of SBP depending on the severity of the condition of injured children over 7 years old.

Table 3.

Dynamics of the mesor of the circadian rhythm SBP in children over 7 years of age

Days	Group 1	Group 2	Group 3
1	104.2±6.3	108.3±8.7	117.4±4.6*
2	104.9±2.9	116.0±4.1	112.0±2.2*
3	108.1±2.5	114.8±3.0	117.2±1.9*
4	110.3±2.1	114.6±3.6	117.7±3.5*
5	107.0±2.0	118.8±2.6*	117.9±2.9*
6	112.5±1.8	119.3±3.5*	112.6±3.0
7	107.4±2.3	114.3±3.1*	115.5±3.2*
8	100.1±4.9	115.8±3.2*	115.8±2.1*
9	100.9±2.0	117.4±2.6*	116.4±2.7
10		113.7±2.5	119.7±2.8
11		113.8±2.5	120.9±2.3°
12		120.9±2.7	116.7±1.8
13		114.6±3.2	113.3±2.1
14		114.4±2.8	112.2±2.0
15		122.8±11.3	117.5±2.1
16		141.0±12.7	118.3±1.4°
17			113.5±1.4
18			112.7±1.8
19			120.1±1.8
20			116.0±1.7
21			113.8±2.6
22			115.4±2.6
23			116.9±1.6
24			115.5±1.4
25			117.4±1.9
26			114.6±2.1
27			120.5±1.6
28			119.2±2.5
29			119.2±2.7
30			118.6±3.1

*-reliable relative to the indicator in group 1

°-reliable relative to the indicator in group 2

On the first day (tab. 3), the SBP circadian rhythm mesor in children of the 3rd group turned out to be more than the indicator in the first by 13 mmHg and more than in the second by - 9 mmHg, remaining within the permissible norm. As shown in table 2, the mesor of the circadian rhythm SBP in group 2 was higher than in the first on days 5-9 by 11-7-15 mmHg higher than in the first ($p < 0.05$, respectively). And in patients of the 3rd group it is higher than in the first one on the 1-8th day by 13-7-15 mmHg ($p < 0.05$, respectively). Thus, the severity of the condition caused by CTBI was expressed in a tendency to arterial hypertension in the first 9 days, which was due to the compensatory nature of the hyperdynamic type of blood circulation, aimed at restoring oxygenation of the damaged primary and secondary brain damage.

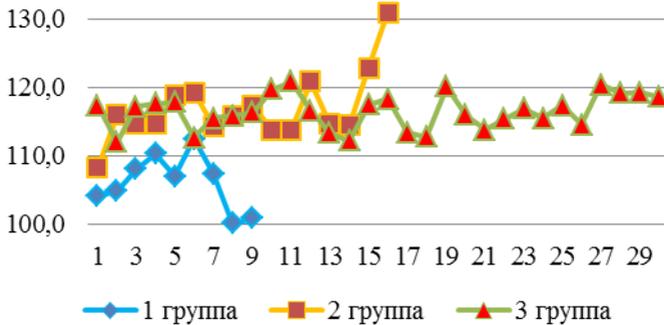


Figure 1. Dynamics of the systolic pressure mesor

On the 11th day, in group 3, a significantly higher by 7 mmHg ($p < 0.05$) increase in SBP mesor was found relative to that in group 2 (fig. 1).

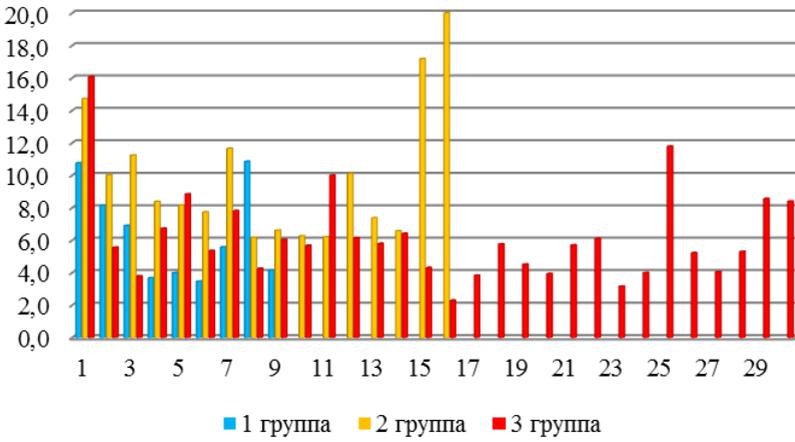


Figure 2. Dynamics of the amplitude of daily fluctuations in SBP

The increase in SBP in group 2 on day 16 was due to a decrease in drug sedation before transfer to the specialized department, indicating that the stability of cardiac output had not yet been restored (fig. 2). The revealed hemodynamic feature in group 2 was confirmed by daily fluctuations of SBP up to 40 mmHg per day (fig. 3).

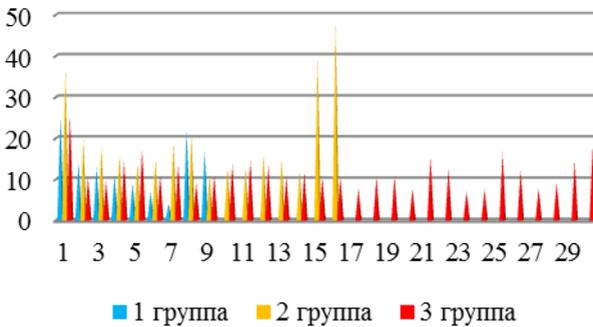


Figure 3. Change in daily fluctuations in SBP

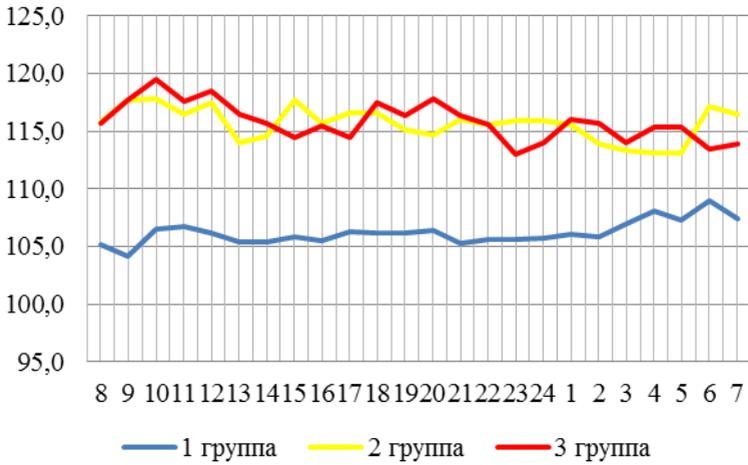


Figure 4. Effect of SCTBI severity on SBP mean circadian rhythm in the first 9 days after injury

Attention is drawn to the fact that the average indicators of hourly monitoring throughout the day were consistently significantly lower in group 1, relative to data in groups 2 and 3 (fig. 4).

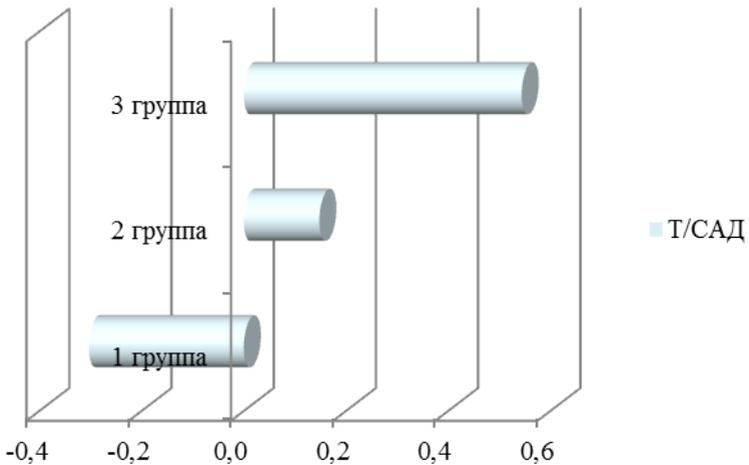


Figure 5. Correlation of SBP and body temperature in a circadian rhythm

A fairly strong (0.52) direct correlation between SBP and body temperature was found in group 3 (fig. 5).

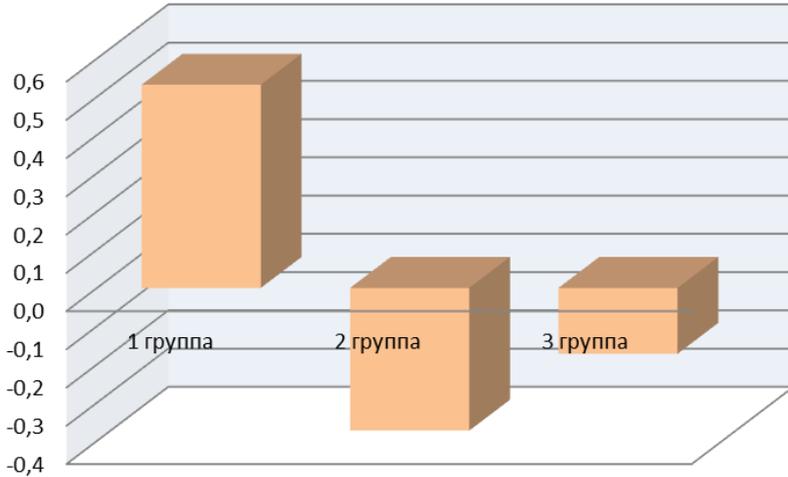


Figure 6. Correlation between changes in body temperature and SBP in the first 9 days after injury

However, in the first 9 days, a moderate direct correlation was found between the dynamics of body temperature and the mesor of the circadian rhythm SBP in the first group, but it turned out to be the most pronounced in comparison with groups 2 and 3 (fig. 6).

Conclusion

On the first day, the SBP circadian rhythm mesor in children of group 3 turned out to be more than the indicator in the first by 13 mmHg and more than in the second by - 9 mmHg. The severity of the patients' condition was predominantly determined by the severity of the brain damage. In case of impaired consciousness 10 ± 0.4 points, the severity of trauma according to PTS 4 ± 0.2 points, the duration of ALV was 2 ± 0.9 days and the duration of treatment in the ICU was up to 7.7 ± 1.7 days. The severity of the condition caused by CTBI was expressed in a tendency to arterial hypertension in the first 9 days, SBP instability (increase in the amplitude of daily fluctuations), which was due to the compensatory nature of the hyperdynamic type of blood circulation, aimed at restoring oxygenation of the damaged primary and secondary brain damage.

References

1. <https://golovnoj-mozg.ru/travmy/temperatura-pri-cherepno-mozgovoj-travme>
2. https://studbooks.net/2470966/meditsina/intensivnaya_terapiya_sochetannoy_cherepno_mozgovoy_travmy

一些获得性凝血病的血小板生成奇异性(假设)
**THROMBOPOIETIC SINGULARITY OF SOME ACQUIRED
COAGULOPATHIES (HYPOTHESIS)**

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抽象的。急性大量失血和病毒感染 COVID-19 的根本不同的病因、发病机制和临床表现在用低凝替代高凝的速度上最大不同: 在急性大量失血中, 这几乎立即发生, 并以出血和感染结束, 高凝时间延长, 虽然活性血小板被去除, 巨噬细胞被去除脾脏和免疫复合物, 但肝脏合成的血小板生成素 (TPO) 不断刺激血小板生成, 从而导致血栓形成和血栓栓塞。在这方面, 当相互比较时, 两种凝血病模型都可以揭示高凝的“鬼脸”, 并提供有关生理反应如何在恶性病理循环中结束的信息。

关键词: 凝血病, 急性大量失血, COVID-19, 血小板生成活性, 年轻血小板, 高凝状态。

Abstract. *Fundamentally different etiology, pathogenesis and clinical manifestations of acute massive blood loss and viral infection COVID-19 differ most of all in the rate of replacement of hypercoagulation with hypocoagulation: in acute massive blood loss, this occurs almost instantly and ends in bleeding, with infection, hypercoagulation is prolonged, and although active platelet cells are removed, macrophage cells are removed spleen and immune complexes, thrombocytopoiesis is constantly stimulated by thrombopoietin (TPO) synthesized in the liver, which leads to the formation of blood clots and thromboembolism. In this regard, when compared with each other, both models of coagulopathy can shed light on the "grimaces" of hypercoagulation and provide information on how the physiological response closes in a vicious pathological circle.*

Keywords: *coagulopathy, acute massive blood loss, COVID-19, thrombopoietic activity, young platelets, hypercoagulability.*

Introduction

In creating man, nature did not invent anything specifically for health or illness; in a particular case, the disease may differ from the norm by an individually excessive adaptive response of the organism to the pathogenic factors of the inter-

nal or external environment [7]. Acquired coagulopathies, the fatal consequences of which begin with hypercoagulation - in essence, the body's adaptive response to damage to the vascular endothelium.

Coagulopathy — diseases caused by disorders of the blood coagulation system, hemostasis. Acquired coagulopathy associated with another pathology, posing a mortal threat, will not be understood without assessing the body's ability to protect itself, for example, from blood loss or from infection, i.e., hemostatic reactions.

Hemostasis — body reactions aimed at preventing and stopping bleeding, i.e. complex interaction of platelets, plasma coagulation cascades, fibrinolytic proteins, blood vessels and cytokines to limit blood loss by maintaining the integrity of the vascular wall and the formation of blood clots while maintaining the liquid state of the blood: "System of regulation of the aggregate state of blood" (RASB) [2].

Thrombocytes or platelets - this "dust of blood", until now, from the moment of their first description, attract the attention of practitioners and researchers [18]. The functions of these cells still cannot be considered uncovered, but it is clear that membrane complexes of glycoproteins (GP) play a leading role in them. It is also clear that the formation of a thrombus at the site of damage to the vessel - **primary hemostasis**, begins with the adhesion, secretion and aggregation of these cells. In addition, circulating usually in large numbers, platelets are the first to get on the path of viral infection, meeting with which accelerates the renewal of their population [28]. In the bone marrow of an adult weighing 70 kg, 175×10^9 platelets should be produced daily. The process of their production controlled by TPO, interleukins (IL-3, IL-6, IL-11) and transcription factors (GATA-1, FOG-1, NF-E-2) is conventionally divided into maturation of megakaryocytes (megakaryocytopoiesis) and platelet biogenesis (thrombocytopoiesis) [41]. An important stage is the formation of young (immature or reticular) cells containing mRNA residues [25]. Informational RNA (mRNA) of newly formed platelets during their circulation in the blood rapidly degrades: within 24 hours in dogs and mice (the life cycle of mature platelets in dogs is 7 days, in humans - 10 days); usually about 10% of platelets contain residues of mRNA (staining with fluorochromes), corresponding to the number of young cells, on the determination of which non-invasive monitoring of thrombocytopoiesis is based [20, 46, 49]. The number of platelets usually falls within the range from $150 \times 10^9/l.$ to $400 \times 10^9/l.$, their number from $100 \times 10^9/l.$ to $150 \times 10^9/l.$ is considered borderline, and bleeding usually does not occur until it falls below $50 \times 10^9/l.$ [40]. With a platelet count of $100 - 149 \times 10^9/l.$ thrombocytopenia is considered mild, less than $100 \times 10^9/l.$ - moderate to severe [43]. In thrombocytopenia, megakaryocytes migrating from the bone marrow are responsible for 50% of platelet biogenesis in the lungs [31].

Interacting with GP receptors with von Willebrand factor (vWF) and collagen, platelets adhere to vascular lesions, release granules, change their shape, and aggregating, bind to plasma ligands, forming a platelet clot [48]. Having a high density of GP-receptors, in particular, the fibrinogen receptor (integrin α IIb α Ib/ β ₃), hemostatically active young platelets in vivo during thrombus growth are the first to attach to the subendothelial matrix, activate and activate mature cells and blood coagulation cascades [17, 36, 37]. The proportion of immature cells in the total platelet population (IPF,%), as well as their daily biogenesis (aIPF) [12], even with relative thrombocytopenia, increases within a short period of time, and the growth of these cells in platelet donors lasts for two weeks [6].

Violations of the mechanisms of primary hemostasis cause almost 80% of cases of bleeding and 95% of cases of blood clots [2].

Acute massive blood loss

A catastrophic decrease in the volume of circulating blood, a prolonged decrease in the efficiency of blood flow, a drop in the oxygen capacity of the blood, and hypovolemic shock are the main consequences of massive blood loss. Severe arterial hypotension, slowing of blood flow in microvessels (stasis) and ongoing bleeding at the same time contribute to the development of hypercoagulation, and then - hypercoagulable and hypocoagulable phases of disseminated intravascular coagulation (DIC) [5], which is characterized by multiple microthrombosis, primarily of capillaries and venules, consumption of thrombocytes and plasma blood factors [4].

It is believed that acute massive blood loss is a traumatic coagulopathy with a hemorrhagic phenotype and microthrombosis of blood vessels due to activation/suppression of blood coagulation [32, 45]. Acute blood loss with concomitant shock, impaired clot formation and, in severe cases, hyperfibrinolysis predominates at the early stage of traumatic coagulopathy, however, the state of systemic endogenous hypercoagulation observed in the immediate post-traumatic period (within 1 hour after injury) quickly turns into consumption coagulopathy [38, 44]. Perhaps due to the accelerated selective removal of young platelets.

Its genesis in this case can be hypothetically represented as follows:

1. Tissue factor (TF) is the primary cellular initiator of blood coagulation; after a vascular injury, it activates the coagulation protease cascade, which leads to the deposition of fibrin and "revitalization" of platelets [34].

2. The "revitalization" of platelets adhered to the endothelium through PAR receptors, apparently, begins with their young forms, since they are the first to interact with the damaged endothelium [36].

3. The duration of circulation in the peripheral blood of young platelets is 24 hours [20], but with thrombocytopenia, their composition is rapidly renewed [6].

4. Active platelets lose sialic acid residues (glycans) and are recognized by Ashwell-Morrell receptors (AMR) of hepatocytes, which is combined with their

apoptosis through the "JAK2-STAT3" signaling pathway [19].

5. AMR-mediated selective removal of desialylated platelets by regulating the synthesis of thrombopoietin in the liver, forcing thrombocytopoiesis [22].

6. Primary hemostasis after selective clearance of young platelets and depletion of blood coagulation factors becomes a pathogenetic link in coagulopathy.

7. In conditions of ongoing bleeding, this mechanism contributes to the transition of hypercoagulation to hypocoagulation.

The mortal danger of acute blood loss, as well as the need for blood replacement, were realized in antiquity: the alchemist Libavius in 1615 described in detail the rules for blood transfusion [27]. Today, transfusion aid for acute massive blood loss is correction by means of modern transfusion medicine: saline and colloidal solutions, components and preparations of donor blood, including plasma, blood gas carriers, platelet concentrates and hemostasis correctors [5].

Coagulopathy COVID-19 (CAC)

The 2020 pandemic caused by a new β -coronavirus or coronavirus of severe acute respiratory syndrome CoV-2 (SARS-CoV-2) and called "COVID-19" manifested itself in a number of organ-specific and systemic phenotypes, some of which were observed in viral infections earlier, and many others are unique [13].

Considering the pathogenesis of infection, Domingo et al. (2020), identified four interconnected vicious circles: viral infection, dysfunction of the renin-angiotensin-aldosterone (RAS) system, inflammation, and coagulation defects - the four riders of the viral apocalypse [16].

With regard to coagulation defects, Chinese doctors were the first to note the efficacy of low molecular weight heparin in CAC: a decrease in mortality after 28 days of observation, even in patients with more than four points for sepsis severity or in patients with a distinct rise in D-dimer. In general, coagulation disorders in COVID-19 are characterized by a distinct rise in procoagulant factors such as fibrinogen and D-dimers, combined with a poor prognosis: in patients in intensive care units (ICU), the frequency of venous thromboembolism increases (25% -36%) with primary localization in the lungs. In 7.7% of them, the standard prophylaxis of venous thromboembolism is not effective.

Infection of endothelial cells, cell infiltration and exposure to cytokines/chemokines cause dysfunction and apoptosis of these cells, contributes to the development of microcirculatory prothrombotic effects: hyperinflammation leads to hypercoagulation. Inflammation involves both the intrinsic and extrinsic coagulation pathways: TF activates endothelial cells and macrophages through the extrinsic pathway, and the intrinsic pathway can be activated by extracellular neutrophil traps (NETs) in the process of so-called NETs, triggered by endothelial cells, platelets and the complement system, after whereby proteases inactivate endogenous anticoagulants.

The role of platelets in CAC is dual. First, the secretion of α -granules recruits

polymorphonuclear neutrophils and macrophages, the main source of interleukin IL-1b. In addition, platelets, stimulating NETs, are activated secondarily (feedback). Second, the assembly of the "enzyme-cofactor-substrate" complex on the platelet surface "triggers" coagulation.

The mechanisms of coagulation and acquired thrombophilia in COVID-19, in most cases leading to venous, arterial and microvascular thrombosis, require careful thought, reflection and research [3, 9, 11, 13].

The data accumulated during 2020 suggests that a consequence of severe COVID-19 infection is a virus-associated CAC with an imbalance in platelet consumption and production [11, 29, 35, 47, 50].

Perhaps SARS-Cov-2 generates fatal hypercoagulability either by attracting increasingly hemostatically hyperactivated platelets to the damaged endothelium, or by acting directly on hematopoiesis:

1. CAC – hypercoagulability: high clot strength, low rate of lysis (decreased fibrinolysis), and rapid formation of fibrin with a greater effect of inflammation on fibrinogen, vWF and platelets than on blood clotting factors [21].

2. The daily increase in young platelets in severe patients only increases [15, 24, 33].

CAC is fundamentally different not only from acute massive blood loss, but also from bacterial sepsis:

1. The absolute number of young platelets in septic coagulopathy, reflecting the forcing of thrombocytopoiesis, increases in the initial stage, but with an increase in the severity of the process, it decreases: on the third day of being in intensive care in patients with severe sepsis, the production of immature platelets falls dramatically [23, 29, 30, 39].

Possibly, like the "neocytolysis" that frees the body from young erythrocytes [10, 42], a kind of "neoclerance" (our definition) removes hyperactive young platelets, simultaneously forcing thrombocytopoiesis, but with massive blood loss or with severe sepsis, platelet production for some reason suppressed.

There are no means of etiotropic therapy for COVID-19 with proven efficacy [8], just as there are no indications for the transfusion of blood components and blood products to patients with COVID-19 ... except for COVID-19 convalescent plasma. The experience of past epidemics has shown that in the absence of specific treatment, transfusion of blood plasma of convalescents can be an effective approach [1]. Passive immunization by administering antibodies to an infectious agent using such plasma has also found applications in patients with COVID-19 [14]. Antithrombotic therapy of COVID-19 is a controversial issue, even though a high level of young platelet production (aIPF) is associated with the severity of infection and in the long term may help in the individualization of the antithrombotic regimen in COVID-19 [15, 24, 26].

References

1. Baklaushev V.P., Averyanov A.V., Sotnikova A.G., Perkina A.S., Ivanov A.V., Yusubalieva G.M., Novikova O.N., Shikina V.E., Dupik N V.V., Kedrova A.G., Sanzharov A.E., Balionis O.I., Valuev-Elliston V.T., Zakirova N.F., Glazov Ya.N., Panyukhina I.A., Soloviev N. A., Vinokurov A.G., Ivanov Yu.V., Vasiliev V.N., Klypa T.V., Troitsky A.V. Preliminary results of a study on the safety and efficacy of convalescent plasma in COVID-19 therapy. *Clinical practice*. 2020; 11 (2): 130–142.
2. Gavrilov O.K. Mosaicity of hemostatic potentials and pathology of the RASB system. In the book: *Problems and hypotheses in the doctrine of blood coagulation*. M: Medicine; 1981: 25 -38.
3. Moroz V.V., Chernysh A.M., Kozlova E.K. Coronavirus SARS-CoV-2: hypotheses of the effect on the circulatory system, prospects for the use of perfluorocarbon emulsion, the possibility of biophysical research methods (editorial) *General rheumatology*. 2020; 16 (3): 4–14.
4. Moroz V. V. and Ryzhkov I.A. Acute blood loss: regional blood flow and microcirculation (Review, part I). *General resuscitation*. 2016; 12 (2): 69 -89.
5. *Essays on industrial and clinical transfusiology* (Edited by Academician A.I.Vorobyov). Newdiamed. M.: 2006. 632 P.
6. Pogorelov V.M., Beskorovainova V.Ju., Chanieva M.I., Dyagileva O.A., Naumova I.N., Skedina M.A. Periodic acid-Schiff (PAS) staining of immature platelets in donors. *Platelets*. 2012; 23 (1): 51-59.
7. Pogorelov V.M., Kozinets G.I., Diaghileva O.A., Protsenko V.V. *Color atlas of blood cells*. M.: Practical Medicine. 2011: 176 P.
8. Simarova I.B., Kostin A.I., Smirnova Yu.V., Ladygina E.A., Logunov D.Yu., Dolzhikova I.V., Ganchin V.V., Vasin E.A., Baykov A.I., Bulanov A.Yu., Borovkova N.V., Petrikov S.S. Formation of a cohort of anticoid plasma donors with a high titer of antibodies that neutralize the SARS-CoV-2 virus. *Hematol. Transfusiol*. 2020; 65 (3): 242 -250.
9. Frank G.A., Kovalev A.V., Gribunov Yu.P., Zaslavsky G.I., Kildyushev E.M., Yagmurov O.D., Tuchik E.S., Timerzyanov M.I., Putintsev V.A., Minaeva P.V. *Study of deaths with suspected coronavirus infection (COVID-19). Temporary guidelines*. (Edited by G.A. Frank and A.V. Kovalev). M. 2020. 428 P.
10. Alfrey C.P., Rice L., Udden M.M., Driscoll T. B. Neocytolysis: physiological down-regulator of red-cell mass. *Lancet* 1997. 10; 349 (9062): 1389-1390.
11. Amgalan A., Othman M. Hemostatic laboratory derangements in COVID-19 with a focus on platelet count. *Platelets*. 2020; 31 (6): 740-745.
12. Barsam S.J., Psaila B., Forestier M., Page L.K., Sloane P.A., Geyer J.T., Villarica G.O., Ruisi M.M., Gernsheimer T.B., Beer J.H. Bussel J.B. *Platelet*

production and platelet destruction: assessing mechanisms of treatment effect in immune thrombocytopenia. Blood. 2011; 117 (21): 5723-5732.

13. Becker R.C. COVID-19 update: COVID-19-associated coagulopathy. *J. Thromb. Thrombolysis. 2020; 50 (1): 54–67.*

14. Briggs N., Gormally M.V., Li F., Browning S.L., Treggiari M.M., Morrison A., Laurent-Rolle M., Deng Y., Hendrickson J.E., Tormey C.A., Desruisseaux M.S. Early but not late convalescent plasma is associated with better survival in moderate to-severe COVID-19. *PLoS ONE. 2021; 16 (7): e0254453.*

15. Cohen A., Harari E., Yahud E., Cipok M., Bryk G., Lador N.K., Mann T., Mayo A., Lev E.I. Immature platelets in patients with Covid-19: association with disease severity. *J. Thromb. Thrombolysis. 2021; Sep. 14; 1-7.*

16. Domingo P., Mur I., Pomar V., Corominas H., Casademont J., de Benito N. The four horsemen of a viral Apocalypse: The pathogenesis of SARS-CoV-2 infection (COVID-19) *EBioMedicine. 2020. 58. <https://doi.org/10.1016/j.ebiom.2020.102887>.*

17. Fager A.M., Wood J.P., Bouchard B.A., Feng P., Tracy P.B. Properties of procoagulant platelets defining & characterizing the subpopulation binding a functional prothrombinase. *Arterioscler. Thromb. Vasc. Biol. 2010; 30 (12): 2400-2407.*

18. Gazzaniga V., Ottini L. The discovery of platelets and their function. *Vesalius, 2001; VII (1): 22 – 26.*

19. Grozovsky R., Giannini S., Falet H., Hoffmeister K.M. Novel mechanisms of platelet clearance and thrombopoietin regulation. *Curr. Opin. Hematol. 2015; 22 (5): 445–451.*

20. Harrison P., Robinson M.S.C., Mackie I., Machin S. Reticulated platelets. *Platelets. 1997; 8 (6): 379-383.*

21. Hartmann J., Ergang A., Mason D., Dias J.D. The Role of TEG analysis in patients with COVID-19-associated coagulopathy: A systematic review. *Diagnostics. 2021; 11: 172 -185.*

22. Hoffmeister K.M. & Falet H. Platelet clearance by the hepatic Ashwell-Morrell receptor: mechanisms and biological significance. *Thromb. Res. 2016; 141 (Suppl 2): 68–72.*

23. Hubert R.M.E., Rodrigues M.V., Andreguetto B.D., Santos T.M., Gilberti M.de F.P., Castro V. de, Annichino-Bizzacchi J.M., Dragosavac D., Carvalho-Filho M.A., Paula E.V. De. Association of the immature platelet fraction with sepsis diagnosis and severity. *Scientific Rep. 2015; 5: 8019 | DOI: 10.1038/srep0801.*

24. Incir S., Komesli Z., Baygul A., Tasdemir Z.A., Palaoglu K.E., Kant H., Kapmaz M., Tekin S., Kilic A., Dagek T., Okan A., Somay K., Akpınar T.S. Immature platelet fraction: is a novel early predictive marker for disease severity in patients

with Covid-19 pneumonia? *Turk. J. Biochem.* 2021; 46 (4): 359–366.

25. Ingram M., Coopersmith A. Reticulated platelets following acute blood loss. *Brit. J. Haematology.* 1969; 17 (3): 225-229.

26. Jose J., Magoon R., Makhija N. Immature Platelet Fraction and COVID-19: Maturing prognostic links! *Card. Crit. Care.* 2021; 5 (3): 176–178.

27. Kaadan A.N., Angrini M. Blood transfusion in history. 2009: 48 p.

28. Koupenova M. Potential role of platelets in COVID-19: Implications for thrombosis. *Res. Pract. Thromb. Haemost.* 2020; 4: 737–740.

29. Koyama K., Katayama S., Muronoi T., Tonai K., Goto Y., Koinuma T., Shima J., Nunomiya S. Time course of immature platelet count and its relation to thrombocytopenia and mortality in patients with sepsis. *PLOS ONE.* 2018: 1 -16.

30. Koyama K., Katayama S., Tonai K., Shima J., Koinuma T., Nunomiya S. Biomarker profiles of coagulopathy and alveolar epithelial injury in acute respiratory distress syndrome with idiopathic/immune related disease or common direct risk factors. *Critical. Care.* 2019; 23: 283 -295.

31. Lefrançois E., Ortiz-Muñoz G., Caudrillier A., Mallavia B., Liu F., Sayah D.M., Thornton E.E., Headley M.B., David T., Coughlin S.R., Krummel M.F., Leavitt A.D., Passequé E., Looney M.R. The lung is a site of platelet biogenesis and a reservoir for haematopoietic. *Nature.* 2017; 544 (7648):105-109.

32. Levi M. & Scully M. How I treat disseminated intravascular coagulation. *Blood.* 2018; 131 (8): 845-854.

33. Linssen J., Ermens A., Berrevoets M., Seghezzi M., Previtali G., van der Sar-van der Brugge S., Russcher H., Verbon A., Gillis J., Riedl J., de Jongh E., Saker J., Münster M., Munnix I.C.A., Dofferhoff A., Scharnhorst V., Ammerlaan H., Deitersen K., Bakker S.J.L., van Pelt L.J., de Hingh Y.K., Leers M.P.G., Ven A. van der. A novel haemocytometric COVID-19 prognostic score developed and validated in 2 observational multicentre European hospital-based study. *Crit Rev Clin Lab Sci.* 2020; 57 (6): 1-36.

34. Mackman N. Role of tissue factor in hemostasis, thrombosis, and vascular development. *Arterioscler. Thromb. Vasc. Biol.* 2004; 24:1015-1022.

35. Maitta R.W. Immature platelets in COVID-19 infection. *Brit. J. Haematol.* 2021; 194 (3): 494–495.

36. Mazepa M., Hoffman M., Monroe D. Superactivated platelets thrombus regulators, thrombin generators, and potential clinical targets. *Arterioscler. Thromb. Vasc. Biol.* 2013; 33 (113): 1747-1752.

37. Mc Bane R.D., Gonzalez C., Hodge D.O., Wysokinski W.E. Propensity for young, reticulated platelet recruitment into arterial thrombi. *J. Thromb. Thrombolysis.* 2014; 37 (2): 148-154.

38. Moore E.E., Moore H.B., Kornblith L.Z., Neal M.D., Hoffman M., Mutch N.J., Schchl H., Hunt B.J., Sauaia A. Trauma- induced coagulopathy. *Nature Rev.* 2021; 7: 30.

39. Muranoi T., Koyama K., Nunomiya S., Lefor A.K., Wada M., Koinuma T., Shima J., Suzukawa M. Immature platelet fraction predicts coagulopathy-related platelet consumption and mortality in patients with sepsis. *Thromb. Res.* 2016; 144 (1): 169-175.

40. Ogedegbe H. O. An overview of hemostasis. *Laboratory medicine.* 2002; 33 (12): 948-953.

41. Patel S.R., Hartwig J.H., Italiano J.E. Jr. The biogenesis of platelets from megakaryocyte proplatelets. *J. Clin. Invest.*, 2005; 115 (12): 3348–3354.

42. Rice L., Ruiz W., Driscoll T., Whitley C. E., Tapia R., Hachey D.L., Gonzales G.F., Alfrey C.P. Neocytolysis on descent from altitude: a newly recognized mechanism for the control of red cell mass. *Ann. Intern. Med.* 2001; 134: 652 -656.

43. Roh J.W., Lim S., Hwang Y., Lee K.Y., Choo E.H., Choi I.J., Hwang B.-H., Kim C.J., Park M.-W., Kim D.-B., Lee J.-M., Park H.S., Kim H.-J., Yoo K.D., Jeon D.S., Youn H.J., Chung W.S., Kim M.C., Jeong M.H., Ahn Y., Chang K. Ischemic and bleeding events associated with thrombocytopenia and thrombocytosis after percutaneous coronary intervention in patients with acute myocardial infarction. *J. Clin. Med.* 2020; 9 (10): 3370-3383.

44. Savioli G., Ceresa I.F., Caneva L., Gerosa S., Ricevuti G. Trauma-induced coagulopathy: overview of an emerging medical problem from pathophysiology to outcomes. *Medicines* 2021, 8, 16: 1 -22.

45. Spahn D. R., Rossaint R. Coagulopathy, and blood component transfusion in trauma. *Brit. J. Anaesth.* 2005; 95 (2): 130–139.

46. Stohlawetz P., Stiegler G., Jilma B., Dettke M., Hocker P., Pancer S. Measurement of the levels of reticulated platelets after platelepheresis to monitor activity of thrombopoiesis. *Transfusion*, 1998; 38 (5): 454-458.

47. Taha M., Sano D., Hanoudi S., Esber Z., Elahi M., Gabali A., Chopra T., Draghici S., Samavati L. Platelets, and renal failure in the SARS-CoV-2 syndrome. *Platelets*, 2021; 32 (1): 130–137.

48. Vinholt P.J. The role of platelets in bleeding in patients with thrombocytopenia and hematological diseases. *Clin. Chem. Labor. Med.* 2019; 57 (12): 1808-1817.

49. Weisbach V., Friedlein H., Glaser A., Zingsem J., Zimmermann R., Eckstein R. The influence of automated plateletpheresis on systemic levels of hematopoietic growth factors. *Transfusion*. 1999; 39 (8): 889-894.

50. Welder D., Jeon-Slaughter H., Ashraf B., Choi S-H., Chen W., Ibrahim I., Bat T. Immature platelets as a biomarker for disease severity and mortality in COVID-19 patients. *British. J. Haematol.* 2021; 194: 530 -536.

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机体长期酒精中毒背景下大鼠大唾液腺的形态学和功能特征
**MORPHOLOGICAL AND FUNCTIONAL FEATURES OF LARGE
SALIVARY GLANDS OF RATS AGAINST THE BACKGROUND OF
PROLONGED ALCOHOL INTOXICATION OF THE BODY**

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抽象的。使用经典的形态计量学和组织化学分析方法，在长期饮用 20% 乙醇溶液的背景下，揭示了雄性 Wistar 大鼠下颌下 (SMG) 和腮腺 (PG) 唾液腺的形态结构和酶活性的变化。180 天。在 SMG 中发现了最明显的变化。

关键词：腮腺唾液腺，下颌下唾液腺，乙醇，肥大细胞，碱性磷酸酶，琥珀酸脱氢酶，NADP氧化酶

Abstract. *Using classical methods of morphometric and histochemical analyzes, changes in the morphological structures and enzymatic activity of the submandibular (SMG) and parotid (PG) salivary glands of male Wistar rats were revealed against the background of long-term drinking of 20% ethanol solution for 180 days. The most pronounced changes were found in the SMG.*

Keywords: *parotid salivary gland, submandibular salivary gland, ethanol, mast cells, alkaline phosphatase, succinate dehydrogenase, NADP oxidase*

Homeostasis of the oral cavity is determined by many factors, but, first of all, by the functional activity of the salivary glands, which contribute to both the presence of dental pathology and the somatic health of a person as a whole. In many countries of the world, excessive alcohol consumption negatively affects the health of the population. The effect of ethanol can be carried out directly on the mucous membrane of the oral cavity, which is characterized by a high degree of permeability, and also indirectly, through the products of ethanol metabolism after a number of transformations in the body and their excretion with saliva. The negative effects of ethanol on the morpho-functional state of the salivary glands are obvious [1-5]. However, most of the studies were completed in a short time. For an objective analysis, it is necessary to conduct a comprehensive study of changes

in the morphological structures and enzymatic activity of SMG and PG rats with prolonged alcohol intoxication.

Materials and methods

The study was carried out on adult male albino rats of the Wistar line weighing from 180 to 210 g. The animals were divided into 2 groups. Group 1 - control (n=20), group 2 - experimental (n=20). Experimental animals received a 20% solution of ethyl alcohol (7 g/kg/day) as a source of drinking for 180 days. All animals were kept in standard vivarium conditions: with standard temperature conditions, 12-hour light/dark cycle, with free access to food and water (GOST 33215–2014 RF entered into force on 01.07.2016).

The selection, observation of laboratory animals was carried out according to the recommendations of I.M. Trachtenberg [6]. All actions involving contact with laboratory animals were carried out taking into account the rules for working with experimental animals [7] and the Federal Law of the Russian Federation "On the Protection of Animals from Cruelty" dated 01.12.1999 № 4679-II GD [8]. To conduct this study, permission was obtained from the University Ethics Committee (protocol № 3 of November 16, 2015) in accordance with the order of the USSR Ministry of Health № 775 of August 12, 1977 [7].

Salivary gland collection

The animals were anesthetized with ether at the rate of 3-5 ml per 1 kg of body weight mixed with atmospheric air. After the absence of the corneal reflex, the rats were decapitated. Then, large SMG and PG were collected, which were subjected to morphological and histochemical research methods.

General morphological analysis

Material SMG and PG were fixed in 10% neutral formalin, then dehydrated in alcohols of ascending strength and embedded in paraffin according to the standard technique. Sections of salivary glands 5-7 μm in size, made using an MPS-2 microtome (Kharkov, Ukraine), were stained with hematoxylin-eosin. Sections were obtained for morphometric analysis taking into account the area of the parenchyma, stroma, acini and ducts in accordance with the protocol of Merlo C. et al. 2010 [9]. Description, comparative morphological analysis of SMG and PG structures was carried out on permanent microslides using a microscope (Mikmed-2, Russia) at magnifications of 10x10, 10x40 and 10x90.

Characterization of mast cells

To qualitatively and quantitatively characterize the population of mast cells (MC), we used the method of staining with polychrome toluidine blue according to A. Unna [10]. In 30-50 fields of view of a light microscope at a magnification of 10x40 in each section, the number of MCs in SMG and PG was counted, and the arithmetic mean values were found for each case. The sizes of MC were determined after photographing the preparations at a magnification of 10x90 using the

"SigmaScanPro 5.0" software package. Each MC was characterized by the degree of degranulation. The degranulation index (DI) was calculated using the formula: $DI = C/B$, where C is the number of degranulating MCs, B is the total number of analyzed MCs. In addition, the degree of metachromasia, visualization of granules and nuclei were determined [11]. According to the degree of metachromasia, α -orthochromic MCs (blue, contain non-sulfated heparin), β -metachromatic (purple, heparin sulfated to varying degrees), γ -metachromatic (purple, containing highly sulfated heparin) were isolated.

Histochemical analysis of enzyme activity. Alkaline Phosphatase Activity

Method for determination of alkaline phosphatase (AP) activity in acini and SMG and PG ducts according to Burstone M.S. based on the hydrolysis of mono-substituted orthophosphate esters [12]. The reaction proceeds with the simultaneous azo coupling of the substrate - naphthol-AS-BI-phosphate (Sigma-Aldrich, USA) with a dye - strong blue BB (Sigma-Aldrich, USA). Alkaline phosphatase breaks down α -naphthol-phosphate with the release of α -naphthol. In the places of localization of the enzyme, an insoluble blue precipitate is formed.

To determine the AP activity, freshly prepared cryostat native sections of salivary glands 10 μm thick were dried. The sections were then incubated with naphthol-AS-BI-phosphate and strong blue BB for 20 min at + 37°C. An alkaline Tris HCl buffer with pH = 8.2-9.2 (Jiangsu Juming Chemical Technology Co., Ltd., China) was used as the basis of the incubation medium. AP activity was quantified using cytophotometry. Photometry was carried out in transmitted light on a microscope (Mikmed-2, Russia) using an FMEL-1 photoelectric attachment with FEU-79 (Russia) and an amplifier output voltage of 900 V. In order to obtain a monochromatic light beam in the red region of the spectrum passing through the preparation, an interference light filter (Russia) with a maximum light transmission ($\lambda_{\text{max}} = 620 \text{ nm}$) was used. Light transmission was recorded using a digital voltmeter. Then, by negative logarithm, the level of light transmission was transformed into light absorption, and the optical density was calculated. According to the Lambert-Bouguer-Beer law, the optical density of a drug is proportional to the amount of dye. In turn, the described method meets the requirement of proportionality of the concentration of the dye and the activity of the enzyme.

Activity of succinate dehydrogenase and NADPH-oxidase

In freshly prepared cryostat sections, the content of succinate dehydrogenase (SDH) and NADPH-oxidase was determined by the method of Z. Lojda [13]. For this, the native sections of the salivary glands with a thickness of 10 μm were dried and then incubated in a tetrazolium reagent for 15 min. The reaction is based on the transformation of the colorless oxidized form of tetrazole salts into a colored reduced form. Enzymatic activity was determined quantitatively using photometry.

The results of the study were subjected to *statistical analysis* using the "BioStat 2009 Professional 5.8.4" software (AnalystSoft, USA). To assess the differences, the nonparametric Mann – Whitney U-test was used, considering the differences to be significant at $p < 0,01$. The results of the study are presented in the table and in the text as the median and the 25th and 75th centiles (Me, Q_1-Q_3).

Results

The body weight of the animals during 180 days did not have statistically significant differences between the groups. During the entire period of the protocol of alcohol consumption, no animal deaths were recorded.

Morphological analysis

When examining sections of PG and SMG animals of the control group, we showed that the structural organization of each organ corresponded to the norm.

In experimental animals exposed to chronic alcohol intoxication (180 days), no significant violations of the general structural organization of the terminal secretory sections and excretory ducts of PG were found. However, changes in the shape of the end sections and variability in the size of the secretory cells that form them were often noted, among which there were also very large ones. In the cytoplasm of many cells, round, unstained vacuoles were observed, which presumably correspond to fatty inclusions. The stroma had moderate fatty infiltration in the form of large adipocytes with isolated lymphocytic foci. Blood stagnation was observed in the blood vessels. The interlobular excretory ducts are unevenly expanded, their cells were of different heights.

In the SMG of the experimental group of animals, mild metachromasia with blue toluidine was observed in all the studied acinar cells of the glands. In some acinar cells, nuclei of irregular shape were found, with varying degrees of heterochromatin inclusions. Lipid inclusions located in different areas of the cytoplasm were observed in almost all cells of the acinus. In some lobules, small atrophic acini were found. The striated ducts showed alternation between dark and clear cells, with atypical, heterochromatic nuclei, irregular contour and located at different levels. The cells of the intercalated ducts contained some lipid droplets. The duct epithelium had nuclear heterogeneity and moderate atrophy with accumulation of secretory material. Fatty infiltration and stromal edema were observed.

On sections PG and SMG of the control group, β -metachromatic MCs with a size of about 10-25 μm in an amount of 4.5 c.u. in the field of view were clearly detected. MCs are mainly concentrated in groups near the interlobular ducts and blood vessels. The identified MCs are predominantly without signs of degranulation, oval or elongated, with well-defined margins and cytoplasm filled with densely spaced metachromatic granules. There were also cells with signs of partial degranulation, without clear boundaries, different sizes, and irregular shapes. The cytoplasm of such MCs is less intensely colored due to loosely located, well-

distinguishable granules. Outside of these cells, a large number of granules were contained. The degranulation index was 0.3.

The number of identified MC PG and SMG experimental groups increased to 8.5 c.u. in the field of view. In the connective tissue septum near the interlobular ducts, MC formed conglomerates. The content of MCs, located inside the lobules, near the terminal sections, intercalated and striated excretory ducts, slightly increased. Whole MCs were single, the main part of the cells was in the stage of degranulation, respectively, the index of degranulation was 0.6. Moreover, all of them were characterized by a high degree of activity - enhanced maturation and release of MC granules. An increase in the number of MCs degranulating by total cytoplasm disintegration was observed. Completely destroyed MCs with light cytoplasm and a small number of scattered, metachromatically stained granules made up 1/3 of the number of degranulated ones.

AP activity

It was shown that in animals with alcohol intoxication after 180 days, in comparison with the control, there was a statistically significant increase in AP activity in serocytes of terminal acini SMG and PG (table 1). At the same time, in the striated ducts of the salivary glands, the level of enzyme activity did not differ between the groups.

Table 1.
Alkaline phosphatase activity in the PG and SMG structures during alcohol intoxication for 180 days (ME; Q1-Q3)

Structure	Gland	Series	
		control	experimental
acini	PG	0.45 (0.395 – 0.69)	0.86 (0.765 – 0.99) (p<0.01)
	SMG	0.43 (0.40 - 0.52)	0.87 (0.84 - 1.095) (p<0.01)
ducts	PG	0.44 (0.40 - 0.49)	0.48 (0.40 - 0.54)
	SMG	0.44 (0.39 - 0.52)	0.47 (0.40 - 0.51)

SDH and NADPH-oxidase activity

We found that the SDH activity in the ducts and acini of the salivary glands did not statistically differ between the control and experimental groups of animals (table 2).

The results of the studies showed (table 2) that with prolonged 180-day intoxication with ethanol in the acini and ducts of PG rats, the activity of NADPH-oxidase remained at the control level. However, in the SMG acini of the experimental group, the enzyme activity increased statistically significantly, while in the ducts it remained unchanged in all groups.

Table 2.

Activity of SDH and NADPH-oxidase in the PG and SMG structures during alcohol intoxication for 180 days (IU; Q1-Q3)

Structure	Gland	Series			
		control		experimental	
		SDH	NADPH-oxidase	SDH	NADPH-oxidase
acini	PG	69 (64.5 – 72)	76 (69 – 86)	63.5 (59 - 76)	77 (70.25 - 81)
	SMG	58 (53.5 - 61)	77 (74 - 81)	54 (42 - 69)	82 (78 - 85) (p<0.01)
ducts	PG	40.5 (34 - 45)	62 (52 – 68.75)	38 (27.25 - 45)	55 (47.75 – 69.25)
	SMG	25 (19.25 - 34)	69.5 (66 - 77)	19 (16 - 44)	63 (55 - 65)

Discussion

Our results showed that long-term ethanol consumption (180 days) in an amount of 7 g/kg per day causes different morphological changes in PG and SMG. More negative impact has affected SMG. If in PG the stroma had moderate fatty infiltration in the form of large adipocytes with the presence of isolated lymphocytic foci, then in SMG complete fatty infiltration and stromal edema were observed. The lipid inclusions found in the acinar cells of the salivary glands are probably associated with disorders of fatty acid metabolism and autonomic innervation of the glands [14]. In addition, more significant structural changes in the acini and ducts were noted in the SMG, which is probably a way to repair the damage caused by alcohol intoxication. It is generally accepted that PG is more vulnerable to toxic agents under the condition of short-term alcohol intoxication [15, 16]; our study covered a longer period of time - 180 days. Probably, PG cells gradually adapted to chronic ethanol intoxication, while SMG cells are more resistant to short-term exposure to the toxin.

We paid special attention to the study of MC, since their state in PG and SMG under conditions of chronic alcohol intoxication of the body remains poorly understood. We have shown that under conditions of chronic alcohol intoxication there was a clear increase in the number of MCs in the salivary glands, especially in the connective tissue layers near the excretory ducts, which is consistent with the literature data, which indicate an increase in MC content in various organs under the influence of alcohol [17]. At the same time, it is interesting that the absolute majority of MCs were in a state of degranulation, due to which the degranulation index doubled. The salivary glands are the organs that excrete ethanol and its metabolite acetaldehyde. Thus, we have shown that, entering the salivary glands, ethanol as an irritant causes a high degree of MC activation, accompanied by their enhanced maturation and intense degranulation. It can be assumed that such a high degree of MC degranulation under the influence of alcohol intoxication causes activation of additional regulatory mechanisms in the salivary glands aimed at accelerated excretion of ethanol and toxic metabolic products from the body.

It is known that the toxic effect of alcohol on the body changes the activity of alkaline phosphatase. It was shown that short-term (10 days) ethanol intoxication of animals did not affect the enzyme activity in the intestine; however, it markedly increased after 20 or 30 days, and after 42 days it decreased both in the soluble and in the membrane fractions of the intestine [18]. Dal Prá, K.J. et.al. have shown that 30-day consumption of the strong Brazilian drink cachaça causes a decrease or complete loss of the functional activity of alkaline phosphatase in the SMG [19]. Our data indicate a significant twofold increase in the enzyme activity in SMG and PG rats after 180-day ethanol intoxication. Probably, this fact may indicate the degree of disturbances in physiological processes in the body.

The early manifestations of alcoholic pathology are based on a violation of tissue respiration due to a change in the level of components of the respiratory chain and an increase in the production of free radicals. SDH plays not only a central role in the Krebs cycle and the respiratory chain, but also differs from other mitochondrial dehydrogenases in its unique redox effect. We have shown that under conditions of 180-day intoxication, the level of SDH activity in the salivary glands of rats remains the same as in the control group. Therefore, this enzyme is quite stable.

It is known that ethanol activates NADPH-oxidase [20]. We found that after prolonged 180-day intoxication with ethanol in the acini and ducts of PG rats, the activity of NADPH-oxidase remained at the control level, while in SMG only in the acini the activity of the enzyme increased statistically significantly. Therefore, by our research, we confirmed that PG showed greater resistance to prolonged alcohol intoxication, while SMG is more susceptible to oxidative stress and associated morphological changes.

References

1. F. Riedel, U.R. Goessler, K. Hormann, *Alcohol-related diseases of the mouth and throat*, *Dig Dis*. 23 (3-4) (2005) 195–203. <https://doi.org/10.1159/000090166>
2. M. Carranza, M.E. Ferraris, M. Galizzi, *Structural and morphometrical study in glandular parenchyma from alcoholic sialosis*, *J. Oral Pathol. Med.* 34 (6) (2005), 374–379. <https://doi.org/10.1111/j.1600-0714.2005.00281.x>
3. L. Bohl, C. Merlo, C. Carda, M.E. Ferraris, M. Carranza, *Morphometric analysis of the parotid gland affected by alcoholic sialosis*, *J. Oral Pathol. Med.* 37 (8) (2008) 499–503. <https://doi.org/10.1111/j.1600-0714.2008.00648.x>
4. L.M.P. Fernandes, F.B. Teixeira, S.M. Alves-Junior, J. de J.V. Pinheiro, C.S.F. Maia, R.R. Lima, *Immunohistochemical changes and atrophy after chronic ethanol intoxication in rat salivary glands*, *Histol Histopathol.* 30 (2015) 1069–1078. <https://doi.org/10.14670/HH-11-604>
5. N.C. Fagundes, L.M. Fernandes, R.S. Paraense, P.M. de Farias-Junior, F.B. Teixeira, S.M. Alves-Junior, J. Pinheiro Jde, M.E. Crespo-Lopez, C.S. Maia, R.R. Lima, *Binge Drinking of Ethanol during Adolescence Induces Oxidative Damage and Morphological Changes in Salivary Glands of Female Rats*, *Oxid Med Cell Longevity*, (2016) 1–11. <https://dx.doi.org/10.1155/2016/7323627>
6. I.M. Trakhtenberg, R.E. Sova, V.O. Sheftel, F.A. Onikienko, *The problem of the norm in toxicology (modern concepts and methodological approaches, basic parameters and constants)*, Moscow, 1991. [In Russian]
7. Order of the Ministry of Health of the USSR of 08/12/1977 No. 755 “On measures to further improve organizational forms of work with the use of experimental animals”. [In Russian]
8. Collected Legislation of the Russian Federation of 1999, No. 50, Art. 6126. [In Russian]
9. C. Merlo, L. Bohl, C. Carda, M.E. Gomez de Ferraris, M. Carranza, *Parotid sialosis: morphometrical analysis of the glandular parenchyma and stroma among diabetic and alcoholic patients*, *J Oral Pathol Med.* 39 (1) (2010) 10–15. <https://doi.org/10.1111/j.1600-0714.2009.00806.x>
10. A.A. Artishevsky, A.A. Leontyuk, A.S. Sluka, *Histology with the technique of histological research: Textbook*, Minsk, 1999. [In Russian]
11. V.S. Gordova, E.P. Ivanova, V.E. Sergeeva, *Properties of toluidine blue stained mast cells in the experiment with the intake of soluble silicon*, *Vestnik IKBFU. Natural and Medical sciences.* 2 (2018) 97–104. [In Russian]
12. M.S. Burstone, *Postcoupling, noncoupling, and fluorescence techniques for the demonstration of alkaline phosphatase*, *J Natl C.ancer Inst.* 24 (1960) 1199–1217.
13. Z. Lojda, *Remarks on histochemical demonstration of dehydrogenases. II. Intracellular localization*, *Folia Morphol (Praha).* 13 (1965) 84–96.

14. G. Guan, J. Won, L. Mei, A. Polonowita, *Extensive adipose replacement of the parotid glands: an unusual presentation of sialadenosis. A Case Report and Literature Review*, *Oral Surg.* 13 (1) (2020) 41–47. <https://doi.org/10.1111/ors.12442>

15. S.E. Maier, J.R. West, *Regional differences in cell loss associated with binge-like alcohol exposure during the first two trimesters equivalent in the rat*, *Alcohol.* 23 (1) (2001) 49–57. [https://doi.org/10.1016/s0741-8329\(00\)00133-6](https://doi.org/10.1016/s0741-8329(00)00133-6)

16. L. Busch, L. Sterin-Borda, E. Borda, *Differences in the regulatory mechanism of amylase release by rat parotid and submandibular glands*, *Arch Oral Biol.* 47 (10) (2002) 717–722. [https://doi.org/10.1016/s0003-9969\(02\)00057-2](https://doi.org/10.1016/s0003-9969(02)00057-2)

17. L.O. Mendes, J.P. Amorim, G.R. Teixeira, L.G.A. Chuffa, B.A. Fioruci, T.A. Pimentel, W. de Mello Jr, C.R. Padovani, S. Pereira, M. Martinez, P.F. Pinheiro, S.M. Oliani, F.E. Martinez, *Mast cells and ethanol consumption: interactions in the prostate, epididymis and testis of UChB rats*, *Am J Reprod Immunol.* 66 (3) (2011) 170–178. <https://doi.org/10.1111/j.1600-0897.2010.00958.x>

18. D. Bansal, C.P. Sodhi, S. Mahmood, A. Mahmood, *Effect of chronic ethanol feeding on intestinal alkaline phosphatase activity in rats*, *Indian J Med Res.* 107 (1998) 118–122.

19. K. J. Dal Pra, A. de Fatima Moraes da Silva, A.H. Chaves-Neto, A.M.P. Soubhia, *Effects of cachaça, a typical Brazilian alcoholic beverage, on submandibular glands of rats: a histomorphometric and biochemical study*, *Clin Oral Invest.* 24 (2020) 4283–4290. <https://doi.org/10.1007/s00784-020-03290-9>

20. J.A. Simplicio, U.V. Hipolito, G.T. do Vale, G.E. Callera, C.A. Pereira, R.M. Touyz, R.C. Tostes, C.R. Tirapelli, *Acute ethanol intake induces NAD(P) H oxidase activation and Rhoa translocation in resistance arteries*, *Arq Bras Cardiol.* 107 (5) (2016) 427–436. <https://doi.org/10.5935/abc.20160147>

与更年期相关的动脉高血压女性的动脉僵硬度
**ARTERIAL STIFFNESS IN WOMEN WITH ARTERIAL
HYPERTENSION WITH REGARD TO MENOPAUSE**

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抽象的。考虑到妇科病史，预防和治疗女性动脉高血压的个体化方法应该是个性化医疗的基础。在大学的临床基础上，对 92 名先前被诊断出患有动脉高血压的女性进行了检查。比较是根据人体测量数据、生化血液检查指标和脉搏波速度指标进行的，该指标表征动脉僵硬。揭示了随着血压数值的增加，脉搏波的速度增加。该研究还证实了早期、充分选择的更年期激素治疗对动脉高血压病程的影响。

关键词：动脉高血压，动脉僵硬，更年期

Abstract. *An individual approach to the prevention and treatment of arterial hypertension in women should be the basis of personalized medicine, taking into account the gynecological history. On the clinical basis of the university, 92 women with previously diagnosed arterial hypertension were examined. The comparison was carried out according to anthropometric data, indicators of biochemical blood tests and an indicator of pulse wave velocity, which characterizes arterial stiffness. An increase in the speed of the pulse wave with an increase in the blood pressure numbers was revealed. The study additionally confirmed the effect of early, adequately selected menopausal hormone therapy on the course of arterial hypertension.*

Keywords: *arterial hypertension, arterial stiffness, menopause*

The leading pathology contributing to the risk of cardiovascular complications and mortality in older patients is arterial hypertension (AH) [1]. Of great practical importance is the relationship between age and AH observed during the aging pro-

cess [2]. This is accompanied by a number of changes in the vascular system, in particular, endothelial dysfunction, increased vascular stiffness, vascular wall remodeling and inflammation, which determine the so-called "vascular phenotype" of AH [3].

Arterial stiffness, which is a marker of vascular damage and an independent predictor of cardiovascular disease, can be used as an indicator of vascular aging.

The pulse wave velocity in the carotid-femoral area is currently considered the most informative indicator of arterial stiffness, reflecting the combined effect of known and unknown risk factors for damage to the arterial wall [4]. Previous studies on gender differences indicate that women are characterized by a higher arterial stiffness with a subsequent increase in the load on the left ventricle of the heart and an increased risk of developing heart failure with a preserved ejection fraction [5,6].

On a clinical basis of A.I. Yevdokimov Moscow State University of Medicine and Dentistry, a single study included 92 patients in menopause, both natural and surgical, with a previously established diagnosis of AH. Clinical examination of patients included clarification of complaints, detailed collection of gynecological anamnesis for women, specifying the presence (and duration) or absence of menopausal hormone therapy; arterial hypertension and identification of risk factors for arterial hypertension and coronary heart disease; clinical examination, which included measurement of blood pressure (BP), heart rate (HR), height, weight, calculation of the body mass index (BMI) by the Quetelet index [body weight (kg)/height (m²)]. The patients underwent a biochemical blood test: total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglycerides (TG), glucose were determined. To assess vascular stiffness, the pulse wave velocity was measured in the area from the carotid to the femoral artery. Pulse wave velocity (PWV) was measured using a Pulse Trace PWV device (Micro Medical, United Kingdom), which measures arterial stiffness between two points of the arterial system.

Descriptive statistics, including the number of observations in each group, mean (M), standard deviation (SD), and percentages were given for all indicators, depending on the nature of the data. Comparison of dependent groups for quantitative variables with parametric distribution of data was carried out using the Student's t-test, with nonparametric distribution - using the Smirnov-Kolmogorov test. All statistical tests were performed for a two-tailed level of statistical significance ($p < 0.05$).

The patients were divided into three subgroups depending on the severity of the course of arterial hypertension.

Table 1.
Characteristics of patients with AH, depending on its degree

Indicator	Patients with grade 1 AH	Patients with grade 2 AH	Patients with grade 3 AH
Number of patients	57	24	11
Age (years)	52.05±6.59*	57.00±5.49	57.73±6.56
Height (cm)	163.76±5.41	162.75±5.29	150.63±30.74
Weight, kg)	74.73±15.31*	81.79±13.48	89.55±29.61
BMI (kg/m ²)	27.89±5.57*	30.86±4.87	31.70±8.76
SBP (mmHg)	133.60±3.87*	151.04±6.42**	175.45±12.93***
DBP (mmHg)	85.96±6.78*	96.04±6.75**	107.27±11.04***
HR (beats/min)	74.77±11.38*	68.33±9.06**	77.82±13.68
PWV (m/s)	11.15±2.09*	13.58±3.71	15.24±3.27***
TC (mmol/l)	5.72±1.19	5.57±1.38	5.74±0.93
TG (mmol/l)	1.35±0.75	1.40±0.62	1.47±0.77
LDL-C (mmol/l)	3.72±0.51	3.09±0.38	3.53±0.69
HDL-C (mmol/l)	1.50±0.43	1.37±0.27	1.23±0.34***
Glucose (mmol/l)	5.22±0.66	5.14±0.92	5.23±0.60
Duration of AH disease (years)	4.60±4.42*	10.38±9.45	12.7±9.63

* - p<0.05 between 1st and 2nd groups of patients

** - p<0.05 between the 2nd and 3rd groups of patients

*** - p<0.05 between 1st and 3rd groups of patients

Analyzing the results obtained, presented in table 1, it should be noted the presence of unidirectional changes in BP values (SBP, DBP) and dynamics of the pulse wave velocity depending on the degree of AH. Thus, in patients of the 1st group, the mean values of arterial stiffness were less than in the other groups, but reached values of 10 m/s, which determine the risk of cardiovascular complications [7]. As the course of AH worsened (progression of the degree of the disease), an increase in the pulse wave velocity was noted, the magnitude of which significantly differed from those in patients of the 1st group. The average absolute values of PWV in the 2nd and 3rd groups significantly exceeded the "safety threshold" for the development of cardiovascular complications. Thus, there is an undeniable relationship between the progression of AH and the increase in arterial stiffness in women with essential hypertension. This conclusion is undoubtedly of great importance for the implementation of preventive and therapeutic measures. Analyzing the metabolic parameters of patients with AH, it should be noted that

in all three groups the examined women had increased BMI values corresponding to various degrees of obesity, as well as lipid metabolism disorders corresponding to atherogenic dyslipidemia (increased concentration of LDL-C and decreased HDL-C). These disorders of lipid metabolism did not have regular differences depending on the severity of AH, with the exception of HDL-C, a significant and significant decrease in which was found in patients of the 3rd group. Thus, metabolic disorders of varying severity are present at all, including at the early stages of the development of the disease, thereby participating in the development of AH complications and, above all, the formation of arterial stiffness.

In addition, the patients underwent an analysis of the peculiarities of their gynecological status. Of interest were the cause of menopause and the menopausal hormone therapy (MHT) carried out in some cases.

All women in the natural menopause subgroup did not receive menopausal hormone therapy. Most patients from the subgroup with surgical menopause had a history of taking menopausal hormone therapy, so it seemed interesting to compare these two subgroups with each other, taking into account the degree of arterial hypertension.

Table 2.
Main indicators in patients with AH grade 1, depending on the cause of menopause

Indicator	Surgical menopause (N=41)	Natural menopause (N=16)
Age, years	51.98±6.68	52.25±6.55
Height (cm)	163.35±5.46	164.81±5.28
Weight (kg)	72.58±10.72	80.25±22.88
BMI (kg/m ²)	27.24±4.08	29.56±8.21
SBP (mmHg)	133.29±3.81	134.38±4.03
DBP (mmHg)	87.07±6.52	82.50±5.48*
HR, beats/min	73.85±11.75	77.13±10.31
PWV (m/s)	10.90±1.97	11.78±2.31
TC (mmol/l)	5.66±0.99	5.89±1.75
TG (mmol/l)	1.26±0.70	1.70±0.87
LDL-C (mmol/l)	3.83±0.52	3.31±0.25
HDL-C (mmol/l)	1.56±0.41	1.19±0.45
Glucose (mmol/l)	5.28±0.67	4.98±0.60
Duration of AH disease (years)	4.78±4.86	4.12±3.09

* - $p < 0.05$ between the 1st and 2nd subgroups of patients

Analyzing the presented results, we did not find a significant difference in the vast majority of parameters. Despite the comparable age, at the time of the study, these subgroups differ significantly from each other. The difference is due to the fact that the first subgroup (surgical menopause) consists of patients in whom menopause occurred on average 10 years earlier due to surgery than the representatives of the second subgroup with natural menopause. On average, patients of the second subgroup are in a state of natural menopause for about 3 years. Patients in the surgical menopause subgroup received an adequately matched menopausal hormone therapy program, which appears to have contributed to the lack of differences between this subgroup and the subgroup of patients with natural menopause.

In the group of patients with grade 2 AH, there was no prescription for menopausal hormone therapy in women with natural menopause, therefore subgroups of women with surgical (n = 15) and natural menopause (n = 9) were compared in a similar way (table 3).

Table 3.
Main indicators in patients with AH grade 2, depending on the cause of menopause

Indicator	Surgical menopause (N=15)	Natural menopause (N=9)
Age, years	56.80±4.89	57.33±6.67
Height (cm)	163.00±4.68	162.33±6.46
Weight (kg)	85.77±12.64	75.17±12.81
BMI (kg/m ²)	32.26±4.47	28.53±4.85
SBP (mmHg)	152.33±6.51	148.89±6.01
DBP (mmHg)	95.67±6.78	96.67±7.07
HR, beats/min	67.67±6.91	69.44±12.25
PWV (m/s)	13.67±4.37	13.45±2.45
TC (mmol/l)	5.57±1.53	5.56±1.17
TG (mmol/l)	1.42±0.71	1.38±0.48
LDL-C (mmol/l)	3.09±0.38	3.31±0.25
HDL-C (mmol/l)	1.37±0.22	1.37±0.49
Glucose(mmol/l)	5.39±1.02	4.66±0.43
Duration of AH disease (years)	11.87±10.91	7.89±6.09

As can be seen from table 3, the reliability of differences was not revealed between patients with surgical and natural menopause, suffering from arterial hypertension of the 2nd degree, which is even more consistent with the previous

conclusions in patients of the 1st group, since the indicators and especially arterial stiffness do not significantly differ in subgroup of surgical menopause, despite a significantly longer history of AH.

In the third group of women with grade 3 AH (n=11), the distribution of women by type of menopause is presented as follows: 8 patients with surgical menopause; three women have natural menopause. It does not seem appropriate to make comparisons in this subgroup due to the small number of samples.

When conducting a correlation analysis on the relationship between the PWV indicator and clinical and anamnestic indicators, several significant ($p < 0.05$) correlations were obtained for groups of women with AH. Of considerable interest is the presence of a significant negative relationship between the value of the pulse wave velocity and the duration of menopausal hormone therapy, which additionally illustrates the previously found relationship between a better vascular condition in patients with AH of varying degrees. The increase in the strength of this bond is clearly demonstrated in table 4.

Table 4.

Correlation relationship between the index of stiffness of the arteries with clinical and anamnestic indicators by groups of patients

Correlations of PWV with different indicators	Patients with grade I AH	Patients with grade II AH	Patients with grade III AH
HR	-0.28	n.a.	n.a.
Duration of taking MHT	-0.27	-0.48	-0.71
Duration of AH disease	n.a.	0.41	n.a.

Analyzing the metabolic parameters of patients with AH, it should be noted that in all three groups the examined women had increased BMI values corresponding to various degrees of obesity, as well as lipid metabolism disorders corresponding to atherogenic dyslipidemia (increased concentration of LDL-C and decreased HDL-C). The indicated lipid metabolism disorders did not have regular differences depending on the severity of AH, with the exception of HDL-C, a reliable and significant decrease in which was found in patients with grade 3 AH. Thus, metabolic disorders of varying severity are present at all, including at the early stages of the development of the disease, thereby participating in the development of complications of arterial hypertension and, above all, the formation of arterial stiffness.

In patients with AH, we did not obtain significant differences in most of the

studied parameters depending on the cause of menopause (surgical or natural). This fact can be interpreted from the standpoint of the effectiveness of previously conducted menopausal hormone therapy, which neutralized the more severe effect of a sharp shutdown of the ovaries on the formation of pathology of cardiovascular diseases during surgical menopause. Of considerable interest is the presence of a significant negative relationship between the value of the vascular stiffness indicator and the duration of menopausal hormone therapy. Thus, this study additionally confirmed the effect of early, adequately selected menopausal hormonal therapy on the course of arterial hypertension.

References

1. Tkacheva O.N., Runixina N.K., Kotovskaya Yu.V. et al. *Arterial hypertension management in patients aged older than 80 years and patients with the senile asthenia. A position agreement of the experts of Russian association of gerontologists and geriatricians, Gerontological society of Russian Academy of Sciences, Russian medical society for arterial hypertension. Cardiovascular Therapy and Prevention. 2017; 16(1): 8-21. doi: 10.15829/1728-8800-2017-1-8-21 [in Russian].*
2. Wang M., Monticone R.E., Lakatta E.G. *Arterial aging: a journey into subclinical arterial disease. Curr Opin Nephrol Hypertens. 2010; 19(2): 201-207. doi: 10.1097/MNH.0b013e3283361c0b.*
3. Barja G. *Updating the mitochondrial free radical theory of aging: an integrated view, key aspects, and confounding concepts. Antioxid Redox Signal. 2013; 19(12): 1420-1445. doi: 10.1089/ars.2012.5148.*
4. Laurent S, Marais L, Boutouyrie P. *The Noninvasive assessment of vascular aging. Can J Cardiol. 2016;32(5):669–679. doi:10.1016/j.cjca.2016.01.039*
5. Coutinho T, Borlaug B, Pellikka P, Turner S, Kullo I. *Sex differences in arterial stiffness and ventricular-arterial interactions. J Am Coll Cardiol. 2013;61(1):96–103. doi:10.1016/j.jacc.2012.08.997*
6. Sapunova D. *Arterial hypertension - a view from the perspective of gender differences. International Conference “Scientific research of the SCO countries: synergy and integration”. Beijing, 4 AUGUST 2021. Melbourne, 2021. P. 119-125. DOI:10.34660/INF.2021.39.54.016*
7. *Cardiovascular prevention 2017. National Guidelines. Russian Journal of Cardiology. 2018;(6):7-122 (In Russ.) DOI:10.15829/1560-4071-2018-6-7-122.*

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COVID-19 大流行对临床试验方案修订风险的影响
**THE IMPACT OF THE COVID-19 PANDEMIC ON THE RISK OF
CLINICAL TRIAL PROTOCOLS AMENDMENTS**

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注解。显然，持续的 COVID-19 大流行情况对全世界所有人的生活和领域产生了巨大影响。临床试验也不例外。目标是评估大流行对协议修订出现概率的影响。我们的分析表明，现有的临床试验方案创建系统已被证明是非常充分的，并且作为大流行的不可预见的情况对修订数量几乎没有影响。

关键词：COVID-19，大流行，临床试验，修订，临床试验方案

Annotation. *Obviously ongoing COVID-19 pandemic situation had a great impact on all people's lives and spheres all around the world. Clinical trials aren't the exception. The goal was to evaluate the pandemic influence on probability of protocol amendments emergence. Our analysis indicated that the existing system of clinical trials protocols creation is proved to be quite adequate and an unforeseen circumstance as a pandemic have had little effect on the number of amendments.*

Keywords: *COVID-19, pandemic, clinical trials, amendment, clinical trial protocol*

Introduction

Obviously ongoing COVID-19 pandemic situation had a great impact on all life spheres: economics, society and, of course, on health care, including clinical trials. Many of them, especially clinical trials of innovative drugs, are international. Global lockdown measures, air, sea and overland transportation restrictions, and implemented in other countries limitations and rules all around the world caused by pandemic, created critical problems to conducting global trials. Clinical research is an important part of scientific research in medicine. All local instructions and COVID-19 implemented limitations are needed to take into consideration by Sponsor as the current situation makes it difficult to conduct clinical

research around the world [1].

Despite of ample resources turned on COVID-19 preventive and treatment trials, other treatment methods and disease prevention clinical trials not connected with COVID-19 are still ongoing.

Clinical trial Sponsors and participants are faced a number of problems due to pandemic situation. Firstly, some risks of viral spread among study participants, investigators and medical workers may arise. [2]. Secondly, there might be a problem with clinical trials conducting due to possible quarantine of study participants, hospital staff or their isolation caused by government travel ban. Thirdly, it is conceivable that clinical trial sites will be closed or there will be investigator medical product supply problems. Furthermore, there is a chance of overload and turned of healthcare system on COVID-19 disease control measures [3,4]. All these problems may have a great impact on data consistency and its interpretation obtained as a part of the studies, while the quality of clinical trials must stay high despite of the changes in the world around [1].

Before each clinical trial start-up a clinical protocol is created and approved to describe how and why it should be conducted [5]. Considering the fact that clinical trials are expensive and long- continued most of ongoing trials were planned before the beginning of pandemic [6,7]. Consequently, these pandemic risks weren't taken in consideration in these protocols.

As new facts which can effect on clinical trials results can appear during its conducting GCP provides the possibility of protocol updates [8]. These amendments can make trails more complicated and expensive [9].

Goals

To evaluate the pandemic influence on probability of protocol amendments emergence, we drew a comparison between amendments to ongoing non-COVID-19 trials, which were published in 2020, and amendments published in previous years.

Materials and methods

For possibility creating of protocol amendments evaluation, we drew a comparison between amendments to ongoing trials, which were published in 2020 and amendments published in previous years. We carried out an analysis of amendments (2017-2020 years) for Sponsor's protocols which were approved by Russian Health Care Authorities between 2017 and 2019 years included. All these trials didn't relate to any drugs against COVID-19.

Results and discussion

Facing a great number of amendments during these 4 years the majority of them had objective reasons to be published: ongoing drugs observations, legislations amendments etc. The quantity of protocol amendments within 4 years had increased. The minimum quantity of them was shown in 2017 -3 (8%) in 2018 - 9

(23%), little more in 2019 - 13 (33%). The biggest quantity was in 2020- 14 (36%).

In 2017 3 amendments were published, 2 of them were initiated by health authorities request and the last one was related to trail information update.

In 2018 9 amendments were announced and only 2 of them were connected with health authorities, 4 amendments were related to general corrections, 2 amendments were connected with adding minimal residual disease points and the last one with statistical section updates.

In 2019 from 13 published amendments 4 of them were initiated by health authorities, 4 were connected with clarifying the risks and efficacy of the investigational drug and concomitant therapy, one-with statistical section updates, one more was announced due to multiplication of participated in trials countries, another one to describe and improve trial procedures and one-by-one amendments connected with lexical errors and with adding another dosing regimen.

Despite of in 2020 the quantity of amendments reached its maximum (14) basically they were not related to COVID-19 pandemic situation. Thus, one amendment was associated with the identified risk of hepatitis B reactivation during treatment, the other with the addition of drugs as recommended concomitant therapy for patients participating in the study. One was due to a dosage change, additional patient allocation parameters and general information about the study, and the other two related to a change in procedures (15%). Large percentage (38%) of amendments was connected with health authorities' requests.

Based on the data obtained, we can say that the quantity of protocol amendments was maximum in 2020 and the entire quantity of protocols were increased as the direct dependence was shown, the scaling factor $r=1$. Proportion of amendments initiated by health authorities haven't been changing within 4 years, this means that health authorities didn't implicate in isolated trials it only published some recommendations. Meanwhile their requirements to conducting clinical trials haven't been changed and they are still controlling all ongoing studies.

In 2020 only one amendment (8%) was related to COVID-19 pandemic situation and was published due to difficulty of performing visits by patients and getting Investigational Medicinal Product. In this connection, schedule of visits was corrected and an opportunity of home investigational medicinal product delivery was afforded. This amendment brought certain physical and material inconveniences to the pharmaceutical company due to the organization of drug delivery events and the postponement of visits, and also affected the research team due to additional paperwork. At the same time, distribution pattern of the reasons creating protocol amendments has not been changed dramatically.

Thus, we can conclude that the existing system of clinical trials protocols creation is proved to be quite adequate. Even such an unforeseen circumstance as a pandemic have had little effect on the structure of the protocols and the number of

amendments. As a result, despite the pandemic situation in the world, the Sponsor can get reliable data at the end of the ongoing research.

References

1. Kunz C. U. et al. *Clinical trials impacted by the COVID-19 pandemic: Adaptive designs to the rescue?* // *Statistics in Biopharmaceutical Research*. – 2020. – T. 12. – №. 4. – P. 461-477.
2. Asaad M., Habibullah N. K., Butler C. E. *The impact of COVID-19 on clinical trials* // *Annals of surgery*. – 2020. – T. 272. – №. 3. – P. e222.
3. Akacha M. et al. *Challenges in Assessing the Impact of the COVID-19 Pandemic on the Integrity and Interpretability of Clinical Trials* // *Statistics in Biopharmaceutical Research*. – 2020. – T. 12. – №. 4. – P. 419-426.
4. Vissers M. F. J. M. et al. *The impact of the global COVID-19 pandemic on the conduct of clinical trials: Return to normalcy by considering the practical impact of a structured ethical analysis* // *British Journal of Clinical Pharmacology*. – 2021. – T. 87. – №. 3. – P. 837-844.
5. Ermolaev D.O. et al. *Clinical studies on humans: issues of protection of human and civil rights and freedoms* // *Modern problems of science and education*. – 2016. – No. 3. – P. 138.
6. Leonova M.V., Asetskaia I.L. *Development of the Protocol and individual registration card of the study* // *Qualitative clinical practice*. – 2008. – No. 2. – P. 14-20.
7. URL : https://www.fda.gov/patients/drug-development-process/step-3-clinical-research#Clinical_Research_Phase_Studies
8. *European Medicines Agency. Integrated addendum to ICH E6R1: guideline for good clinical practice E6 (R2)*. – 2016. – p. 45
9. Getz K. A. et al. *The impact of protocol amendments on clinical trial performance and cost* // *Therapeutic innovation & regulatory science*. – 2016. – T. 50. – №. 4. – p. 436-441.

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提高学生自我调节和适应压力负荷的有效性
**IMPROVING THE EFFECTIVENESS OF SELF-REGULATION AND
ADAPTATION OF STUDENTS TO STRESSFUL LOADS**

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抽象的。 文章介绍了学生中枢神经系统心理生理自我调节特点和适应能力的研究结果。 提出了一种通过在压力情况下优化功能状态和发展自我调节能力来提高学生适应能力的方法。

关键词: 适应能力, 学生, 自我调节, 功能状态, 生物防治

Abstract. *The article presents the results of a study of the characteristics of psychophysiological self-regulation and adaptive capabilities of the central nervous system of students. A method is proposed for increasing the adaptive capabilities of students by optimizing the functional state and developing self-regulation skills in stressful situations.*

Keywords: *adaptive capabilities, students, self-regulation, functional state, biocontrol*

It is known that students are one of the groups most at risk of developing maladaptive disorders, often lacking developed self-regulation skills and the ability to economically manage their psychophysiological resources [4].

The adaptive systems of the body, and especially the nervous system of young people, experience overloads under the influence of informational, emotional and physical influences, which often leads to the disruption of regulatory mechanisms and the development of a number of psychosomatic pathologies [5].

Correction of these problems is often carried out using methods aimed at reducing neuropsychic stress by teaching relaxation techniques, auto-training, breathing exercises, meditation, visualization, self-massage, group psychotherapy [3, 6]. The disadvantage of these methods is the high dependence on subjective factors,

such as personal characteristics and motivation of the participants in therapy. In addition, they are not always effective due to the impossibility of an objective assessment by the student of his psychophysiological state and its dynamics.

A promising area related to teaching self-regulation skills is the technology of instrumental biocontrol based on the principles of biofeedback (BFB). Biofeedback is used to teach optimal psychoemotional self-regulation under conditions of current stress [1]. This technology has a number of advantages: the almost complete absence of contraindications and side effects, the absence of pharmacological and physiotherapeutic interventions, the comfort of the procedure for the patient, and the availability for use in an educational institution.

Despite the fact that there are quite a lot of studies devoted to the study of the functional states of students during adaptation to training loads in the literature, the inconsistency of some of the conclusions and the low degree of implementation of the results of such studies into practice draws attention. In connection with the above, **the purpose of the study** was to study the features of adaptive reactions and self-regulation of students and develop a method for their improvement using biocontrol technology.

The research was carried out on the basis of the research laboratory of Krasnoyarsk State Pedagogical University named after V. P. Astafyev. The study involved 100 students aged 18 to 21 years. The study was conducted with the informed consent of the participants. Determination of adaptive reserves was carried out using the method of cerebral omegametry, which included registration of the stable potential of the millivolt range (omega potential) in the projections of the frontal cortex of the right and left hemispheres of the brain [2, 7], as well as psychological testing with stress load simulation - game biocontrol under control of heart rate (HR).

According to omegametric data, in a state of calm wakefulness with a normal training load, 46% of the subjects had a normal level of brain activation, 20% had depression of activation influences and a low level of wakefulness, 7% had an excessively high level of activation of the frontal cortex, 27% of the omega potential of the left and the right hemisphere at different levels.

After a test session of biocontrol, high and medium levels of self-regulation were found in 41% of the participants, 59% had a low or below average level of self-regulation.

The most effective self-regulation was achieved by subjects with an average level of activation (20-40 mV) and dominance of the left hemisphere of the brain, although individuals with a low level of activation were characterized by a moderate increase in HR with a significantly lower ($p < 0.001$) average heart rate in comparison with the rest of the subjects.

Thus, it was found that the level of brain activation, which ensures a func-

tional state, affects the success of self-regulation under conditions of emotional stress, and therefore a normal level of activity of the nervous system is necessary to ensure effective adaptation, including to training loads. We used this fact to develop a way to increase the adaptive reserves of students. The essence of the method consists in teaching techniques and techniques of self-regulation, individually selected for each student, depending on his functional state and aimed at its optimization:

- With a low level of activation, neuropsychological exercises are used to activate and increase the tone of the nervous system: movements of the eyes in all directions and in a circle; finger gymnastics; self-massage of earlobes and fingers; search for numbers in Schulte tables; frequent deep breathing, etc.);

- High level of activation: techniques are used to relax and reduce emotional stress: diaphragmatic breathing; breathing with delayed exhalation; breathing with the account of inhalation and exhalation; progressive muscle relaxation; visualization of pleasant memories; elements of autogenous training and meditation.

- High asymmetry of activation: tasks are used to improve interhemispheric interaction: drawing with 2 hands at the same time simple geometric shapes; breathing alternately through the right and left nostril; cross movements with the intersection of the center of the body.

The fixation of the most effective methods was carried out using biofeedback (game biofeedback).

In the experimental substantiation of the proposed method was attended by 32 students aged 18 to 21 years, who were divided into experimental and control groups. In the experimental group, a course of biofeedback with biofeedback sessions was conducted depending on the level of brain activation with the selection of individual techniques and exercises, in the control group there were no special training and education. The results of the experiment are shown in the table.

Table.

Physiological indicators after a course of biofeedback in individuals with different levels of voluntary self-regulation success (N = 32)

Indicator	Group			
	Experimental (n=16)		Control (n=16)	
	Before the course	After the course	Before the course	After the course
OP of the left hemisphere, mV	19.2 ± 2.4	26.6 ± 2.2*	11.3 ± 3.1	15.6 ± 2.9* #
OP of the right hemisphere, mV	31.2 ± 2.7	25.92 ± 2.5 *	23.7 ± 2.7	18.3 ± 3.5* #

Interhemispheric asymmetry, mV	-12.0 ± 1.2	0.7 ± 0.5*	-12.4 ± 1.3	-5.7 ± 1.1* #
Interhemispheric asymmetry, mV	-5 ± 2.12	1 ± 1.12	-7 ± 3.12	-3 ± 2.12
Time to reach the "plateau", sec	204 ± 50	89 ± 36	253 ± 59	131 ± 51
Maximum potential amplitude, mV	25.1 ± 5.2	7.6 ± 4.0	20.4 ± 5.1	15.1 ± 3.4
HR, bpm	86.2 ± 2.7	72.1 ± 2.2*	84.7 ± 2.5	79.4 ± 2.3* #

Note: * - reliability of differences between groups according to the Mann-Whitney test, # - reliability of differences within the group according to the Wilcoxon test

Comparison of the initial parameters before the biofeedback course in the selected groups did not reveal significant differences, which indicates their homogeneity. At the same time, after the end of the course in the experimental and control groups, there were significant changes in the characteristics of the omega potential. There was a decrease in interhemispheric asymmetry, normalization of OP parameters and heart rate. However, in the control group, fewer positive shifts were observed, which was expressed in non-optimal values of the omega potential, large values of the wave amplitude and slower stabilization of oscillatory processes.

After the course of correction, a significant decrease in the representation of insufficient and asymmetric activation of the central nervous system was noted in the absence of a state of hyperactivation in the experimental group. In 90% of the subjects, the omega potential corresponded to the optimal level. At the same time, 75% showed a decrease in interhemispheric asymmetry, which averaged 1.6 mV. In the control group, there was a shift towards a decrease in the level of activation while maintaining a high interhemispheric asymmetry, 40% had a low level of activation, 32% had an asymmetric level, which can be considered as a sign of a suboptimal state of the brain and the body as a whole.

Comparison of the coefficient of efficiency of heart rate control showed that in the experimental group, the success of mastering the skills of self-regulation was on average 35-40% higher than in the control group.

Thus, the proposed method solves the problem of increasing the adaptive reserves of students, which contributes to the improvement of the functional state and performance through the development of productive strategies for self-regulation and normalization of the functional state of the brain of students.

References

1. Jafarova O. A. *Biofeedback in pedagogy and psychology // Materials of the scientific-practical conference "Modern problems of psychology and education in the context of work with various categories of children and youth". 2018. V. 26. P. 39-43.*
2. Ilyukhina V.A. *Ultraslow information-control systems in the integration of vital processes of the brain and the body // Human Physiology. 2013. V. 39, № 3. P. 114.*
3. Karjakina T.N., Golub O.V. *Methods of self-regulation of functional states of the individual // Logos et Praxis. 2006. №. 5. P.71-73.*
4. Kirsanov V.M., Shibkova D.Z. *Psychophysiological characteristics of the personality of students in the period of adaptation to training at the university // Siberian Pedagogical Journal. – 2012. №. 9. P. 127-132.*
5. Lisova N.A., Shilov S.N. *The effectiveness of energy supply of adaptive reactions among female students depending on the typological properties of temperament // Journ. of med.-biol. research. 2020. V. 8, № 3. P. 314–318.*
6. Malkov A.P. *Improving the performance of students with the use of methods of psychological self-regulation // Promoting the professional development of the personality and employment of young specialists in modern conditions. 2016. P. 82-87.*
7. Murik S. E. *Omegaelectroencephalography: formation history and diagnostic capabilities of the new method in electrophysiology // The bulletin of Irkutsk State University. «Geoarchaeology, Ethnology, and Anthropology Series». 2018. №. 26. P. 69-85.*

二酮衍生物作为真菌腐蚀抑制剂的研究
**STUDY OF DIKETONE DERIVATIVES AS INHIBITORS OF
MYCOLOGICAL CORROSION**

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抽象的。该文章描述了使用二酮的两种衍生物作为抑制剂来防止微生物腐蚀的可能性。已经研究了基于固体醇、4,4,4-三氯-1-(3-氯苯基)丁烷-1,3-二酮衍生物的混合物的组合物,这些组合物在初步研究中已在低浓度下显示出它们的杀真菌特性。该研究是在钢种 St3 的样品上进行的。28 天后,在曲霉属、青霉属微生物的影响下。和木霉属。研究了表面的生长速度和涂抹(以确定材料的抗真菌性)。根据获得的数据得出结论,由于涂层的低真菌抗性和样品的高生长速率,不可能使用 lis-24 和 lis-86 作为真菌腐蚀抑制剂。Lis-89 对曲霉菌属的微生物有足够的保护作用,但是,它对其他微生物的抵抗力比对照组差。

关键词: 生物腐蚀, 霉菌, 缓蚀剂, 二酮

Abstract. *The article describes the possibility of using two derivatives of diketones as inhibitors for protection against micromycete corrosion. Compositions based on a mixture of solidol, derivatives of 4,4,4-trichloro-1-(3-chlorophenyl) butane-1,3-dione, which in preliminary studies have shown their fungicidal properties in low concentrations, have been investigated. The study was carried out on samples of steel grade St3. After 28 days under the influence of micromycetes of the genera Aspergillus spp., Penicillium spp. and Trichoderma spp. the rate of growth and smear from the surface were studied (to determine the fungal resistance of the material). Based on the data obtained, it was concluded that it is impossible to use lis-24 and lis-86 as inhibitors of mycological corrosion due to the low fungal resistance of the coating and the high growth rate of the samples. Lis-89 sufficiently protects against micromycetes of the genus Aspergillus, however, it copes with other micromycetes worse than the control group.*

Keywords: *biological corrosion, micromycetes, corrosion inhibitors, diketones*

Introduction

At the moment, more and more attention is paid to the processes occurring at the intersection of sciences. One of these processes is biological corrosion. Microbiological corrosion (MBC) is a form of corrosion that is caused by the metabolic activity of microbial colonies, which may include bacteria and fungi [1]. This type of corrosion is one of the most destructive; some researchers cite data that $\frac{3}{4}$ of all losses from pipeline corrosion are caused precisely by microorganisms living in the soil [2].

Depending on the belonging of corrosive organisms to different kingdoms of the living, bacterial, mycological and mixed corrosion are distinguished.

The type of destruction caused by microscopic fungi or micromycetes is called mycological. Corrosion occurs under the influence of various aggressive environments that arise due to the presence of mold fungi. One of the biggest problems of this type of corrosion is the high adaptability of micromycetes to changing environmental conditions, as well as their huge species diversity. Another problem is that the habitat of micromycetes is soil and air, which is why almost all metal structures can be exposed to mold. Compared to bacterial corrosion, a larger volume of metal structures is susceptible to mycological. Not only ferrous, but non-ferrous metals are exposed to corrosion. Typical representatives of corrosive fungi are the genus *Aspergillus*, *Penicillium*, *Fusarium*, *Cladosporium* and *Trichoderma*.

If we talk about the effect of microorganisms on metals, then there are several types. The most common: direct influence of metabolites, often of various acids, such as hydrogen sulfide and various organic, or ammonia [3], on the metal surface, or coating the surface with build-ups and films, under which pitting corrosion can develop.

The effect of micromycetes on the corrosion rate can be diametrically opposite, as some researchers cite data on the inhibitory effect of *Cladosporium herbarum* on the surface of aluminum samples and a simultaneous increase in the corrosion rate under the influence of *Aspergillus niger*. Some authors [4] have shown that the inhibiting effect of fungi on steel and aluminum corrosion consists primarily in increasing the resistance to charge transfer through the inner oxide layer [5].

Many organic substances can be used to protect metals from biocorrosion. However, a problem arises as some substances may be suitable for bacterial corrosion, but not suitable for mycological. For example, N-benzyl-diethylenediammonium chloride has a high inhibitory activity against bacteria, but its effect on micromycetes has not been studied [6].

From all of the above, the relevance of the study follows. There are not so many methods of protection against micromycete corrosion, while micromycetes do great damage to metal structures.

Methodology

To study the antimicrobial activity of substances that in the future can be used as inhibitors of mycological corrosion, we used the method of two-fold serial dilutions in a liquid nutrient medium by the micro method [7]. In the wells of a sterile 96-well flat-bottomed microplate, two parallel rows of two-fold serial dilutions of chemical compounds in Sabouraud broth were prepared. Each well contained 150 μ l of a certain concentration of the test substance and 150 μ l of culture inoculum. The last rows contained the nutrient medium and culture in equal volumes (control). The microplate was placed in a thermostat of an Epoch spectrophotometer and the optical density (OD) was measured at a wavelength of 540 nm. After 48 hours and 7 days, the OD of the culture fluid was again recorded. The study involved 3 substances, the structure of which is shown in Figure 1.

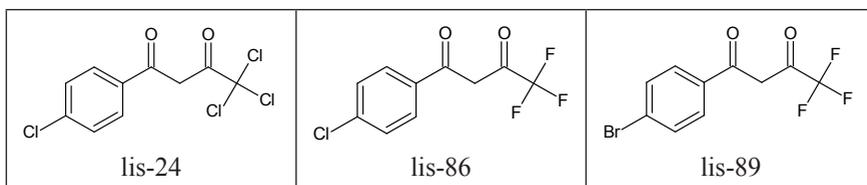


Figure 1. Structural formulas of the most effective compounds

An aqueous suspension of fungal spores was prepared from the micromycete colonies (*Aspergillus*, *Penicillium*, and *Trichoderma*) isolated from soil and water samples from the Perm Territory, grown for 14 days at a temperature of $29 \pm 1^\circ\text{C}$ on a chapek slant nutrient medium. The spore load of each fungus in distilled water was prepared according to the McFarland turbidity standard using a densitometer OD = 1.0 equal to 109 microbial cells / μ l.

Due to the fact that the selected substances are poorly soluble in water, but well in organic solvents, it was decided to use solidol as a solvent for the substances.

To study the inhibitory effect of the selected substances, the method of studying the fungal resistance of the metal was used. Samples of steel grade St3 (C 0.14-0.22%; Ni not more than 0.3%; Cu not more than 0.3%; Cr not more than 0.3%; Mn 0.4-0.65%; Si 0.05-0.17%; As not more than 0.08%; S not more than 0.05; P not more than 0.04% [8]). Samples with an area of 14 and 22 cm^2 were covered with a mixture of solidol and a representative of a number of diketones, kept for a day, after which they were weighed and placed in a Petri dish. An aqueous suspension of spores of each type of fungi was used to infect prototypes of steel with inhibitors; the steel surfaces were irrigated with a spray gun until they were completely moistened, preventing droplets from merging. The contaminated samples were placed in pre-prepared desiccators, on the bottom of which water was poured

and thermostatic at a temperature of $29 \pm 1 \text{ }^\circ\text{C}$ and a relative humidity of more than 90% for 28 days. After testing, the samples were removed from the desiccator and examined visually, re-weighed on an analytical balance to determine the rate of rise, and then using a Micromed microscope with a TouPCam digital camera and TouP View software, at a magnification of $\times 10$, each steel variant was evaluated for the presence or absence of mushrooms according to the point system [9]. The control of the viability of mold spores was pure cultures applied in the form of drops on the surface of the slant agar culture medium in test tubes. The results of the growth and development of micromycetes were confirmed after 5 days.

Results

Anti-fungicidal activity tests

Diketone halide derivatives were chosen as the proposed inhibitors. Earlier [11], similar compounds proved their antimicrobial activity in small doses. Within the framework of this study, the minimum inhibitory concentration (MIC) and the minimum fungicidal concentration (MFC) were determined based on the data on the change in optical density over time (Fig. 2). It was found that lis-24, lis-86 and lis-89 exhibit their antimycological activity already at concentrations of 3.9 - 7.8 $\mu\text{g} / \mu\text{l}$.

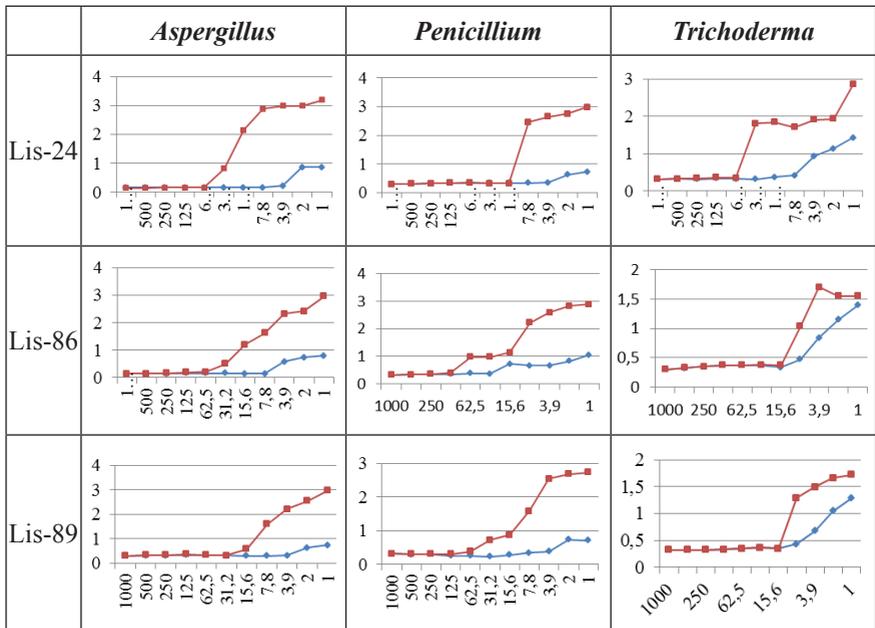


Figure 2. Change in optical density of samples on the second (blue) and tenth days (red)

Corrosion tests

After carrying out gravimetric tests for each compound, the average growth rates of the samples were determined. The results are shown in Figure 3. Samples treated with solidol were used as a control group. The results of the effect of micromycetes on the surface of steel without protective coatings were described earlier [10]. Along with this, the protective effect of the diketone derivatives was calculated. However, none of the substances showed a positive value.

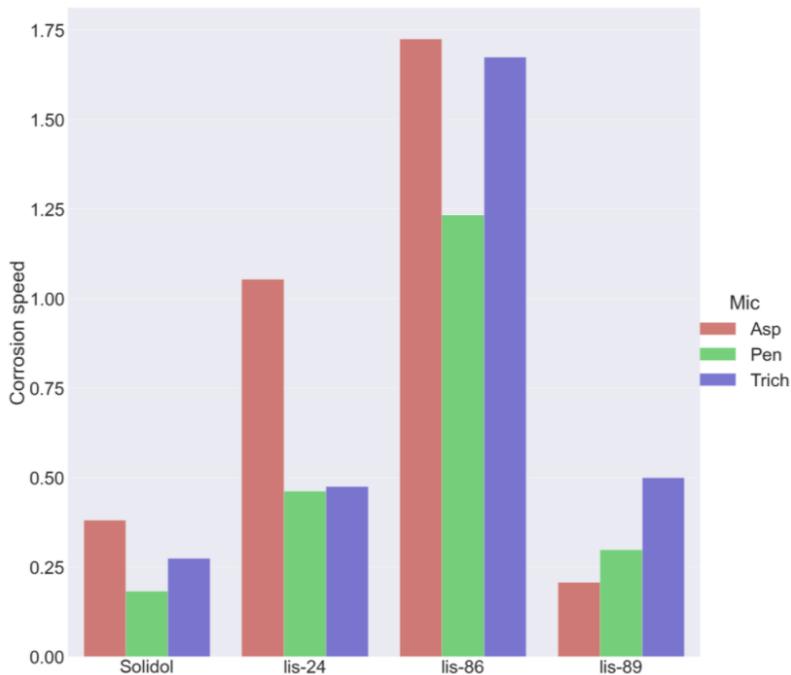


Figure 3. Growth rate diagram of samples, $g/(m^2 \cdot hour)$

Table 2.

The results of the study of scraping from the surface of metals

Inhibitor	Microscopy	Grade
Lis-24	Discovered spore germination, mycelium, sporulation	3
Lis-86	Discovered spore germination, mycelium	2
Lis-89	Discovered spore germination, mycelium	2
Solidol	Discovered spore germination, mycelium	2

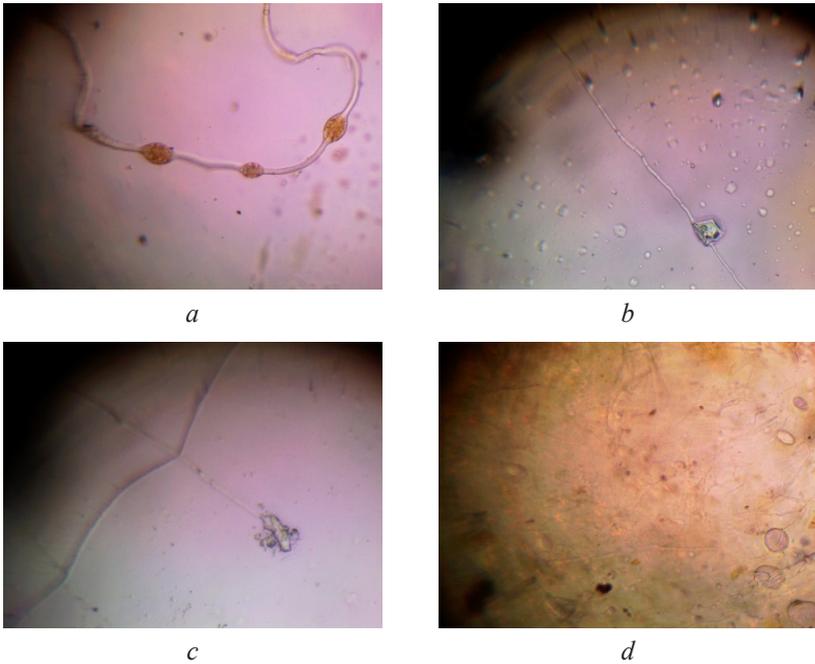


Figure 4. Micrographs of a smear taken from a sample: *a* – *lis-24*, *b* – *lis-86*, *c* – *lis-89*, *d* – *Solidol*

Conclusion

To protect metals from micromycetes, substances of the diketone halide group were proposed, which in preliminary studies showed fungicidal properties in low concentrations. To study their possible use as inhibitors of mycological corrosion, the effect of micromycetes on metals coated with protective films of solidol with the proposed substances was studied. Based on the results of the data on the rate of growth and the study of scraping to assess fungal resistance, it was concluded that it was impossible to use the substances *lis-24*, and *lis-86* as inhibitors. *Lis-89* partially copes with the task, however, its concentration is insufficient for use as an inhibitor.

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References

1. Beech, I.B. and C.C. Gaylarde, 1999. *Recent advances in the study of biocorrosion - an overview*. *Revista de Microbiologia*, 30: 177-190
2. Рязанов, А.В., Вигдович, В.И., Завершинский, А.Н. Биокоррозия металлов. Теоретические представления, методы подавления // *Вестник ТГУ*. 2003. №5. С. 821—837
3. Iyer, R. N., Pickering, H. W., Takeuchi, I., & Zamanzadeh, H. (1990). *Hydrogen Sulfide Effect on Hydrogen Entry into Iron. A Mechanistic Study*. *Corrosion*, 46, (6). 460–467.
4. Gunasekaran, G., Chongdar, S., Gaonkar, S. N., Kumar, P. *Influence of Bacteria on Film Formation Inhibiting Corrosion Corrosion Science* 46 2004: pp. 1953 – 1967.
5. Lugauskas, A., I. Prosycevas, R. Ramanauskas, A. Griguceviciene and A. Selskiene, 2009. *The Influence of Micromycetes on the Corrosion Behaviour of Metals (Steel, Al) under Conditions of the Environment Polluted with Organic Substances*. *Materials science*, 3(15): 224-235
6. Мухаммадеева Г.Р., Леваишова В.И., Черезова В.М. Исследование моно-*N*-бензилдиэтилендиаминоаммоний хлорида в качестве ингибитора биокоррозии // *Вестник технологического университета*. 2016. №4 (19). С.14–15
7. *Руководство по экспериментальному (доклиническому) изучению новых фармакологических веществ* - М.: И-во Медицина, 2005
8. ГОСТ 380-2005 «Сталь углеродистая обыкновенного качества»
9. ГОСТ 9.048-89 «Единая система защиты от коррозии и старения (ЕСЗКС). Изделия технические. Методы лабораторных испытаний на стойкость к воздействию плесневых грибов»
10. Медведева Н.А., Баландина С.Ю., Бортник А.Г., Плотникова М.Д., Лисовенко Н.Ю. О возможности влияния микромицетов на коррозионное поведение углеродистой стали. // *Вестник Пермского университета. Серия: химия*. 2020. №1 (10). С. 84 – 93
11. Пат. 2582236 Российская Федерация, МПК7 C07C 49/807, A61K 31/122. 4,4,4-трихлор-1-(4-хлорфенил)бутан-1,3-дион, обладающий анальгетической и противомикробной активностями/ Лисовенко Н.Ю., Махмудов Р.Р., Баландина С.Ю.; заявитель и патентообладатель Пермский государственный национальный исследовательский университет. – № 2015108096/04; заявл. 06.03.2015; опубл. 20.04.2016, Бюл. № 33 (II ч.). – 5 с

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改性固体油膜保护钢丝的腐蚀和力学试验
**CORROSION AND MECHANICAL TESTING OF STEEL WIRES
PROTECTED BY FILMS OF MODIFIED SOLID OIL**

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注解。通过重量和力学测试发现，改性固体油膜对08kp钢在0.1摩尔CH₃COOH溶液中的酸腐蚀具有抑制作用。它还提供了在假定抑制剂存在下钢丝破坏性质的数据。然后，获得的数据可用于在存在微菌的情况下进行进一步的腐蚀和机械测试。

关键词：酸腐蚀，缓蚀剂，腐蚀速率，腐蚀-机械破坏，08KP钢，加氢

Annotation. *It was found by gravimetric and mechanical tests that the films of the modified solid oil have an inhibitory effect on acid corrosion of 08kp steel in a 0.1 molar solution of CH₃COOH. It also provides data on the nature of the destruction of steel wires in the presence of putative inhibitors. The data obtained can then be used for further corrosion and mechanical tests in the presence of micromycetes.*

Keywords: *acid corrosion, corrosion inhibitors, corrosion rate, corrosion-mechanical destruction, steel 08KP, hydrogenation*

Introduction

Corrosion is a persistent and pressing problem that is often difficult to completely eliminate. At present, this has become of great importance in connection with the large budgetary problems arising in industrialized countries in connection with the repair and protection of materials from wear and loss [1].

Losses from corrosion today in developed countries are estimated at 2–4% of the gross domestic product (GDP). Damage from broken metal structures, products and equipment is 10–20% of the annual steel production [2]. In Russia, the

annual loss of metals due to corrosion is up to 30% of the metal produced [3].

Corrosion destruction of metal equipment is one of the main problems in oil and gas production [4]. Acid treatment of wells is a widespread method of intensification of oil and gas production processes and is used even at the stage of exploration of new hydrocarbon deposits [5], therefore, corrosion inhibitors are used to reduce the aggressive effect on steel structures of technological equipment [6]. They inhibit corrosion in several ways: (a) adsorption on the metal surface and the formation of a protective thin film; (b) the formation of oxide films on the base metal, which reduces the rate of oxygen transfer to the metal surface, and (c) interaction with a corrosive component present in an aqueous medium [7]. In modern practice of inhibitory protection, complex multicomponent compositions of complex action are mainly used as additives [8]. The most famous acid inhibitors are organic compounds containing nitrogen, sulfur and oxygen atoms [9].

Most of the research in the field of creating new inhibitors is aimed at developing compositions that inhibit the corrosion process of steels, which are one of the main structural materials [3].

Carbon steels (CS) are widely used in industry and in everyday life due to their amazing properties, and in addition, they are the most common type of steel alloys used in many industrial communities. Carbon steel is considered the backbone for most of the business and is widely used throughout the world. Every year, petrochemical enterprises and the oil and gas industry utilize colossal amounts of CD. One of the disadvantages of carbon steel is that it is easily damaged by moisture and corrosive environments [10].

Thus, the corrosion of this metal material is dangerous from the point of view of human life, biological diversity and the economic state of industry [11], therefore, studies aimed at developing new, more effective inhibitor compositions with a wide range of characteristics are of great scientific and practical importance [12]

Experiment

Corrosion and mechanical tests were carried out on wire samples of 08kp steel. Parameters of each sample: length 13 cm, wire diameter 0.45 mm. As potential inhibitors, there are two organic compounds (OC), the synthesis of which was carried out according to the method [13]: OC I – 1-(4-chlorophenyl)-4,4,4-trifluorobutane-1,3-dione, OC II – 4,4,4-trichloro-1-(4-chlorophenyl)butane-1,3-dione.

Table 1.
Chemical composition of steel grade 08kp

Content, mass. %	C	Si	Mn	Ni	S	P	Cr	Cu	As
08kp	0,05 – 0,11	less than 0,03	0,25 – 0,5	less than 0,25	less than 0,04	less than 0,035	less than 0,1	less than 0,25	less than 0,08

On the surface of steel wire samples, modified protective films based on solidol and the studied organic compounds were formed. Thus, the studied protective films had the following composition: 5% OC solution in synthetic solid oil produced by Oilright.

Corrosion tests

Corrosion tests were carried out using the gravimetric method. A model solution of acetic acid with a concentration of 0.1 mol / L was used as an aggressive medium. The residence time of the steel samples in the solution was 7 days at a temperature of 27 ± 1 °C. The corrosion rate was calculated by the formula:

$$V_{cor} = \frac{\Delta m}{S \cdot t} (1),$$

where V_{cor} – corrosion speed, Δm – mass changing, S – sample area, t – time.

Mechanical tests

To check the elastic-mechanical properties after the effect of corrosion, a universal machine IR 5081-1.0 of the Impulse company was used with a universal electronic dynamometer ATSDU-11-1 (1 kN) and clamps that prevent slippage of the samples under tension.

Experimental data were obtained for steel samples before and after exposure to a corrosive environment. The tensile curves are plotted taking into account the cross-sectional area of the wire samples.

On the basis of the tensile curves, the influence of the investigated organic compounds on the ultimate strength (σ_B) and the value of the coefficient of loss of strength (K_p) of steels was determined. The value of σ_B was determined from the tension diagrams, and K_p – according to equation (2). The effect of the proposed protective films was assessed by the coefficient of loss of strength:

$$K_p = \frac{\sigma_0 - \sigma}{\sigma_0} \cdot 100\% (2),$$

where σ_0 and σ – tensile strength of the tested steel, untreated and treated in a corrosive environment.

After mechanical tensile tests, the nature of the destruction was assessed using photomicrographs of the ends of the wire. Micrographs were obtained using a Hitachi S-3400N scanning electron microscope in SE mode at magnifications in the range of $\times 200 \div 250$.

Results

Table 2 shows the results of gravimetric tests. All investigated OCs reduce the corrosion rate of steel and the depth index, but to a different extent. To a greater extent, a decrease in the corrosion rate is observed in the presence of solid oil, which also determines the high protective effect of this compound, which is 77.9%. It is possible that the greater efficiency of OC I in comparison with OC

II is associated with the presence of fluorine in the molecular structure of this compound.

Table 2.

Corrosion characteristics of steel in a model solution of acetic acid (0.1 mol / L) in the presence of protective films at an exposure time of 7 days

Steel surface	Corrosion rate, (g / (sm ² · day)) · 10 ³	Depth index, (mm/year)	Protective effects Z, %	Inhibition coefficient γ, %
without protective film	1,62	0,75	–	–
solid oil	0,67	0,17	77,9	4,4
OC I (lis-86)	1,00	0,45	39,5	1,7
OC II (lis-24)	1,30	0,60	19,7	1,3

The list of properties that modern corrosion inhibitors must possess includes protection against hydrogen saturation and the resulting embrittlement of steel [14]. When in acidic corrosive environments, steel can also become hydrogenated, which is accompanied by a change in the mechanical characteristics of the material. Figure 1 shows tensile diagrams of steel wires. Table 3 shows the results of processing these diagrams.

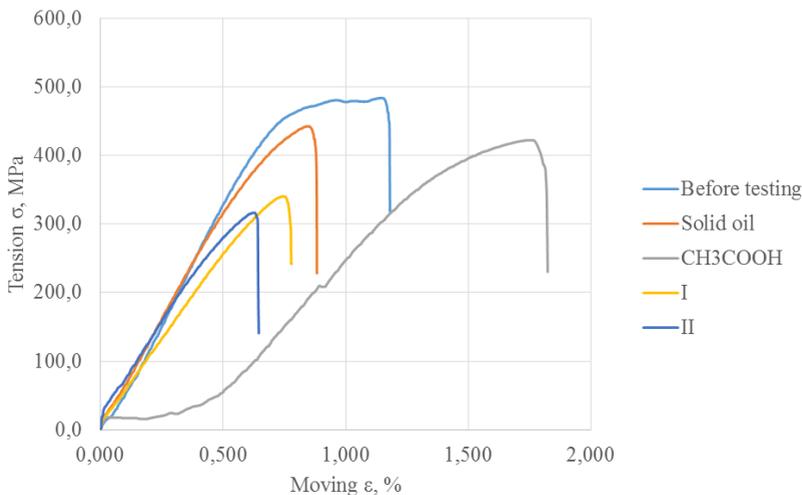


Figure 1. Tensile diagrams of steel wire before and after being in a corrosive environment for 7 days

Table 3.

Mechanical characteristics of steel before and after being in acetic acid (0.1 mol / L) in the presence of test compounds

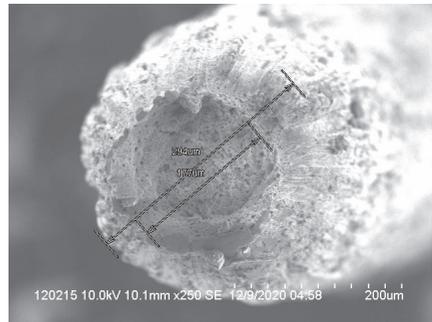
Steel surface	Tensile strength σ_B , MPa	Coefficient of loss of strength K_p , %
Before testing	476,2	–
Without protective film	421,9	11,4
Solid oil	432,4	9,2
OC I (lis-86)	343,2	27,9
OC II (lis-24)	339,3	28,8

The values of the strength loss limit and the strength loss coefficient of steel in the presence of OC in a model solution of acetic acid correlate with gravimetric tests. From table 3, it can be seen that in the presence of solid oil without additives of the studied compounds, the mechanical characteristics of steel are higher compared to steel without an inhibitor, and compounds I and II reduce the strength characteristics of the steel.

The nature of the damage after corrosion tests was assessed by means of photomicrographs of the ends of the wire after mechanical tensile tests. The results are shown in Fig. 2.



Steel before testing



Steel without protective film

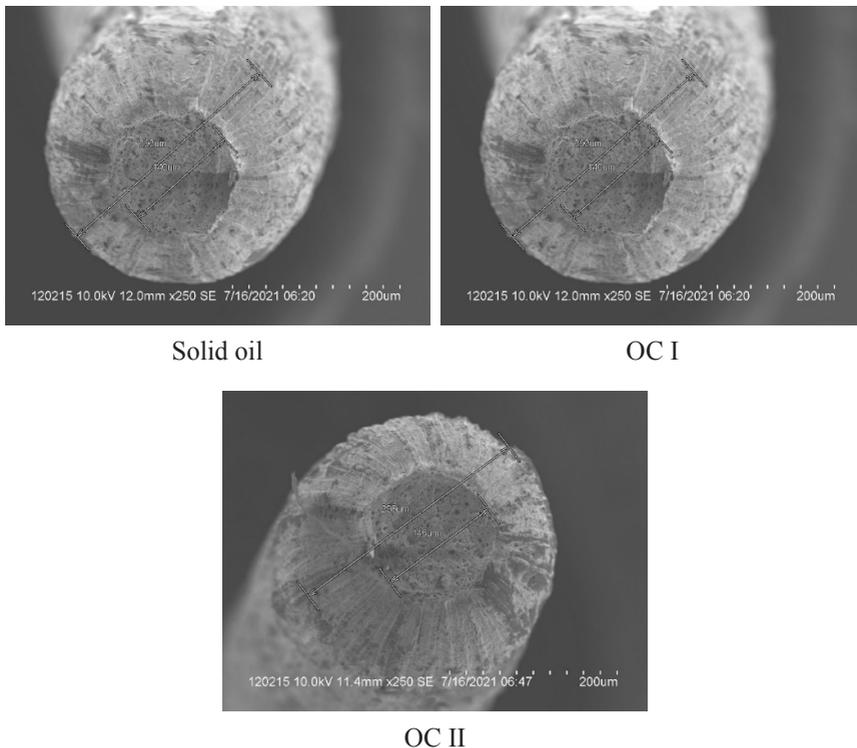


Figure 2. The nature of the destruction of steel wires before and after being in a corrosive environment for 7 days

It should be noted that these organic compounds have a pronounced fungistatic effect at low concentrations. OC I and OC II inhibit the growth of cultures of *Aspergillus pss.*, *Penicillium pss.*, *Trichoderma pss.* at a concentration of 3.9 - 7.8 $\mu\text{g} / \text{ml}$, the fungicidal effect of the compounds on micromycetes varies significantly, acting on cells at concentrations from 15.6 to 125.0 $\mu\text{g} / \text{ml}$. At the same time, synthetic lubricants are susceptible to destruction by micromycetes [15], therefore, the use of bioprotectors, along with a decrease in the corrosion rate of steel, will provide additional protection for the lubricant used on the open surface of structures.

Conclusion

It was found that the presented 1-substituted-4-trihalomethylbutane-1,3-diones inhibit the corrosion of steel in an acetic acid medium. In the future, these compounds are recommended to study the fungicidal properties of protective films

modified with organic compounds based on diketones in relation to mycological corrosion of steel.

References

1. Serbout J., Touzani R., Bouklah M., Hammouti B. *An insight on the corrosion inhibition of mild steel in aggressive medium by henna extract // INTERNATIONAL JOURNAL OF CORROSION AND SCALE INHIBITION.* — 2021. — №3. — P. 1042—1068.
2. Аминова Э. К., Лихачева Н. А., Гайсина В. Н., Попова А. В. *Получение ингибиторов коррозии, содержащих амино- и карбоксигруппы // Электронный научный журнал нефтегазовое дело.* — 2020. — №5. — С. 63—73.
3. Румянцева Н. П., Белова В. С., Балмасов А. В. *Исследование влияния азотсодержащего ингибитора на коррозионную стойкость конструкционных сталей // Известия высших учебных заведений. серия: химия и химическая технология.* — 2020. — №11. — С. 65—70.
4. Царьков А. Ю., Роднова В. Ю., Нечаева О. А. *Исследование защитного действия ингибиторов углекислотной коррозии в динамических условиях // Экспозиция нефть газ.* — 2021. — №4. — С. 54—56.
5. Байрамов М.Р., Аскарова Г.М., Мехтиева Г.М., Агаева М.А., Мамедов И.Г., Мамедова П.Ш., Джафарзадэ С.Х. *Синтез и исследование 1-алкенил-2-пропаргилокси-3-аминометилбензолов в качестве ингибиторов кислотной коррозии и антимикробных присадок к смазочно-охлаждающим жидкостям // Журнал прикладной химии.* — 2020. — №11. — С. 1534—1542.
6. Федоренко Е. И., Анфилов К. Л. *Новые ингибиторы кислотной коррозии для нефтедобычи // Южно-сибирский научный вестник.* — 2020. — №4. — С. 93—98.
7. Altomani M.A., Al-noaimi M., Hayajneh M.T., Alshurafat H.H., Alshamaileh E.M. *Experimental evaluation of new organic compounds as corrosion inhibitors for mild steel in hydrochloric acid // International journal of corrosion and scale inhibition.* — 2021. — №3. — P. 1141—1156.
8. Аль-маишадан А. А.-Б. И., Мишууров В.И. *Влияние некоторых производных бензимидазола на коррозионное поведение стали в соляной кислоте // Молодой исследователь дона.* — 2020. — №3. — С. 2—6.
9. Abdel hameed R.S., Qureshi M.T., Abdallah M. *Application of solid waste for corrosion inhibition of steel in different media - a review // International journal of corrosion and scale inhibition.* — 2021. — №1. — P. 68—79.

10. Fouda A.S., Ahmed A.M., El-darier S.M., Ibrahim I.M. *Wihania somnifera* extract as a friendly corrosion inhibitor of carbon steel in hcl solution // *International journal of corrosion and scale inhibition*. — 2021. — №1. — С. 245—261.

11. Элибоев И., Бердимуродов Э., Турсунов Б. Физико-химическое исследование механизма ингибирования коррозии стали с производными 4,5-дигидрокси-4,5-ди-*n*-толилимидазолидин-2-тионами // *Universum: химия и биология*. — 2021. — №9. — С. 77—81.

12. Успенский И.А., Фадеев И.В., Пестряева Л.Ш., Садетдинов Ш.В., Казарин А.С. Новые ингибиторы коррозии для защиты сельскохозяйственной техники // *Известия нижеволжского агроуниверситетского комплекса: наука и высшее профессиональное образование*. — 2020. — №3. — С. 365—376.

13. N. Yu. Lisoenko, D. G. Chemadurov, S. Yu. Balandina, R. R. Makhmudov. Antinociceptive And Antimicrobial Activity of 1-Substituted 4,4,4-Trichlorobutane-1,3-Diones *Pharmaceutical Chemistry Journal* (2017) 51 (3). 191-192; <https://doi.org/10.1007/s11094-017-1580-9>.

14. Плотникова М. Д., Тиунов И. А., Новиков А. А., Шеин А. Б. Испытания ингибиторов коррозии на основе имидазолинов при наводороживании малоуглеродистой стали в кислых средах // *Химия и технология топлив и масел*. — 2015. - №3. — С. 16-18.

15. Blinkova L.P., Matjusha G.V., Semenov S.A., Gorobets O.B. Method of technical lubricant protection from micromycete effect RU 2 177 497 C1.

DOI 10.34660/INF.2021.65.51.017

硝酸钠盐浓度对电浮吸附法提取铁(III)离子效率的影响
**EFFECT OF SODIUM NITRATE SALT CONCENTRATION ON
THE EFFICIENCY OF EXTRACTION OF IRON (III) IONS BY
ELECTROFLOTOSORPTION METHOD**

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抽象的。在这项工作中，已经对浓度为 1 - 50 g/l 的硝酸钠溶液以静态模式吸附在“OU-A”牌粉末吸附剂上的 Fe^{3+} 离子进行了实验研究。为了从 $NaNO_3$ 的水溶液中提取废碳吸附剂，使用了电浮选法，为了强化，使用了合适的絮凝剂。考虑了硝酸钠浓度增加对从溶液中电浮提取粉煤效率的影响。显示了使用电浮吸附法从铁(III)离子中纯化浓度高达 50 g/l 的硝酸钠溶液的可能性和前景。

关键词：电浮，吸附，碳粉材料，絮凝剂。

Abstract. *In this work, experimental studies of the sorption of Fe^{3+} ions on a powder sorbent of the "OU-A" brand in a static mode from sodium nitrate solutions with a concentration of 1 - 50 g/l have been carried out. To extract the spent carbon sorbent from aqueous solutions of $NaNO_3$, the electroflotation method was used, for the intensification of which an appropriate flocculant was used. The effect of increased concentration of sodium nitrate on the efficiency of electroflotation extraction of powdered coal from solution is considered. The possibility and prospects of using the electroflotosorption method for purifying a sodium nitrate solution with a concentration of up to 50 g/l from iron (III) ions is shown.*

Keywords: *electroflotation, sorption, carbon powder material, flocculant.*

Introduction

The environmental problem related to water pollution by technological waste has been in the focus of human attention for many years, since the wastewater of chemical plants has a complex composition and contains heavy metals, toxic organic compounds, as well as high concentrations of suspended and dissolved solids. Waste aqueous solutions with high salt content are given special attention,

since at present there are a large number of industrial enterprises that generate huge amounts of liquid waste with high salt concentrations. Highly concentrated salt solutions are widely used in electroplating industries, where they are part of electrolytes for the application of various metal coatings [1-2]. As a result of the accumulation of impurities in the working baths and, as a consequence, disruption of their performance, waste concentrated solutions are discharged. A significant amount of wastewater with a high salt content is also formed after pickling and degreasing of coatings. In this regard, the search for the most expedient method of wastewater treatment is a difficult task. Currently, most often, the purification of aqueous solutions with a high salt content is carried out by the method of ion exchange, in which both inorganic ion-exchange materials and organic ion-exchange resins can be used as ion exchangers [3-5]. The ion exchange resins used in this method are easily regenerated, but their regeneration requires a large consumption of acids and alkalis, which leads to high economic costs [6]. Also, in [2] it was noted that as a result of ion exchange, a large amount of sediment is formed, which must be disposed of.

In this work, a combined method of purification of aqueous solutions of sodium nitrate salts is considered, including sorption on powdered activated carbon (AC) in a static mode, followed by extraction of the spent sorbent during electroflotation treatment. The adsorption technology of wastewater treatment is popular due to its simplicity, low cost and high efficiency in the separation of chemical compounds [7-8]. A universal sorbent is activated carbons, which have surface functional groups, a high specific surface area (1000–1300 m²/g), and a porous structure that provides selective sorption of molecules [9]. Due to these features, they are able to sorb organic and inorganic substances of various natures on themselves, which makes carbon sorbents practically indispensable for wastewater treatment.

By absorbing various harmful and toxic chemical compounds from solutions on its surface, the carbon material becomes hazardous to the environment, but since the size of powdered coals is very small, its extraction from aqueous solutions is difficult. The electroflotation method of cleaning allows you to quickly and efficiently clean solutions with high salt content from suspended solids, organic and inorganic impurities.

Research methodology

The object of research is coal of the "OU-A" grade, which is made on the basis of birch charcoal. Sorption tests were carried out in a static mode with continuous stirring of a solution containing Fe³⁺ and 1;5;10 and 50 g/l NaNO₃, with a sorbent for half an hour. Then the sorbent was separated by settling and filtration, as well as during the electroflotation treatment of the solution.

The amount of sorption (A, mg/g) was determined by the formula (1)

$$A = \frac{(c_0 - c_r) \cdot V}{m} \quad (1)$$

where c_0 – initial concentration, mg/l

c_r – residual concentration of a pollutant in a solution or equilibrium concentration, mg/l

V – volume of the treated solution, l

m – sorbent weight, g.

In the experiments, to increase the efficiency of the process, a nonionic flocculant of the Superfloc N-300 series with a concentration of 5 mg/l was used.

Studies of the electroflotation process of extracting suspended solids were carried out in a laboratory setup, the scheme and principle of operation of which are described in detail in [10].

The efficiency of extracting coal particles from solution was estimated by the formula (2):

$$\alpha_{ef} = \frac{c_0 - c_{con}}{c_0} \cdot 100\% \quad (2)$$

where, c_0 – initial concentration, mg/l

c_{con} – residual concentration of coal in solution, mg/l.

The mass concentration of coal was measured by the turbidimetric method using a HI 98703 turbidity meter.

The concentration of Fe^{3+} ions was determined photometrically in the presence of sulfosalicylic acid. The optical density of the solutions was measured on an SF-2000 spectrophotometer at a wavelength of 500 nm.

Results and discussions

Activated carbons, due to their porous surface and the presence of functional groups, can participate in both physical and chemical adsorption of various substances. The type of adsorption and its value are greatly influenced by the salt anions present in the aqueous solution, as well as the concentration of this salt. Experimental data were obtained showing the effect of the concentration of sodium nitrate salt on the sorption capacity of the sorbent during the extraction of Fe^{3+} ions from the solution (figure 1).

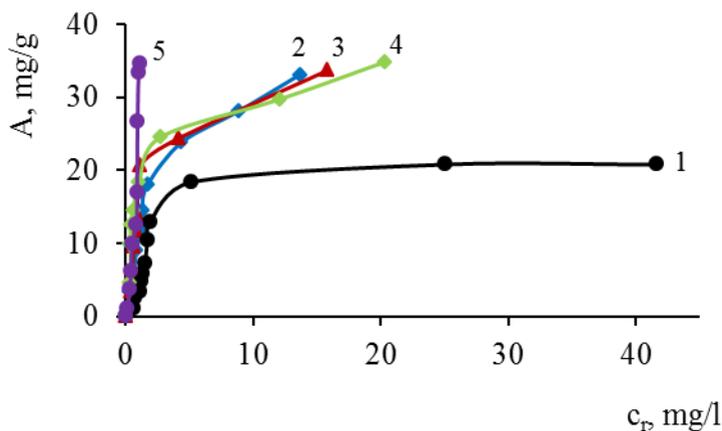


Figure 1. Isotherms of adsorption of iron (III) ions on a powder carbon sorbent from water (1), 1 g/l NaNO_3 (2), 5 g/l NaNO_3 (3), 10 g/l NaNO_3 (4), 50 g/l NaNO_3 (5) $\text{pH} = 2,5$

From the data presented in the figure, it can be seen that an increase in the concentration of sodium nitrate in an aqueous solution increases the amount of adsorption of the carbon material. An increase in the concentration of the studied salt to 5 and 10 g/l increases the sorption capacity of activated carbon at equilibrium concentrations of Fe^{3+} ions <11 mg/l with a further increase in the concentration of Fe^{3+} in the solution, a slight decrease in the sorption capacity of coal is observed. With an increase in the salt concentration to 50 g/l the adsorption isotherm shape can be attributed to the H type according to the Giels classification, while complete saturation of the adsorbent is not observed, which indicates that the use of a powder sorbent is promising for the extraction of Fe^{3+} ions from nitrate solutions with increased salinity.

Further extraction of the spent sorbent from solutions of sodium nitrate salts was carried out by the electroflotation method with preliminary correction of the pH values of the medium to 4 and 7 units (table 1). It is known from literary sources that increased salt content complicates the electroflotation process, since a high electrolyte concentration suppresses the hydrogen evolution reaction due to the reduction of nitrate ions. So, under these conditions, the gas saturation of the aqueous solution with hydrogen decreases.

Table 1

Influence of sodium nitrate concentration and pH of the medium on the electroflotation process of extracting carbon material "OU-A" in the presence of Fe³⁺

c (NaNO ₃), g/l	Recovery rate "OU-A" (α _{sp}), %			
	pH = 4		pH = 7	
	0.2	0.5	0.2	0.5
1	90	97	97	98
5	90	97	95	97
10	90	97	94	97
50	90	96	94	95

Experimental conditions: τ=20 minutes; i_v = 0,2 A/l; c(Fe³⁺) = 25 mg/l; c_{floc.} (N-300) = 5 mg/l

It can be seen from the obtained experimental data that an increase in the concentration of the background sodium nitrate salt in an acidic and neutral medium in the presence of Fe³⁺ ions in an aqueous solution does not affect the electroflotation process of extracting carbon material. It can be assumed that this is due to a change in the surface properties of the dispersed phase due to a high concentration of nitrate ions in an aqueous solution, which has a positive effect on the extraction of the carbon sorbent.

It should be noted that the added nonionic flocculant promotes the enlargement of particles and the purification of the aqueous solution both from the carbon sorbent and from the forming insoluble iron (III) hydroxide in the process of adjusting the pH of the solution.

During the experiment, it was found that the residual concentration of Fe³⁺ ions after electroflotation treatment of a solution containing 50 g/l of sodium nitrate at pH = 7 in the presence of 500 mg/l of activated carbon was 0.123 mg/l, which corresponds to the MPC for iron (III).

Conclusion

As a result of the performed experimental studies, it was found that an increase in the concentration of sodium nitrate affects the adsorption mechanism and the sorption capacity of iron (III) ions. The adsorption isotherm with an increase in the concentration of sodium nitrate to 50 mg/l indicates the occurrence of chemisorption of iron (III) ions, when the adsorption is accompanied by the formation of a chemical compound. It was found that an increase in the salt concentration does not reduce the efficiency of the electroflotation process of extracting the spent powder sorbent, while the residual concentration of iron (III) ions in a neutral medium does not exceed the permissible MPC standards.

References

1. Babu, B. Ramesh; Bhanu, S. Udaya; Meera, K. Seeni. *Waste Minimization in Electroplating Industries // A Review. Journal of Environmental Science and Health, Part C.* – 2009. – V. 27(3). – P. 155–177.
2. Tang, Lin; Guo, Yong-Feng. *Experimental Study of Special Purpose Stainless Steel on Electrochemical Machining of Electrolyte Composition // Materials and Manufacturing Processes.* – 2013. – V. 28(4). – P. 457–462.
3. Moore, Mark; Counce, Robert; Watson, Jack; Hall, Howard. *Ion exchange of alkali metal cations with an inorganic resin // Separation Science and Technology.* – 2018. – 54(8). – P. 1–5.
4. Elektorowicz, M.; Muslat, Z. *Removal of heavy metals from oil sludge using ion exchange textiles // Environmental Technology.* – 2008. – V. 29(4). – P. 393–399.
5. Myhre, Kristian G.; Knowles, Justin R.; Du, Miting. *Europium and samarium separation using ion exchange between molten salts and beta“-alumina // Separation Science and Technology.* – 2020. – V. 55(9). – P. 1695–1701.
6. Verbych, Svetlana; Hilal, Nidal; Sorokin, Genady; Leaper, Mark (2005). *Ion Exchange Extraction of Heavy Metal Ions from Wastewater // Separation Science and Technology.* – 2005. – V. 39(9), – P. 2031–2040.
7. Ameri, Abolhasan; Tamjidi, Sajad; Dehghankhalili, Faeghe; Farhadi, Arezoo; Saati, Mohammad Amin // *Application of algae as low cost and effective bio-adsorbent for removal of heavy metals from wastewater: a review study. – Environmental Technology Reviews.* – 2020. – V. 9(1). – P. 85–110.
8. Liu, Zhongmou; Zhang, Zhiruo; Peng, Juwei; Wu, Jinghui; Huo, Yang. *Rapid removal of trace haloacetic acids from drinking water by a continuous adsorption process using graphene oxide // Environmental Technology.* – 2020. – P. 1–24.
9. Güneş, E., Çiğçi, D. İ., & Çelik, S. Ö. *Comparison of Fenton process and adsorption method for treatment of industrial container and drum cleaning industry wastewater // Environmental Technology.* – 2017. – V. 39(7). – P.824–830.
10. Gaydukova A., Kolesnikov V., Stoyanova A., Kolesnikov A. *Separation of highly dispersed carbon material of OU-B grade from aqueous solutions using electroflotation technique // Separation and Purification Technology.* – 2020. – V.245. – Article Number 116861.

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材料金相研究数据分析方法的自动化
**AUTOMATION OF DATA ANALYSIS METHODS FOR
METALLOGRAPHIC RESEARCH OF MATERIALS**

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抽象的。 本文致力于开发优化金相分析实验数据处理的方法。 开发了一种基于图像分割的图像中物体初始化算法，可用于合金和金属微观结构物体参数计算的分析。 通过分析镁基合金的微观结构来测试该方法的效率。 该方法的准确性使得确定材料微观结构中的缺陷和异物成为可能。

关键词：软件，数据处理，金相分析，信息技术，python。

Abstract. *This article is devoted to the development of methods for optimizing the processing of experimental data of metallographic analysis. An algorithm for the initialization of objects in the image based on image segmentation has been developed, which can be used in the analysis when calculating the parameters of objects of the microstructure of alloys and metals. The efficiency of this method was tested by analyzing the microstructure of a magnesium-based alloy. The accuracy of the method makes it possible to determine defects and foreign phases in the microstructure of materials.*

Keywords: *software, data processing, metallographic analysis, information technology, python.*

At a given moment, digital technologies, if not in all areas of human activity, then at least in the vast majority of them. The market of IT-technologies in various industries over the past 5-10 years has a general increasing trend (Fig. 1), and therefore the demand for software is steadily growing. Here one cannot fail to note the increasing popularity of instrumental software, that is, software products (SP) that perform, as the main task, the processing and analysis of large amounts of data [1].

In the field of materials science, more and more complex areas of materials research are being discovered every year, and therefore the load on the human factor only increases. Thus, the method of metallographic analysis, aimed at studying the macrostructure of metals and alloys, takes significant time resources at the stage of processing the obtained experimental data. In order to optimize and accelerate the process of studying the microstructure, there is a need to create highly efficient automated software tools for image analysis.

This article is devoted to the development of the main algorithms for a potentially realizable software product, the main task of which will be to automate the processing of data obtained during metallographic analysis. Today there are several software products, the main functionality of which is aimed at processing metallographic analysis data (Fig. 2). The overwhelming majority of such SP have modest expert assessments for one or several quality parameters, such as the quality of the user manual, functionality and ergonomics [5].

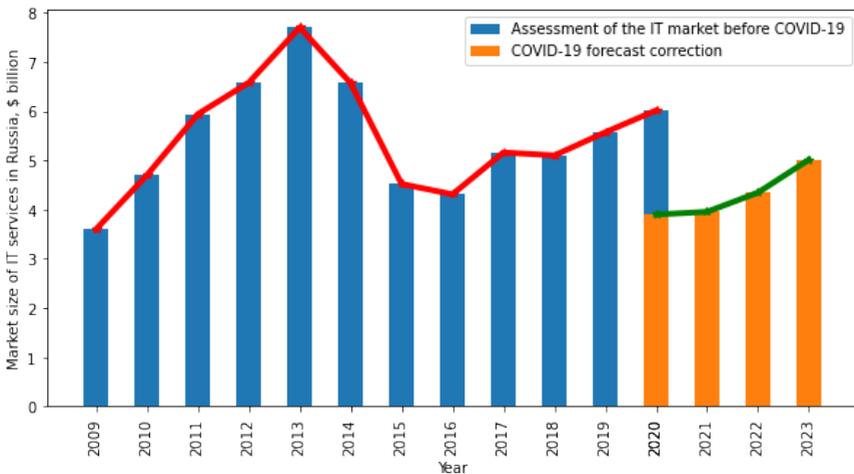


Figure 1. Assessment and forecast of the growth of the IT services market in Russia for the period from 2009 to 2023

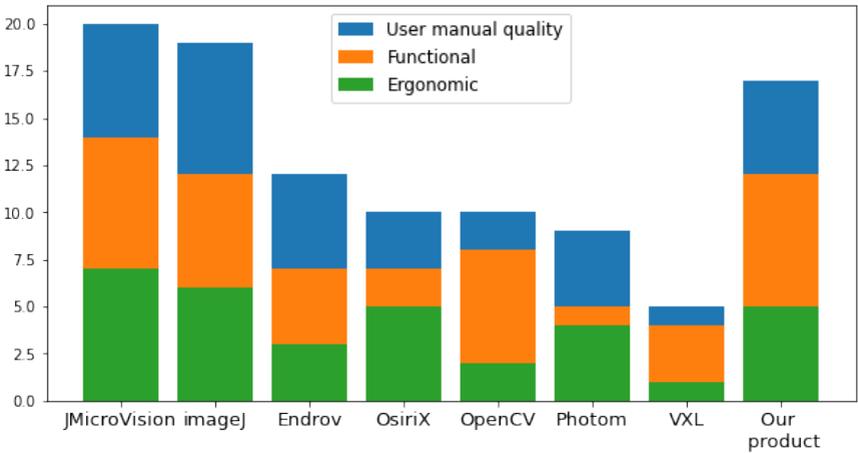


Figure 2. Ranking free software for image analysis using the method of expert estimates [5]

A tool for analyzing not only images, but video series, which has an open source code called OpenCV, has high functionality, for the absolute lack of a graphical user interface. Therefore, our analysis algorithms were based on the main methods of this functional package with the addition of user interface elements.

The algorithms are mainly implemented using the python programming language, as well as C ++ and Java. The purpose of the described algorithms is to process images obtained using a metallographic microscope, in our case it is an «OLYMPUS BX51M» optical microscope. The principle of operation of the algorithms is shown in the diagram (Fig. 3).

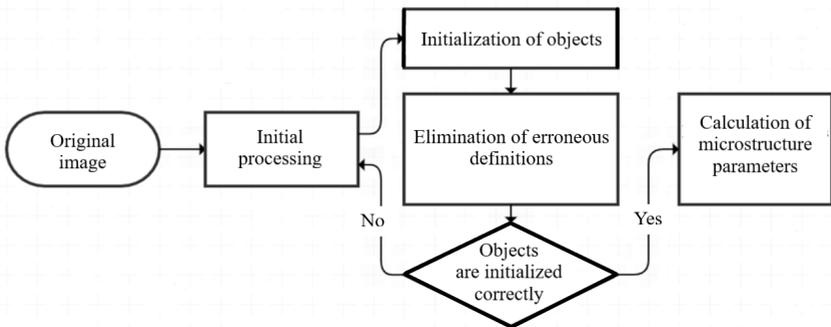


Figure 3. The scheme of the image analysis algorithm

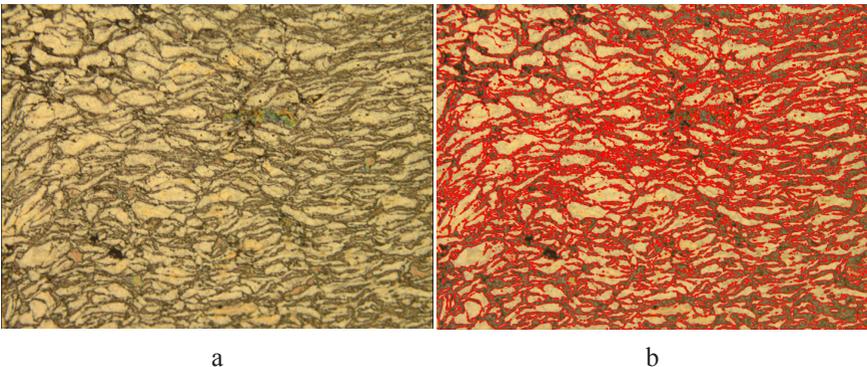
At the stage of initial processing, the image is divided into separate color channels [2, 3]. These channels are used to automatically determine the threshold value of the color characteristics of the boundaries of the desired objects. Based on this, the image will be converted to a black and white variation of the original image [4].

The initialization of the contours is carried out according to the approximation algorithm [4], while for all extracted contours their complete hierarchy is preserved. Despite all the transformations, when defining the contours of objects, there will still be false definitions or noise. Their elimination is carried out due to various variations in the threshold values of the intensity of the chromaticity of the pixels of the original image. At the same time, about 95% of all erroneous definitions are eliminated, which indicates the high accuracy of the implemented analysis algorithms.

The algorithm described and implemented by us is quite correctly able to determine such objects of the microstructure of metals and alloys as grains, defects, as well as objects of third-party phases of the material, for example, inclusions of carbon in steels of various grades [5, 6].

In the images (Fig. 4) it is not difficult to see the result of this algorithm when analyzing a micrograph of an alloy based on magnesium.

The result of the work can be fully considered relevant to reality, and the data obtained can be used in further calculations. Thus, the data obtained can be visualized in the form of a diagram of the distribution of the number of grains depending on their area (Fig. 5a). Diagrams of this type allow us to judge the dimensional characteristics of the microstructure of metallic materials, which is important in the overall assessment of the suitability of the material in a particular industry.



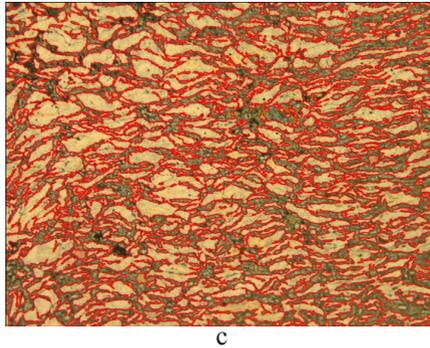
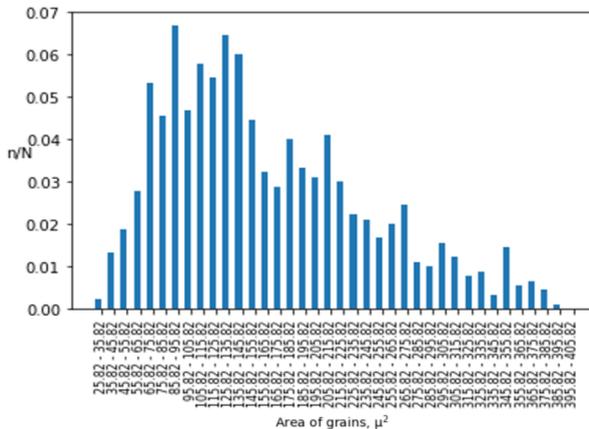


Figure 4. Visualization of the algorithm for analyzing a micrograph of the surface of a magnesium alloy: a - the original image, b - initializing an object, c - noise elimination

As mentioned earlier, an algorithm for evaluating the phase characteristics according to the color parameters of the image of their surfaces is also implemented. A similar analysis method is based on the construction of a histogram (Fig. 5b) of the distribution of the number of pixels from the values of color values RGB (red-blue-green).

Based on such a representation of the microstructure image data, it becomes possible to approximately estimate the phase composition of the material, which has its advantages, for example, in the metallographic analysis of steels of various grades, as well as the automation of the determination of the steel grade itself.



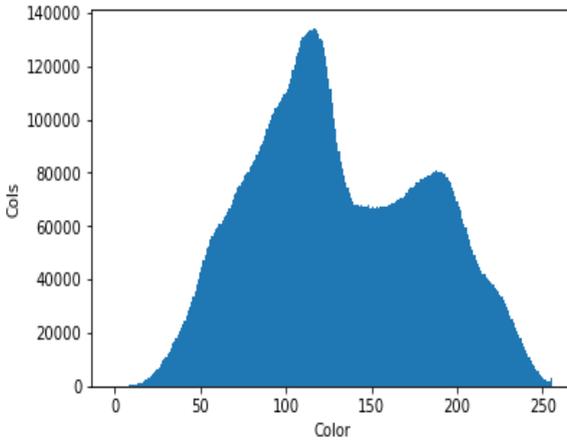


Figure 5. Visualization of the results of microstructure analysis:
a - diagram of the distribution over the area of grains,
b - diagram of the distribution of the number of pixels from the value of the color intensity

Another important and promising method of analyzing microstructural functions is the algorithm for constructing and analyzing a 3D surface model (Fig.6). This approach will make it possible to optimize to a greater extent the analysis of the results of the microstructure necessary to assess the performance characteristics of materials.

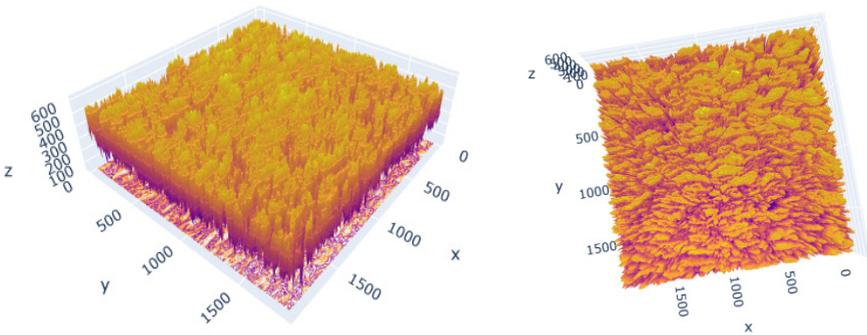


Figure 6. Visual representation of a 3D-model of the surface of a material with a pronounced granular structure

Conclusion

The implemented image analysis algorithms significantly reduce the time spent on processing the data obtained as a result of metallographic analysis. In the future, such an approach contributes to the complete leveling of the human factor in attempts to determine the composition of the material and the parameters of its microstructure. Obtaining quantitative characteristics of the microstructure, such as, for example, the average dimension of the crystals of the material, or grains, the phase composition of the material, etc., will reveal the fields of application of metallic materials in various fields of industry.

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The authors declare no conflicts of interest.

References

1. Kim V.A., Bashkov O.V., Popkova A.A., Shpileva A.A., Zolotareva S.V., Belova I.V., Yemets N.E., *Fundamentals of quantitative and computer metallography: study. Allowance*, 2013, 133 p.
2. W. McKinney, *Python for Data Analysis*. Sebastopol: O'Reilly, 2017. 540 p.
3. Open Source Computer Vision Library. <https://docs.opencv.org/master/index.html>
4. Gafarov MF, Pavlova KP, Gafarova EA, *Review of software products for metallographic analysis. Modern science: topical problems of theory and practice. Series "Natural and Technical Sciences"*. 2018. No. 11. pp. 69-73.
5. J. M. Li, Li L`u, M. O. Lai and B. Ralph. *Image-Based Fractal Description of Microstructures*. Published by Kluwer Academic Publishers, 2003, pp. 1–273.
6. Rusanovsky, Matan & Beeri, Ofer & Ifergane, Sigalit & Oren, Gal. (2021). *An End-to-End Computer Vision Methodology for Quantitative Metallography*.

原子collapsar-monopolyum的缩合催化冷核嬗变反应。量子引力理论的启发式假设-演绎模型

**CONDENSATION OF AN ATOMIC COLLAPSAR-MONOPOLYUM
CATALYZING REACTIONS OF COLD NUCLEAR TRANSMUTATION.
HEURISTIC HYPOTHETICAL-DEDUCTIVE MODEL OF THE
THEORY OF QUANTUM GRAVITY**

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抽象的。作为冷核嬗变反应的结果，释放的能量多于消耗的能量。为了解释这一现象，提出了一种串缩合链式反应的启发式算法。由于磁单极子效应，由此产生的原子塌陷催化冷核嬗变反应。

关键词：启发式算法，链式反应，量子漩涡，超导，孤子，超对称，物质的极端状态，量子宇宙学。

Abstract. *As a result of the reactions of cold nuclear transmutation, more energy is released than is expended. To explain the phenomenon, a heuristic algorithm for the chain reaction of string condensation is proposed. The resulting atomic collapsar catalyzes the reactions of cold nuclear transmutation due to the magnetic monopole effect.*

Keywords: *heuristic algorithm, chain reaction, quantum vortices, superconductivity, solitons, supersymmetry, extreme state of matter, quantum cosmology.*

Introduction

On March 23, 1989, the scientific community was reported on the discovered phenomenon of cold nuclear transmutation (Martin Fleischman, Stanley Pons). The setup on which the experiment was performed included an electrolyzer with a palladium cathode, a platinum anode, and a current source (battery). The essence of the experiment consisted in the electrolysis of heavy water with additions of heavy lithium hydroxide (LiOD). In the course of the reaction, the cathode was destroyed. Gamma radiation (0.1-3 meV) of nuclear nature and X-rays (1.0-2.5 keV) were also observed, and the main product was tritium, which turned out to be 10^8 times more than neutrons. It was noted that the reaction channel with the neutron

yield is strongly suppressed [1, 2]. On photographic films and nuclear photographic plates, traces of "strange radiation" of a magnetic nature were recorded [3]. In some experiments, the effects of levitation were observed [4]. In the present work, we discuss a possible process based on the hypothesis of Academician Fortov V.E. about the probable course of reactions in a superdense medium [5]. The reasoning is based on the mechanism of quantum fluctuations with the formation of plankeons in extreme conditions of nuclear matter. For this, a heuristic algorithm for the chain reaction of obtaining a catalyst for cold nuclear transmutation is proposed in the context of the terminology of quantum gravity.

Initial conditions

Juvenile surfaces, that is, places of a fresh fracture in the crystal lattice, which leads to its elastic vibrations with the appearance of spin-phonon interaction, are among the supposed active zones for the onset of nuclear transmutation reactions. Cracks in the palladium cathode must necessarily occur. Indeed, when this metal is saturated with hydrogen or deuterium, palladium hydrides are formed, and their crystal lattice is very different from the lattice of the parent metal. Inevitably, strong stresses arise, the metal structure is strongly deformed, and in the end, the growth of hydride plates leads to the formation of microcracks with a characteristic size of $\sim 1 \mu\text{m}$. As a result of cracking of the cathode, high-energy electrons are emitted from freshly formed surfaces of microcracks in vacuum, reaching a value of $\sim 100 \text{ keV}$. This effect is due to the separation of unlike charges during the formation of juvenile surfaces, which lead to the appearance of strong electric fields (with a strength of up to 10^7 V/cm). In the process of electron emission, hard X-rays with a wavelength of the order of 10^{-1} - 10^{-2} nm are generated [6]. Thus, the atoms of the crystal lattice find themselves in the area of action of external disturbing factors: the applied potential difference and the resulting electric field, scattering of electrons and X-rays, as well as phonon interaction.

Formation of a composite vortex

As a result of cracking of the cathode, the arising phonon interferences lead to strong fluctuations with the discharge of a burst of energy on one of the palladium atoms [7], and shell density fluctuations are observed in the process of electron emission and their scattering on the electron shell. The energy of fluctuations is spent on exciting the rotational motion of a deformed palladium nucleus in which, as a result of coherent correlation of nucleons, vortex rings are formed from superconducting pairs of protons containing a flux quantum fluxon: $pF_{s,p}$ [8], which leave the nucleus due to the bleaching of the potential barrier [9]. As a result of electrolysis, a double electrical layer of a capacitor (dielectric) is formed on the surface of the cathode with a tension between the layers within 10^6 V/cm and a high electrical capacity of $\sim 10^{-5} \text{ f/cm}^2$ [10]. In the resulting trap of a long Josephson junction (LJJ), due to Andreev reflection, a superconducting vortex ring is

formed, consisting of two electrons containing a magnetic flux quantum: $eF_N e^-$ [11]. When the proton and electron vortices interact, a composite vortex is formed with a common vortex center [12] in the form of dark hydrogen [13]: $pF_S p + eF_N e^-$

Formation of neutron-degenerate matter in the form of Abrikosov's vortex

As a result of the attraction of magnetic vortices, electrons are scattered by protons: $2(p+e^-) \rightarrow 2(n+V_e)$; $V_e F_S = V^S$; $V_e F_N = V^N$. The resulting magnetically excited sterile Dirac neutrinos circulate around a non-superconducting cylindrical domain of neutrons, forming a neutron-degenerate matter-neutronium in the form of an Abrikosov vortex [14, 15]: $V^S V^N + nn$

The dynamic mechanism of chiral symmetry breaking and the formation of a quark bag

Due to mutual attraction, the antisoliton cylindrical domain is located in the hole of the soliton magnetic ring. The process of transition of an antisoliton to a soliton, and a soliton to an antisoliton [16], which occurs during the interaction, entails, with a decrease in the diameter of the ring and an increase in the diameter of nucleons, an increase in pressure and breaking of chiral symmetry [17]. This leads to the precipitation of a gluon condensate in the form of pseudoscalar para-positronium (dark positronium): $(V^S P_s V^N + nn)$, which entails effective interaction with the Goldstone boson and leads to the synthesis of a singlet majoron (axion): $2V_e \rightarrow M_0^0$ [18]. From the liberated Dirac bion and positronium, two dions are formed: $(^+eF_S + ^+eF_N)$, catalyzing the decay of nucleons into quarks [19]: $2n \rightarrow 2(ddu)$, which leads to the restoration of axial symmetry during the formation of a quark bag.

Tachyon condensation with the formation of Majorana neutrinos

In the quark bag, the Higgs tachyon boson is synthesized from the electron-positron pair: $^+e e^- \rightarrow H^0$, which forms a magnetic dipole T with the Dirac bion of Hooft Polyakov (GUT monopoles) [20]: $H^0 + F_S F_N \rightarrow SN$. The emerging tidal forces due to the magnetic Callan - Rubakov effect [21] catalyze the extreme phase transition of the rupture of quark matter into rishons with the formation of a double massive Majorana right-handed quasinutrino [22]:

$$2(V^+ V^- T + V^- V^+ T + TTV) \rightarrow 2(V^+ V^- V^-) \Rightarrow 2v_e^m.$$

It should be borne in mind that the resulting scalar Higgs field, being near the local maximum of the potential, is tachyonic and unstable with an imaginary part in the form of a negative square of mass. However, when the tachyon field reaches the minimum potential, its quanta are no longer tachyons, but ordinary Higgs bosons with a positive square of mass [23]. In our case, the system transitioned to an extreme massless state due to the fact that the resulting tachyon Higgs boson with negative mass neutralized the ordinary Higgs boson with a positive mass contained in nucleons.

Formation of a dynamic wormhole with a strong magnetic field

In the system, when the baryon and lepton numbers are violated, the R-parity is preserved, which entails the lifting of degeneracy when supersymmetry is violated and the paired production of stable lightest supersymmetric quasiparticles. This leads to the decay of a double Majorana right-handed quasineutrino with the formation of the second axion, the Higgs boson with positive mass, and two Goldstones (Goldstone fermion, doublet majoron, supersymmetric partner of neutrinos) [24]. From two singlet majorons and one Higgs boson with a positive mass, paired Higgs-Goldstone gravitons with spin equal to two are synthesized: $M_0^0 2\sqrt{v_e^m} > M_0^0 M_0^0 H^0 + 2M_{1/2}^0 \rightarrow 2(GM_{1/2}^0)$. As a result of the interaction of two c-neutrinos with a magnetic dipole, an antisoliton sterile coupled pair of magnetically excited c-neutrinos is formed: $M_{1/2}^0 M_{1/2}^0 SN \Rightarrow V_s^S V_s^N$ Being inside the graviton tube of a two-dimensional soliton [25, 26], vortex filaments are formed from paired vortex magnetically excited c-neutrinos that hold an open massless dynamic wormhole with a strong magnetic field due to the soliton-antisoliton interaction, forming a vortex cord [27]: $V_s^S V_s^N + GG$

Formation of a stringed atomic collapsar -monopolyum

As a result of the gravitational compression of the radial magnetic field, the wormhole collapses and degenerates [28]. Due to the tachyon instability [29], the wormhole transitions from a state with a strong magnetic field to a state with a weak magnetic field due to the formation of paired gravitinos with an imaginary mass having a spin of 3/2 according to the scheme [30]: $M_{1/2}^0 M_{1/2}^0 SN \longleftrightarrow gg F_S F_N$

Due to the occurred dual Seiberg transition, an annular singularity is formed from two filamentary graviton strings [31], which is located under the sphere of the inner event horizon formed by paired graviton rings. The formed singular core from a pair of gravitational supermultiplets, in turn, is itself under the sphere of the outer event horizon formed by the orbital fluxon pair of the formed atomic collapsar-monopolyum: $2(gGF)$ [32,33]. In this case, the ring singularity keeps the system from collapse due to the forces of fermionic repulsion. The resulting atomic collapsar catalyzes the reactions of cold nuclear transmutation due to the magnetic monopole effect [34, 35]. When calculating the dimensions, the external four-dimensional space-time should be added to the seven-dimensional collapse, as a result of which the eleven-dimensional space is obtained.

Balance of the reaction in the formation of an atomic collapsar

The complete balance of the chain reaction shows a violation of the lepton and baryon numbers by two during the formation of a quantum of dark matter [36,37]. It should be noted that two protons take part in each fusion act, and therefore there is a scheme of nuclear transmutation of the parent palladium atom with a step every two: ${}_{46}\text{Pd} \rightarrow {}_{44}\text{Ru} \rightarrow {}_{42}\text{Mo} \rightarrow {}_{40}\text{Zr}$. An increase in the impurities of molybdenum and zirconium by a factor of 1200-2500 was observed experimentally [38]

Conclusions

The proposed heuristic hypothetical-deductive model of the theory of quantum gravity in the form of a chain reaction of catalyst synthesis for cold nuclear transmutation is in good agreement with the complementary theories of the string and loop parts of quantum gravity. The evolution of the gravitational collapse, which occurs as a result of the quantum fluctuations of the physical vacuum, leads to the condensation of oscillating plankeons. The resulting string atomic collapsar coincides with scientifically grounded arguments for the existence of a similar medium in the Cosmos, which can be attributed to the defining criterion in string cosmology. For the detection of dark matter, one can be guided by scientific work [39]. In addition, the surrounding magnetic field of the Earth indicates the presence of dark matter. Continuing research into the proposed heuristic model of string condensation will allow a deeper understanding of the nature of the phenomenon and create a complete scientific theory of everything based on the effect of quantum fluctuations of the physical vacuum with the formation of oscillating plankeons with the participation of which our Universe is formed. In addition, this line of research will make it possible to create a fundamentally new energy and technical means that allow one to move in the environment of atomic collapsars similar to the observed flying disks of unearthly origin, which are being created in developed countries of the world [40]. It can be assumed that it is possible to create stable conditions for the existence of a traversable wormhole phase with a polarizer around the aircraft [41]. When moving in such an environment around the spacecraft, a glow of dark matter will be observed, which is observed during operation of polarizers and from UFO [42]. According to scientific studies, nature has provided for the use of the quantum mechanism of nuclear transmutation also in biosystems [43].

References

1. V. A. Tsarev, *APS* 160,1 (1990)
2. Yu. N. Bazhutov, G.M. Vereshkov, *Cold fusion: Proceedings of the 1-st Russian conference on cold fusion. M.: ISTC "Vent",23 (1994)*
3. L.I. Urutskoev, V. I. Liksonov, V. G. Tsinoev, *Applied Physics №4, 83 (2000)*
4. V. M. Dubovik, E. N. Dubovik, V. A. Krivitsky, *Almanac Space and and Time* 1,1(2012)
5. V. E. Fortov, *APS* 179, 653 (2009)
6. B.V. Deryagin, N. A. Krotova, V. V. Karasev. *Discoveries of Soviet Scientists. / Edited by Yu. P. Konyushaya. M: MSU, H. 1,372 (1988)*
7. A.I. Slutsker, A. I. Mikhailin, I. A. Slutsker, *APS* 164, 357 (1994)

8. I.M. Pavlichenkov, *Physical encyclopedia / ed. A.M. Prokhorova, M: Great Physical Encyclopedia 1,338 (1998)*
9. V.I. Vysotsky, S. V. Adamenko, *JEP 80,23 (2010)*
10. *Electrical double layer. www.xumuk.ru*
11. A. V. Yulin. *Resonant radiation of vortices in dispersive Josephson systems. Dissertation introduction (part of the abstract) of an appl. deg. cand. phys.-math. sci.: 01.04.03. Institute for Physics of Microstructures, 1988*
12. T.P. Konovalyuk, *Applied Hydrodynamics 7,44 (2005)*
13. D. S. Baranov, V. N. Zatelepin, *Scientific developments: the Eurasian region. Materials of the international scientific conference of theoretical and applied developments - September 25. Moscow,90 (2019)*
14. Yu. L. Ratis, *JEND 1, 27 (2013)*
15. J. Loshak, *Applied Physics №2,5 (2006)*
16. Filippov A.T. *The many-sided soliton. 2nd ed. rev. and add. M.: Science,1990, 288 P.*
17. V. A. Miransky, P. I. Fomin, *EPAN 16,496 (1985)*
18. M.G.Schepkin, *APS 143,513 (1984)*
19. A.Yu. Morozov, *APS 150,387 (1986)*
20. A. A. Slavnov, *TMP 183,163 (2015)*
21. V. A. Matveev, V. A. Rubakov, A. N. Tavkhelidze and others., *APS 156,253 (1988).*
22. V. E. Kuzmichev. *The laws and formulas of physics. Directory. Kiev: "Naukova Dumka", 1989,864 P.*
23. N.V. Samsonenko, M. V. Semin, *Bulletin of the Moscow Regional University. Series: Physics-mathematics №2,102 (2020)*
24. E.A. Kryukova, *Brief Communications of IPAS №2, 17 (2021)*
25. K. Rebbie, *APS 130,329 (1980)*
26. V. P. Neznamov, I. I. Safronov, V. E. Shemarulin, *JETP 155,69 (2019)*
27. N.S. Kardashev, I. D. Novikov S. V. Repin, *APS 190,664 (2020)*
28. I. D. Novikov, D. I. Novikov, *JETP 156,585 (2019)*
29. A. Yu. Andreev, D. A. Kirzhnits, *APS 166,1135 (1996)*
30. N. V. Krasnikov, V. A. Matveev, *APS 174,697 (2004).*
31. B.M. Barbashov, V.V. Nesterenko, *APS 150,489 (1986)*
32. V. V. Burdyuzha, *JETP 151,416 (2017)*
33. V.P. Neznamov, I. I. Safronov, *JETP 154,761 (2018)*
34. Vladimir Vysotsky. *Fantastic reality of cold fusion [https:// regnum-ru. turbopages.org/regnum. ru /s/news/2629986.html](https://regnum-ru.turbopages.org/regnum.ru/s/news/2629986.html). May 17, 2019*
35. V.C. Ignatovich // *Eurasian Scientific Association №7-1 (41),19 (2018)*
36. S.V. Klimenko, I. N. Nikitin, L. D. Nikitina et al., *Proceedings of the International Scientific Conference SRT (2015). International Scientific Conference of the MIPT Institute of Physical and Technical Information, 79 (2016)*

37. L. V. Prokhorov, *Bulletin of St. Petersburg University. Physics. Ser. 4,3* (2011)
38. I.B.Savvatimova, A. B. Karabut, Ya. R. Kucherov, *Cold nuclear fusion: Proceedings of the 1-st Russian conference on cold nuclear fusion. M: ISTC "Vent", 132* (1994)
39. V. V. Burdyuzha, *JETP* 154,751 (2018)
40. V.S.Leonov, O.D.Baklanov, M.V. Sautin et al., *Aerospace №1* (98),68 (2019)
41. A. A. Kirillov, E. P. Savelova, *Nuclear Physics and Engineering* 4,932 (2013)
42. V. V. Roshchin, S. M. Godin, *Letters JEP* 26,70 (2000)
43. A.A. Kornilova, V. I. Vysotsky, *RENSIT. Nuclear physics* 9,52 (2012)

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有前景的烟熏制粒方法及其硬件设计分析
**ANALYSIS OF PROMISING SMOKING AND PELLETING METHODS
AND THEIR HARDWARE DESIGN**

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抽象的。适当和有益健康的营养问题过去并且仍然具有相关性。同时，随着食品生产先进技术的发展，快餐产品的紧凑性和份量问题也很突出。科学家们正在这方面进行研究并且非常成功。本文分析了使用现代技术设备的有前途的熏制脂肪方法，然后获得固体颗粒状态的熏制脂肪。作者研究了不同作者的实验装置的操作。考虑了专利研究的优缺点，并在分析的基础上，揭示了最有前途的吸食动物脂肪的方法。根据对快餐零食市场的分析，需要注意的是，这类零食越来越受欢迎。

关键词：食品、烟熏、造粒、肥尾脂肪、烟熏室、挤压、水分去除、烟熏部件、拉瓦尔喷嘴、传热和传质。

Abstract. *The problem of proper and wholesome nutrition was and remains relevant. At the same time, in connection with the development of progressive technologies for the production of food products, the issue of the compactness and portion size of fast-food products is acute. Scientists are conducting research in this area and are very successful. This article provides an analysis of promising methods for smoking fats, using modern technological equipment, followed by obtaining smoked fats in a solid granular state. The authors studied the operation of experimental installations of different authors. the advantages and disadvantages of patent studies are considered, and on the basis of the analysis, the most promising methods of smoking animal fats are revealed. Based on the analysis of the market for fast food snacks, it should be noted that this kind of snacks are becoming more and more popular.*

Keywords: *Foodstuffs, smoking, pelletizing, fat tail fat, smoking chamber, extrusion, moisture removal, smoking components, Laval nozzle, heat and mass transfer.*

Consumer interest in meat snacks is growing all over the world. Naturally, this predetermines new opportunities for expanding the assortment of snacks on the part of manufacturers. According to the Mintel Group [1], a Chicago-based global market research company, sales of various types of snacks and snacks are on the rise as they grow. consumers are looking for products that satisfy their unassuming, rational and emotional needs, and meat and poultry choices are becoming an increasingly popular part of this range. While traditional snacks, including potato chips, crackers, nuts, and dried fruit mix, still account for the largest share of sales, meat snack activity is growing rapidly.

Based on the analysis of the market for food products, breakfasts in the form of granules are becoming more and more popular. This category includes smoked animal fats, in particular portioned fat tail fat. It should be noted that fat tail fat occupies an important place in the diet, in the current difficult epidemiological situation. According to medical research, in various sources, it is noted that in case of a disease of the respiratory tract, the alveoli of the lungs, which are covered from the inside with a special substance - surfactant, due to the consumption of animal fats, including fat tail fat, not only keeps them in shape and accelerates the saturation of the blood with oxygen, but and is a kind of barrier for viruses [2].

With regard to the methods of granulation of smoked fat tail fat, these are mixed physicochemical processes that ensure the formation of particles of a certain size, shape, required structure and physical properties of the final product. Such processes are the most common and widely used in food, pharmaceutical, chemical and other industries. The pelleting process is designed to improve the quality of products, including intermediate raw materials. Quality indicators depend on the specifics of the product and its purpose. In general, granulation can significantly reduce the tendency of the product to cake, and, consequently, simplify storage, transportation and dosing. Along with this, granulation opens up the possibility of homogenizing the mixture in terms of physicochemical properties, increasing the surface of heat and mass transfer, regulating the structure of granules and related properties. All this contributes to the intensification of processes in which granular products are used, an increase in labor productivity and production culture.

The goals and methods of granulation, their hardware design, the properties of raw materials and products, the quality requirements of the latter are so diverse that it is not possible to use the results obtained under conditions different from those required without scientific systematization. The study of the essence, mechanism and means of implementing various granulation processes is based on

the general laws of physical chemistry, hydrodynamics of dispersed materials and heat and mass transfer in capillary-porous bodies. Nevertheless, at present, there are general principles of approach to the selection of the most expedient granulation methods, depending on the state of aggregation and physical properties of the starting materials.

It is known from the life cycle of mankind that food products were smoked for a long period of time, most often in the air. The development of scientific and technological progress has also affected this area, the most important in human life, the existence of mankind. Studies of scientists from different countries show that to intensify the smoking process by means of convection gases, and to improve the diffusion process during the granulation of food products, it is advisable to use methods of increasing or decreasing pressure, as well as their alternation. In this regard, an interesting technical solution, which was proposed by scientists from the Voronezh State University of Engineering Technologies, presented in the source [3].

The authors of the invention [3] set themselves the task of developing an installation for smoking granular products with a developed structure. A distinctive feature is that the external supply of smoke allows to increase the rate of directed deposition of smoking components on the inner surfaces of the pores of the product. This factor provides a deeper penetration of smoking components deep into the material and a sequence of processes for the formation of its porous structure. Simultaneously, the evacuation removes steam, non-condensed gas and air. At the same time, smoking is organized continuously in an electrostatic field and the aroma of the product smoke is saturated throughout the volume, which increases the quality of the product as a result of deeper penetration of the smoke components into the pores of the material, which, in addition, makes it possible to increase the storage time of the finished granules.

The technical problem of the invention [3] is as follows: the installation for obtaining smoked products, with external supply of smoke, consists of a smoking chamber connected to a system for generating smoke, i.e. preparation and supply of smoke. The same system creates a vacuum and provides moisture condensation. The peculiarity is that the smoking chamber, located in a vertical plane, was divided into two parts. One part was made in the form of a Laval nozzle, dividing it into smoking zones, and the second was made in a conical shape, with a zone of saturation of the product with smoking components located here. The flared portion of the Laval nozzle was used to create a porous structure. Behind it, a steam valve, an evacuation zone and a zone of action of an electrostatic field were placed in series. In the area of the electrostatic field, corona electrodes were placed, which ensure the action of the electrostatic field. The cone-shaped lower part, with a dividing device - a granulator located in it, was used to saturate the product with

smoking components. Also, an extruder with an injection screw and a feed hopper is vertically mounted on the smoking chamber. Figure 1 shows a general view of the installation for obtaining smoked products with a developed structure and external supply of smoke.

Installation (fig. 1) works as follows. A vacuum is created in the smoking chamber using a vacuum pump. Then the initial product from the loading hopper 12 by the extruder 11 and the injection screw 3 is fed to the upper part of the smoking chamber. Reduced pressure creates a sharp expansion effect on the product, moisture evaporates and the product receives a porous structure. Removal of moisture and non-condensed gases behind the apparatus occurs through the perforated surface to the vacuum pump.

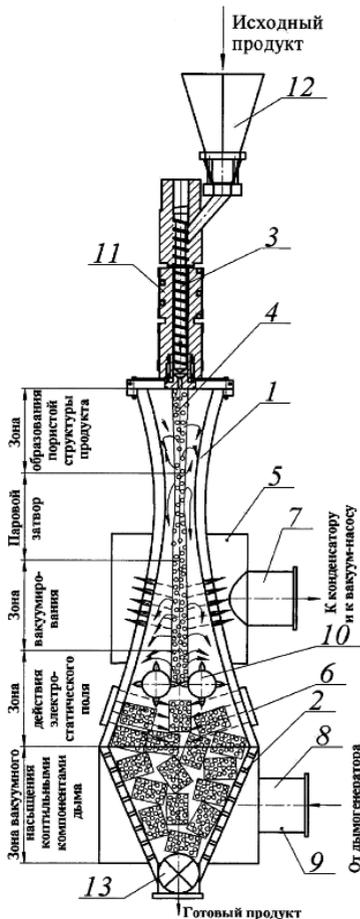


Figure 1. Scheme of the installation for obtaining smoked products with a developed structure and external supply of smoke:

1. – Laval nozzle;
2. – the lower part of the nozzle;
3. – delivery auger;
4. – product in the form of a bundle;
- 5, 9. – casing;
6. – corona electrodes;
7. – connecting pipe;
8. – branch pipe of the smoke generator;
10. – dividing mechanism;
11. – extruder;
12. – loading hopper;
13. – airlock.

The formed rope 4 of the product moves to the dividing mechanism 10, with the help of which the product is granulated into equal pieces. At the same time, smoke is supplied to the lower part of the cone of the Laval nozzle 2 by a smoke generator, which fills the pores of the product. It is necessary to remove air from the pores of the product at the stage of evacuation. With the help of the discharge electrodes 6, an electric field is created, under the influence of which the deposition of smoking components on the surface of the product is carried out. The same field prevents the penetration of smoke into other areas of the smoking chamber. The final stage is the unloading of the finished, smoked granular product from the installation using the sluice gate 13.

The advantages of the proposed installation are that it is located in a vertical plane made of a Laval nozzle and a conical part, it makes it possible to carry out sequentially the processes of forming the porous structure of the product with simultaneous removal of steam, air and non-condensable gases from the pores by evacuation and continuous smoking in an electrostatic field, which provides an increase in the reliability of saturation with a smoke aroma throughout the volume of the product, and thereby improve the quality of the product, as well as, due to the vertical arrangement of the installation, save production space.

It should be noted that the low porosity of the raw material (tail fat) prevents the movement of smoke (steam). This fact creates large hydraulic resistances, and at the same time, the intensity of the smoking process and, accordingly, the quality of the finished product decreases. Perhaps the preliminary grinding of fat tail fat, before it is fed into the receiving hopper of the preliminary smoking device, would provide an intensive supply of smoking components to the inner layers of the processed product.

In this regard, an interesting technical solution, which, like the previous one, was proposed by scientists from the Voronezh State University of Engineering Technologies, presented in the source [4]. The technical objective of this invention is the development of an installation for obtaining smoked products with a developed structure and internal supply of smoke, which makes it possible to increase the rate of directed deposition of smoking components on the inner surfaces of the pores of the product, to ensure the continuity of the combined process of creating a product with a developed structure and the smoking process, to purify smoking smoke from carcinogenic components, to improve the quality of the product due to the deeper penetration of the smoke components of smoke, purified from carcinogenic substances into the pores of the product.

The novelty of the technical solution of this invention lies in the fact that in the installation for obtaining smoked products (fig. 2), namely on the smoking chamber, a co-extruder is vertically located, at the base of which an insert is coaxially located below the injection screw in the central channel, through which the

smoke-air supply pipe passes. mixtures. At the same time, a chamber with corona electrodes is additionally installed in the smoke supply system, the inlet pipe of which is connected to the active nozzle of the ejector, and a dividing-packing device (granulator) is installed directly behind the Laval nozzle.

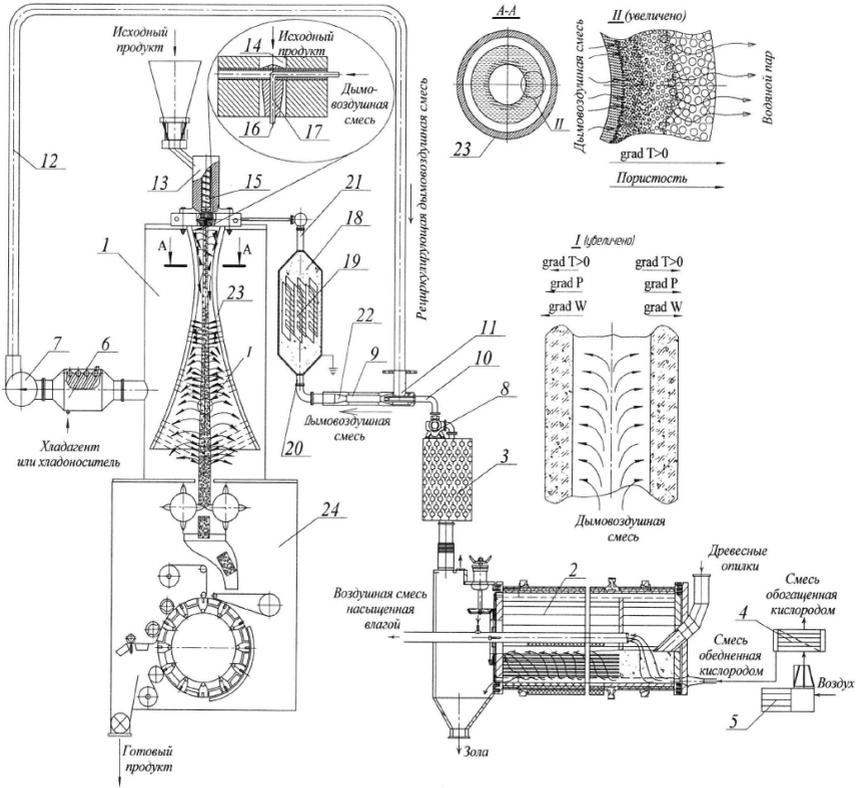


Figure 2. Scheme of the installation for obtaining smoked products with a developed structure and internal supply of smoke:

- 1. – smoking chamber; 2. – smoke generator; 3. – filter; 4. – membrane apparatus; 5. – air heater; 6. – capacitor; 7, 8. – pumps; 9. – ejector; 10. – passive nozzle; 11. – mixing chamber; 12. – recirculating pipeline; 13. – co-extruder;
- 14. – central channel; 15. – delivery auger; 16. – insert; 17, 21. – branch pipes; 18. – camera; 19. – corona electrodes; 20. – inlet branch pipe; 22. – injection nozzle; 23. – nozzle in the form of Laval; 24. – granulator-packer

The technical result of the invention [4] is to increase the rate of directed deposition of smoking components on the inner surfaces of the pores of the product, in the continuity of the combined process of creating a product with a developed structure and the smoking process, as well as in the purification of the air-smoke mixture from carcinogenic components. At the same time, an increase in the quality of the product is expected due to a deeper penetration of the smoking components of the smoke, purified from carcinogenic substances, into the pores of the product.

The principle of operation of the installation in Figure 2 is as follows. At the initial stage, nitrogen is generated, obtained by the method of barometric membrane air separation on semipermeable membranes. An example of such a membrane is a cermet-based membrane. The pressure in the inert gas generator 3 is within 0.5...4 MPa. This pressure is achieved by a compressor, which is built into the air heater 5. In order to achieve intensification of air separation on the membranes and more effective removal of moisture from sawdust, the flow is heated in the zone of their heating and drying. After the membrane-type inert gas generator 4, the air mixture enriched with nitrogen is directed into the channel nozzles of the drum smoke generator 2. Wet sawdust is loaded into the smoke generator 2 through a locking type metering unit, pump 7 and condenser 6 are started. After filling the drying zone with sawdust, they are heated to a temperature 180...190°C. At the same time, enrichment of the air mixture with nitrogen through channel nozzles is achieved. Due to the high nitrogen content in the air mixture, the sawdust dehydration process is intensified. This is explained by the formation of associated groups of moisture and nitrogen molecules, where gas molecules act as a carrier of vapor molecules from the evaporation surface to the space of the smoke generator 2 body free from sawdust, and also "bombard" the product, weakening the forces of interaction between molecules at the points of contact. At the places of collision of molecules, the pressure becomes higher than the ambient pressure, and with an increase in the rate of evaporation of moisture, the pressure difference at the interface also increases. At the same time, the total pressure in the medium increases, which means that the value of heat and mass transfer also increases. The moisture removed from the sawdust is removed from the smoke generator body.

The sawdust moved due to the rotation of the body of the smoke generator 2 through a segment-shaped hole from the pre-drying zone to the dry distillation zone is heated by heating elements in the form of cylindrical ferromagnetic rods to a smoldering temperature, for example, 290...300°C. The rods are heated as a result of the generation of heat in them (according to the Joule-Lenz law) as a result of the induction of eddy currents on them from the intense electromagnetic radiation of the tires and the inductor using a special generator (not shown) of powerful high-frequency currents.

In this zone, under conditions of limited access of oxygen, provided, on the one hand, by its reduced content in the air mixture by removing it in a membrane type 4 inert gas generator, and on the other hand by a locking flap, smoke is formed as a result of dry distillation of sawdust with constant joint mixing of sawdust and cylindrical ferromagnetic rods. The resulting smoke is removed through the peripheral (when they are in the upper position) openings, and the resulting ash is discharged into the unloading hopper.

From the smoke generator 2, the smoke is sucked out through the filter 3, in which it is simultaneously cooled and cleaned from carcinogenic components by the pump 8 and is pumped into the ejector 9 under a pressure in the range of 0.12...0.13 atm, at a high speed passes through the passive nozzle 10 of the ejector 9 and is pumped into the smoking chamber 1 through the chamber 18, equipped with corona electrodes 19. In the chamber 18, the smoke, passing through the gaps between the corona electrodes 19, is intensely ionized under the action of the electrostatic field. In the smoking chamber 1 with the help of the pump 7, a vacuum of 0.06...0.05 atm is maintained. By means of the injection screw 15, the initial product is fed through the central channel 14 into the peripheral coaxial channel, in which, under the action of the turns of the screw 15, it moves to the outlet annular hole formed by the extruder body 13 and the insert 16. When the initial product enters through the coaxial peripheral channel and outlet through the annular hole into the vacuum space of the smoking chamber 1 of the product, moisture begins to evaporate intensively from it, its rapid dehydration occurs and a highly porous structure is formed with the formation of a tubular dried frame. Simultaneously, the smoke under pressure in the chamber 18 is fed through the nozzles 21 and 17 into the inner cavity of the tubular frame of the product, intensively fills the vacuumized cavities and pores in the product intended for smoking, thereby achieving the effect of directional smoke movement, with the combined use of electric potentials. Due to electrostatics, the smoking components of the smoke are deposited on the surface of the pores of the product, and due to vacuum they are filtered through the product, which ensures its uniform and intensive smoking. Upon reaching the tubular dried frame of the narrow part of the Laval nozzle 23, a highly developed uniformly distributed porous structure is finally formed. The formed rope of product is transferred to a separating-packing device (granulator) 24 and is discharged from the installation by means of a sluice gate. The exhaust smoke that has passed through the product frame is separated from the moisture removed from the product during the formation of its porous structure using the condenser 6, and moves through the recirculating pipeline 12 into the passive nozzle 10 of the ejector 9 for reuse in the smoking process.

According to the patent [4], the installation shown in Figure 2. has the following advantages:

- location in the smoking chamber around the outlet, a vertically located device for feeding the product into the smoking chamber in the form of a co-extruder, a nozzle in the form of a Laval nozzle, provides the creation of a steam seal separating the zones for feeding the product into vacuum and smoking it, which contributes to the uniform and high-quality formation of the porous structure of the extrudate;
- the connection of the central nozzle of the co-extruder with the chamber equipped with corona electrodes, and its inlet nozzle is connected to the active nozzle of the ejector, allows for high-quality preparation of the smoke-air mixture and intensifies the process of deposition of smoking components on the product in an electrostatic field using a vacuum;
- installation of a dividing-packing device directly behind the nozzle at the bottom of the smoking chamber allows packing the finished product in a vacuum environment, which facilitates its long-term storage.

An analysis of the advantages and disadvantages of the above installation (fig. 1.3.2) from the perspective of implementing the technology recommended in this work leads to the conclusion that it is advisable to improve the smoking unit by eliminating electrostatic effects in the process of saturating the product with smoking substances, due to its low efficiency at a fairly high cost and complication of the installation, since pre-blanching and chopped fat tail fat is used as an object of smoking, which in itself intensifies diffusion processes, due to the developed internal structure of the semi-finished product supplied for smoking, which is justified by the author in staged experiments.

According to the latest literature data [5], it is advisable to obtain the finished product in granular form with a protective coating, which is supposed to be substantiated and implemented as a result of this study.

References

1. *Meat snacks: consumers drive market growth. [Electronic resource]. Access: <https://meat-expert.ru/articles/431-myasnye-sneki-potrebiteli-stimuliruyut-rost-ryinka> (Appeal date: 17.02.2021).*
2. *Scientists believe that lard can help fight COVID-19. [Electronic resource]. Access: <https://riafan.ru/1320140-uchenye-uveryeny-cto-salo-mozhet-pomoch-v-borbe-s-covid-19> (Appeal date: 17.02.2021).*
3. *Pat. 2581008 Russian Federation, A23B 4/056. Installation for obtaining smoked products with a developed structure and external supply of smoke [Text] / Shakhov S.V., Tkachev O.A. and etc; applicant and patentee FSBEI HE "Voronezh State University of Engineering Technologies". – №2015101890/06; apl. 22.01.2015; publ. 10.04.2016.*

4. *Pat. 2551566 Russian Federation, A23B 4/044. Installation for obtaining smoked products with a developed structure and internal supply of smoke [Text] / Antipov S.T., Shakhov S.V., Tkachev O.A. and etc; applicant and patentee FSBEI HE "Voronezh State University of Engineering Technologies". – №2014127833/13; apl. 08.07.2014; publ. 27.05.2015.*

5. *Aleksanyan, A.I. Improvement of the processes of obtaining frozen minced fish granular mixtures: dissertation ... candidate of technical sciences: 05.18.12 / Aleksanyan A.I.; [Presentation location: S.-Pet. nat. res. un-ty. inf. tech, mechanics and optics]. - St. Petersburg, 2018. - 215 P.*

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城市供电系统网络事故率及可靠性分析
ANALYSIS OF THE ACCIDENT RATE AND RELIABILITY OF THE
CITY POWER SUPPLY SYSTEM NETWORKS

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抽象的。 本文对城市供电网络的可靠性指标和事故统计主题进行了分析。在分析的基础上，作者考虑了事故的原因、概率和统计指标、导致技术违规的违规行为，以及该课题进一步发展的主要方向在平面上的结论。 确定事故的不明原因，进行模拟实验，预测事故并确定问题不同方面之间的因果调查因素。

关键词：电源，事故率，可靠性，故障，统计。

Abstract. *This article provides an analysis on the subject of reliability indicators and statistics of accidents in urban power supply networks. Based on the analysis, the authors considered the causes of accidents, their probabilistic and statistical indicators, violations of the regulations that contribute to technical violations, as well as the conclusion that the main directions for the further development of this topic are in the plane of identifying unidentified causes of accidents, conducting a simulation experiment, predicting accidents and establishing causal - investigative factors between different aspects of the issue.*

Keywords: *power supply, accident rate, reliability, failures, statistics.*

The problem of accidents and reliability of urban power supply networks in the last 7-8 years has acquired a high degree of relevance. There are several reasons for the increased demand in the development of this issue.

Firstly, this is the economic aspect, the knowledge of which helps to assess the possible costs in case of accidents, to prevent possible failures by dismantling economically disadvantageous and installing economically optimal nodes of the city power supply system (CPSS). As an additional result of the analysis of the ac-

cident rate and reliability of CPSS, it is possible to predict the probable damage in monetary terms for the given economic parameters of the urban infrastructure of the power supply system (for example, budget parameters for the repair of CPSS, renewal of cable lines and electrical distribution equipment, re-equipment of control points).

Secondly, infrastructural capital investments and optimization of the material and technical base make it possible to talk about the social and humanitarian aspect of the analysis of the accident rate and reliability of the CPSS. Improving the operating conditions of the CPSS will entail the optimization of occupational health and safety, provided that the extensive approach prevails over the intensive, that is, when financing is relied on not on a quantitative measure of capital investment, but on a qualitative one: intellectualization and automation of equipment, development and motivation of CPSS service personnel, long-term prospects for infrastructure development.

Third, a substantive analysis of the accident rate and reliability of the CPSS will help in the rational use of energy resources. This is the environmental aspect of this issue. For example, in the event of an accident at a traction substation, an energy leak is possible, which leads to an irrational use of electrical energy.

Fourthly, the technical side of this issue allows making small "discoveries" in the causal factors that affect the accident rate and reliability of CPSS. For example, when setting up a modeling experiment, D. Ye. Alekseev establishes significant deviations in the parameters of accident rate and reliability of CPSS, depending on the simultaneity or non-simultaneity of testing of all nodes and devices of the CPSS [1].

Here is a diagram of the main causes of technical failures in the urban power supply systems of the Sakhalin Oblast, according to the data of PJSC "Sakhalinenergo" for the period 2010-2020 (see fig. 1).

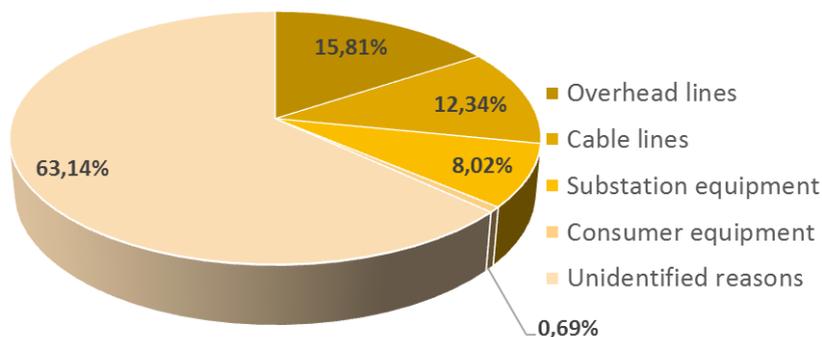


Figure 1. CPSS accident statistics by type of equipment, in percent

Let's analyze this diagram. The high degree of unidentified causes of technical failures leads to the fact that the degree of data reliability is at the level of $100 - 63.14 = 36.86\%$. However, this diagram retains the ranking of the causes of accidents. Indeed, overhead lines are the most vulnerable because they are in open space, so they come first. Cable lines are located in the area of construction works, so they are in second place. Substation equipment in comparison with consumer equipment - high-voltage - has a high utilization rate, therefore, they quickly wear out and fail.

The work of T. V. Alferova provides a list of technical violations (TV) of air and cable lines [3]. In a similar way, we will present an overview of such violations for the urban power supply systems of the Sakhalin Oblast, for the same period of 2010-2020 (see fig. 2, 3).

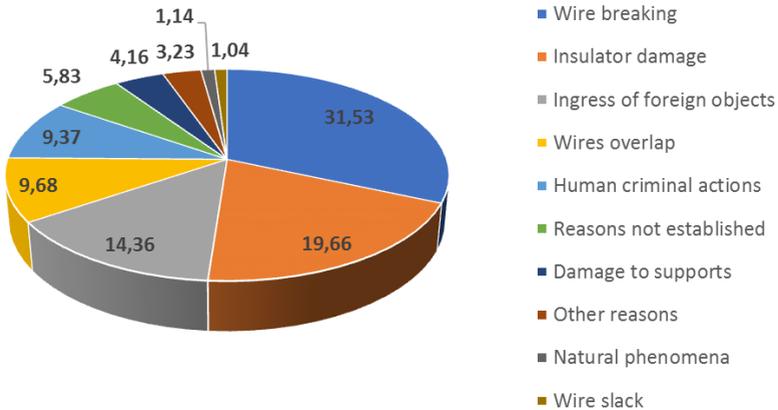


Figure 2. Distribution of technical violations of overhead lines, in percent

As you can see from this diagram, for overhead power lines, the first place is taken by a break, the second is damage to the insulator, 3 is the ingress of foreign objects (fallen trees during a strong wind, the accidental hit of thrown objects), 4 is a clash of wires, 5 is criminal human actions.

For cable lines, the distribution is different. Here, in the first place, not a cable break, but unidentified reasons. Then, on the 2nd place - insulation breakdown, on 3 - actions of 3 persons, on 4 - damage to the coupling, and only on 5 - cable break (see fig. 3).

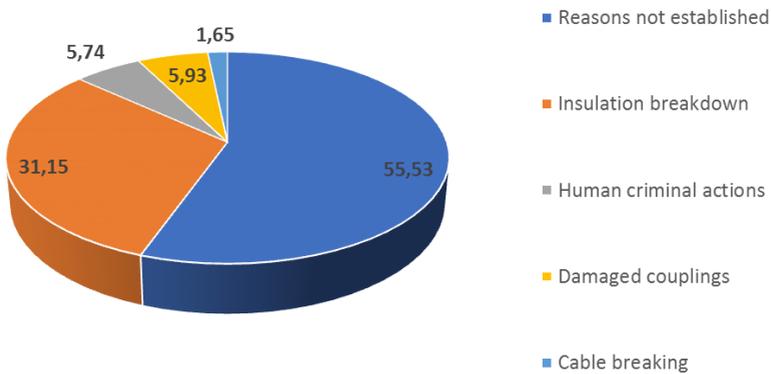


Figure 3. *Distribution of technical violations of overhead lines, in percent*

In their article, S. A. Zakharov, D. S. Kudryashov and others deviate from the empirical nature of their research and cite theoretical factors. So, in their opinion, the availability of high-quality equipment and accurate operation does not guarantee 100 percent fault tolerance of electrical equipment [4].

As these authors rightly point out, the contradiction of the situation lies in the objectivity of the reasons and the non-deterministic nature of the refusal. Untimely elimination of this discrepancy leads to a situation of exponential "expansion" of deviation monitoring data during the operational use of CPSS equipment. Further, the authors provide various theoretical estimates of the reliability parameters. The frequency and length of the CPSS are used here as a quantitative measure of reliability indicators.

Unfortunately, such indicators are difficult to statistically process by elementary statistical methods due to the "floating" nature of the time intervals of technical violations and their movement from the independent variable (argument) to the dependent variable.

The quantitative measures of reliability proposed by M. V. Akulov and V. P. Maksimov are the basis for the methodology for assessing economic efficiency in the rational modernization of CPSS [1]. The economic parameters of losses from such undesirable processes in the functioning of CPSS, as disconnecting consumers from power supply, breaks for emergency and counter-emergency repairs, can act as arguments for the function of assessing the reliability of objects and components of CPSS. Having calculated the extrema of this function, it is possible to set criteria for the optimal reliability of power supply in the standards and operating agreements of the service level.

The strategic goal of supplying CPSS is to find an extreme point of the overall CPSS reliability indicator not as a function of annual costs, as well as to meet

the cost-benefit criterion for the above processes. The authors cite a trend in the statistics that denoted the uniqueness of device failures in the years following the first failure. This trend is a consequence of the non-determinism of undesirable processes in the functioning of CPSS and a statistically determined low percentage of repetition.

Thus, unscheduled preventive maintenance work on these devices, aimed at preventing an already occurring failure, can only bring extra costs without achieving the ultimate goal of increasing the reliability of CPSS in the next year.

S.G. Zakharenko emphasizes that due to the probabilistic nature of reliability indicators, economic damage can be estimated only within the range with minimum and maximum values. He divides the problems of assessing damage into 2 types: with a known and unknown reliability indicator. The thesis of his research is that the determination of reliability parameters will lead to a narrowing of the range of economic damage [5].

In his work, the author cites general trends typical for CPSS, such as wear at the level of 65-70%, low power-to-weight ratio, and underfunding of the industry since the 90s of the last century.

D. V. Chernov gives formulas for the main indicators of CPSS reliability [6], including PNFO (probability of no-failure operation):

$$P(t)=n(t)ln(o),$$

where $n(o)$ – the number of objects observed at the beginning of the experiment; $n(t)$ – the number of remaining operational objects at time t (non-recoverable objects).

Failure rate in a short period of time $t, t+\Delta t$:

$$\lambda(t) = \frac{n(t) - n(t + \Delta t)}{n(t)\Delta t} \quad (1)$$

Recovery rate:

$$\lambda(t) = \frac{n(t + \Delta t) - n(t)}{n(t)\Delta t}, \quad (2)$$

where $n(t + \Delta t), n(t)$ – the number of objects whose restoration lasted less than $t+\Delta t$ and t respectively.

Studies conducted by the Department of Electric Power Industry of Sakhalin State University, using the example of technical violations in the city power supply systems of the municipalities of the Sakhalin Region, allow us to conclude that the main causes of technological violations with damage to equipment are "Failure to meet deadlines or fail to meet the volume of maintenance" (more than 47%) and "Overlapping of insulation as a result of lightning surges" (almost 38%),

which is due to severe wear and tear of the equipment.

It should be noted that the control over the effectiveness of measures outlined by the acts of investigation of technological violations to prevent the causes of similar outages is not carried out at the proper level, and the necessary measures to eliminate similar (previously identified) violations at power facilities are not fully planned and implemented.

References

1. Akulov, M. V. *Experience of work to reduce electricity losses in the branch distribution networks of PJSC "Sakhalinenergo" / M. V. Akulov, V. P. Maksimov // Modern problems of technology, economy and society development: Materials of the II International scientific and practical full-time -correspondence conference, Kazan, April 04, 2017 / Scientific editor A. V. Gumerov. – Kazan: "Rocket Soyuz", 2017. – P. 39-41.*

2. Alekseev, D.E. *Reliability of power supply systems of urban electrical networks: scientific article in the journal "Energy saving in power supply systems and electric power systems" / D.E. Alekseev. – Tula, publishing house of TulSU, 2011. – 6 P. [Electronic resource]. – Access: <https://cyberleninka.ru/article/n/nadezhnost-sistem-elektrosnabzheniya-gorodskih-elektricheskikh-setey> (appeal date: 20.09.2021).*

3. Alferova, T.V. *Reliability of electricity supply to consumers of the agro-industrial complex: a tutorial / T.V. Alferova. – Gomel, 2017. – 113 P. [Electronic resource]. – Access: https://elib.gstu.by/bitstream/handle/220612/15096/учебное_пособие.pdf?sequence=1&isAllowed=y (appeal date: 20.09.2021).*

4. Zakharov, S. A. *Analysis of accidents in 6-110 kV electrical networks of the Kuzbass power system: materials of the II All-Russian youth scientific and practical conference "Environmental problems of industrially developed and resource-extracting regions: solutions" / S. A. Zakharov, D. S. Kudryashov, V. A. Brodt, I. N. Paskar, V. A. Voronin. – Kemerovo, 2017. [Electronic resource]. – Access: <http://science.kuzstu.ru/wp-content/Events/Conference/Ecoprom/2017/egpp/pages/Articles/404.pdf> (appeal date: 20.09.2021).*

5. Zakharenko, S. G. *Analysis of accidents in the power grid complex: scientific article. – Kemerovo: publishing house of KuzSTU, 2016. – 4 P.*

6. Chernov, D. V. *Research of the influence of the reliability of the power supply system on the quality of electricity on the buses of rural consumers: thesis abstract for the degree of candidate of technical sciences: 05.14.02 / Chernov Dmitry Valerevich. - Irkutsk, 2009. - 24 P. [Electronic resource]. – Access: <https://dlib.rsl.ru/viewer/01003472847#?page=1> (appeal date: 20.09.2021).*

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装饰玉石涂层产品的竞争优势

COMPETITIVE ADVANTAGE OF PRODUCTS WITH DECORATIVE JADE COATING

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抽象的。文章讨论了提高包括机械工程在内的各种产品在国际市场上的竞争力的问题。文章显示，中国是俄罗斯制造商产品销售最有前景的市场之一。文献资料分析表明，带有翡翠装饰涂层的产品在中国市场具有较高的竞争优势，因此有必要朝这个方向进行科学研究。

关键词：翡翠，竞争优势，健康环境，国际市场。

Abstract. *The article discusses the issues of increasing the competitiveness of various products, including mechanical engineering, in the international market. The article shows that China is one of the most promising markets for the sale of products of Russian manufacturers. Based on the analysis of literature data, it was shown that products with a decorative coating made of Jade will have high competitive advantages in the Chinese market, therefore, it is necessary to conduct scientific research in this direction.*

Keywords: *Jade, competitive advantages, healthy environment, international market.*

The number and range of devices and products for various purposes on the international market is increasing. The number of goods entering the territory of Russia from the near and far abroad creates serious competition for domestic producers. China is the undisputed leader in the mass production of industrial and civil goods. Every year, Chinese manufacturers increase the quality of their products, and due to mass production, they have a competitive cost. In addition, the material well-being of Chinese citizens is increasing and they, in addition to the global supplier of products, are becoming a promising market for products from other countries.

During my school years, I often had to visit China with my parents. Having visited many different resort and industrial cities, it was hard not to notice that jade is the national stone of this country. Jade in China is found as jewelry and

decorative items, as elements of enclosing structures and as a heat transfer surface of heating devices. One of the suggestions for tourists in China is "visiting the jade baths".

All products where jade is installed are in special demand in China, despite the high cost. Plates of various sizes are installed in the products, which have a uniform color and do not have any surface damage. In the Irkutsk region there are enterprises that use jade in their production, and which have a large amount of waste, the so-called "non-business" jade.

In 2021, I entered to study for the specialty "Technologies of Artistic Processing of Materials" and decided to conduct research in the field of applying jade coating to various metal products that are used in mechanical engineering.

Previously, I have identified the competitive advantages that will appear in products with a jade coating:

➤ Jade has good heat capacity, keeps heat for a long time, evenly distributing it over its surface. Accordingly, jade-coated products can create a favorable temperature balance in rooms, heating up during the day and gradually giving off heat in the evening and night hours.

➤ Jade is a natural filter against negative external thermal effects and has been used since ancient times to optimize the circulation of thermal energy in the human body [1].

➤ Due to its natural characteristics, jade emits thermal energy in the frequency range favorable for the human body, thereby creating a healthy and environmentally friendly environment [2].

➤ Jade is widely used in therapeutic equipment for the treatment of various diseases [3], respectively, all jade-coated products for advertising purposes can be called "Healing".

➤ Jade is one of the most common minerals used to optimize heat exposure and can be used for heat transfer surfaces in heating and thermoelectric systems. It is resistant to tests, has high strength, has good dielectric characteristics, and has antiseptic properties [4]. Accordingly, this coating will create favorable thermal comfort and, at the same time, retain its properties during long-term use.

➤ In the manufacture of building envelopes, jade is used for a positive biostimulating effect. Scientists have proven that architectural ensembles made of stones, intended for contemplation, normalize the psychological state [5], this method is used in the sanatorium "Grove", located near Kharkov [6]. The buildings and structures where this coating will be used will have a calm and friendly atmosphere.

These advantages can only be obtained if, when applied to the jade surface, such a structure is created in which the coating will give the same spectral analysis as an intact whole plate.



Figure 1. Jade coated specimens

At our University, work is underway to apply a dielectric coating on metal surfaces with borosilicate glasses [7] by pneumo-electrostatic method. Jade, like glass, is a dielectric, but under the influence of temperature it does not melt and it cannot be restored to its original state by thermal action. Therefore, for application, I use a mixture of jade powder and low-melting borosilicate glasses, fig. 1 shows the first samples that were made in this way. Visual assessment and mechanical impact on the applied surface showed that the coating has an attractive appearance, does not wear off and it is possible to create ensembles with different combinations of colors.

I will continue my research in this area so that it becomes possible to create decorative coatings for a healthy environment and to increase the competitiveness of products from Russian manufacturers.

References

1. Portnov A.M., Dronova N.D. *Unique jade // Nature. Mineralogy. 2016. № 12. P. 18.*
2. Shelekhov I. Yu., Shelikhova GA *Research of nephrite for creating a healthy environment for human life. Applied science of today: problems and new approaches: collection of articles of the III International Scientific and Practical Conference (April 12, 2020) – Petrozavodsk: ICNP "New Science", 2020. – P. 85-90.*

3. Golubeva E.O., Shvaiko E.S. *The use of minerals in ancient medicine*. - In the collection: *Fundamental science in modern medicine 2016 Materials of the satellite remote scientific-practical conference of students and young scientists*. Edited by A.V. Sikorsky, O.K. Doronina, T.V. Terekhova. 2016. P. 89-93.

4. Valeev R.G. *Stones are treated! Novels about precious stones*. — K.: Radianskiy writing, 1971. — 191 P. <https://search.rsl.ru/ru/record/01007291619>

5. Tondiy L.D., Zakrevskaya E.L. *DO STONES HEAL? Eastern European Journal of Internal and Family Medicine*. Kharkiv regional organization "Association of general practitioners - family medicine" (Kharkov) 2016. № 2. P. 34-36. <https://elibrary.ru/item.asp?id=29003318>

6. Zhuravlev V.A., Tondiy L.D. *The book about the clinical sanatorium "GROWTH"*. — Kharkov: Word, 2014. — 260 P. <https://www.ds31.ru/goods/1209955/>

7. Shelekhov I.Yu., Shishelova T.I. *Properties of a dielectric coating applied by a pneumo-electrostatic method to a conductive surface. // 3rd international scientific and technical conference "Electrical insulation - 2002".- St. Petersburg, 2002, P.258-260.*

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经济转型条件下俄罗斯东北部的人口发展
**DEMOGRAPHIC DEVELOPMENT OF THE NORTH-EAST OF RUSSIA
IN THE CONDITIONS OF ECONOMIC TRANSFORMATIONS**

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The article was prepared within the framework of the state task: registration number AAAA-A16-116110810013-5 "Geographical and geopolitical factors in the inertia, dynamics and development of various ranked territorial structures of the economy and settlement of the population of Pacific Russia".

抽象的。这篇文章考虑了俄罗斯北极地区人口发展过程的现状。研究表明，极地区人口外流导致人口稳定下降的原因是该地区吸引力下降，使宏观区域特别容易受到全球性挑战的影响。土著少数民族发现自己面临着艰难的选择：在优先集中开发北部现有自然资源与保护传统生活条件和环境管理之间。传统经济部门的危机状态导致了社会问题的恶化。大多数农村人口失业，生活在贫困线以下。在北方恶劣的自然条件下，为了在生活条件下保持基本的社会保障，在社会领域找到国家和市场监管者的最佳比例的重要性正在增加。

关键词：俄罗斯东北部，人口统计学，移民，北方人民的生活水平，人口动态。

Abstract. *The article considers the current state of demographic processes in the Arctic territories of Russia. It is shown that the stable decline in the population as a result of the outflow of the population from the polar regions occurs due to a decrease in the attractiveness of the region and makes the macroregion especially vulnerable to global challenges. Indigenous minorities found themselves in a difficult choice: between the priority of intensive development of the existing natural resources of the north and the preservation of traditional living conditions and environmental management. The crisis state of the traditional sectors of the economy has led to an aggravation of social problems. Most of the rural population is unemployed and lives below the poverty line. The importance of finding the optimal ratio of state and market regulators in the social sphere is increasing in order to preserve basic social guarantees in the conditions of living in the difficult natural conditions of the North.*

Keywords: *North-East of Russia, demography, migration, standard of living of the peoples of the North, population dynamics.*

Introduction

The relevance of the study of the demographic situation in the north-eastern regions of Russia in the current economic conditions is beyond doubt. Arctic issues are always relevant for Russia, since Arctic territories occupy 18% of the country's area, with less than 2% of the population of the Russian Federation, but more than 40% of the population of the entire world Arctic, and explored and forecast mineral resources make up most of the country's mineral resource base. The importance of the issue is becoming more acute today, in the context of the elevation of the Northern Policy to the category of national priorities, the intensification of the processes of development and launch of a large number of strategic projects.

For the Arctic territories, the situation itself has a twofold nature. On the one hand, the availability of natural resources that are significant not only for the Russian Federation, but also for other countries [4]. On the other hand, these territories of residence of ethnic small peoples with traditional activities that are important for their existence are in clear contradiction with the current state and prospects of development in market conditions of indigenous small peoples of the North (KMNS).

Out of 40 small-numbered peoples in 28 constituent entities of the Russian Federation, 9 Arctic regions are included in the Russian Arctic, which is slightly more than 80 thousand people out of 250 thousand indigenous small-numbered peoples of the North. By ethnic composition, these are Nenets, Chukchi, Khanty, Evenks, Selkups, Sami, Eskimos, Dolgans, Chuvans, Mansi, Veps, etc. some of them lead a nomadic or semi-nomadic lifestyle associated with traditional occupations: reindeer husbandry, fishing, marine hunting, gathering (about 20 thousand people). The Eastern Arctic Economic Zone of the Republic of Sakha (Yakutia) consists of 13 municipalities: with 7.2% of the population of the republic. Chukotka is classified as a place of traditional residence and traditional economic activity of the indigenous peoples of the North of Russia. There are six indigenous peoples of Chukotka [6, 7]

Discussion of the results

During the period 1990-2000, the population of the Arctic zone of the Russian Federation decreased by 1.1 million people or by 12.1%. The largest outflow was observed in the CHAO and Nenets Autonomous District, in the Murmansk Region. By 2000, the CAO had lost about 64% compared to the number in 1990 [1, 4]. In the Russian sector of the Arctic, the degradation of the northern territories was developing, manifested in literally everything and, above all, in the destruction of industrial and social infrastructure, in the decline in the technical and eco-

conomic level of still operating enterprises, in a sharp decline in the pace of preparation of the raw material base, in the regular disruption of the delivery of goods for production and the population, in the financial bankruptcy of payments and non-payment of wages, etc. Crisis phenomena in the economy, especially affected the demographic situation in the north of the region. In the absence of motivation, apathy spread among people, there was a sense of meaninglessness of life, the number of suicides among the indigenous population sharply increased. During this period, the Northerners experienced an unprecedented increase in alcoholism, many of them lost their work skills and life initiative. The result of the crisis phenomena was unemployment, social explosions and the outflow of population from northern cities and towns. The curtailment of production led to an outflow of skilled workers who could easily find a job in more attractive regions of the country in terms of climate and living conditions. During the post-Soviet period, only in the Chukotka Autonomous Okrug the population decreased from 169 thousand people to 49.0 thousand people (3.5 times). At the beginning, the population decreased as a result of migration outflow, and since 1995, a decrease has been recorded due to natural attrition. From 1991 to 2018, the region lost 23.2% of its population [7] Since 1993, a high mortality rate has been established, characterizing the social state of society. The mortality rate of the indigenous population of the CHAO significantly exceeds the mortality rates of the entire population of Chukotka. However, according to general indicators of mortality, for example, in the CHAO from cardiovascular diseases has been and remains much lower in recent years than in the Russian Federation.

In the 1990s, in the Far East, as in all other territories, there was a decrease in the birth rate by more than 2 times. If in 1990 the total fertility rate in the Far East was 2.07, by 1999 it had decreased to 1.21 (the lowest level in the history of settlement of the region). Further, this indicator still maintains an upward trend, and in 2015 it amounted to 1.89. In areas inhabited by ethnic minorities, there was an increase in the birth rate, which was established at the level of 16-14%, higher than in the whole macroregion [5]. Since 2005 The indicators in the Republic of Sakha (Yakutia) correspond to the simple replacement of generations (1,8), Chukotka Autonomous Okrug (2,2), Koryak Autonomous Okrug (1,9) children per woman. In the rural population of national formations, the change in the total fertility rate is especially noticeable: more than 2 children for every woman of fertile age.

The interrelation of childhood and future development is indicated among small indigenous peoples in family, marital, gender, cultural and other conditions and traditions of life. In areas with an ethnic population, a significant number of children born out of wedlock is noticeable in the birth rate structure, which can be explained by several reasons.

1. Unlike European ethnic groups, a significant number of births of children

among women at young ages is associated with the established structure of reproduction among small-numbered peoples. Only the "right European values" have led to hypertrophic social consumerism, ignoring the problems of self-reproduction.

2. The number of ethnic minorities increases due to the instinct of self-preservation from extinction.

3. For indigenous peoples inherent in lower life expectancy, in this regard, all life cycles of the "compressed".

4. In Russia at birth and upbringing of children are 9 types of benefits, but they are also the parent capital, are not so significant for the rest of Russia, for the North-tions of regions to protect the family from declining living standards for child birth.

5. In the North, in conditions of hidden unemployment, the appearance of children among very young women in the Chao and Sakha (Yakutia) is associated with the problem of employment, the inability to receive vocational education near home, and the birth of children allows you to receive payments for their maintenance provided for by law.

6. Social benefits in the form of subsidies for utility payments, especially in urban areas, are intended to a greater extent for single mothers and they are significantly more than lump-sum payments (until 2020) at the birth of children. They are added together and a more significant amount is obtained, for which you can refuse to register a marriage.

7. The establishment of a modern type of reproduction among small ethnic groups, in view of their established life principles and values, conservation behavior in nature management, in contrast to consumer society. The planned economic growth in the development of fuel and energy resources, with the current system of income distribution, will not ensure an increase in the standard of living of indigenous ethnic groups.

According to the federal District, life expectancy is lower in the Chukotka Autonomous Area. As a result of the spread of undesirable phenomena, the average life expectancy of the indigenous population of the Arctic has decreased to 45 years. Representatives of the Northern nationalities in the 1990s lived on average 25 years less than the inhabitants of Russia and 35-40 years their life was shorter than that of people living in developed countries. An increase in life expectancy should be considered a positive moment: in the Chukotka Autonomous Okrug: in 2005 58.48 years; 2012 - 60.79 years; in the Republic of Sakha (Yakutia) – 64.68 years, in 2012 – 67.93 years, respectively [2, 6].

The main part of the indigenous minorities live in rural areas, where traditional life-support industries - reindeer husbandry, marine, fishing, hunting are not supported, which does not allow them to have a permanent income. The majority

of the rural population is unemployed and lives below the poverty line. The crisis state of the traditional sectors of the economy has led to an aggravation of social problems. The unemployment rate is 1.5-2 times higher than the average in the Russian Federation. The areas of their compact residence still have a high level of unemployment and poverty. The most problematic are identified in the polar regions: a low level of real monetary incomes of the population, with a high cost of living, transport remoteness, high cost of energy resources and electricity. The purchasing power of the income of the population of Chukotka is at the level of the average Russian value, which does not contribute to the influx of population. In the high level of average wages, district coefficients are laid down, removing which, real incomes will decrease by 3-4 times. There was an outflow of population from the region, a shortage of highly qualified labor resources, especially in the shortage of teachers, doctors, etc. Lump-sum payments for those who expressed a desire to come to work at a school or hospital (1,000,000 rubles) are ineffective. The same amount of payment is established for the middle, southern latitudes and polar territories.

At the same time, great importance is attached to the preservation of the national culture of the CMNS (art, crafts, rituals, traditions, beliefs and folklore). Such skills are transmitted and assimilated in the process of socialization. Children of the CMNS are the most socially and culturally vulnerable category of the population. [2] Social maladaptation of young people is developing, weak orientation to education, which has become paid, lack of work skills, early alcoholism, due to the loss of the traditional mechanism of their habitual life, way of life, culture have become an insurmountable obstacle. Polar regions, to a greater extent than other regions, need socialization in the context of universal informatization and the total spread of the Internet to relieve social tension; providing a standard of living several times higher than Russian indicators; obtaining high-quality education, at various levels, including additional.

Socio-demographic and medico-ecological problems of the small peoples of the Far North are mainly determined by the technogenic development of their territories, by the newly arrived population working in shifts. Exclusion of these territories from natural use by the indigenous population and environmental pollution, together with other social factors, contribute to an increase in natural mortality among the population for "industrial reasons". Globalization, which erases economic, political, socio-cultural differences between regions, affects the ways of interaction between childhood and society, as well as indirectly on the physical and mental state of children, through the structural dynamics of age-related changes in the population.

The main conclusions

In modern economic conditions, the importance of finding the optimal ratio

of state and market regulators in the social sphere is increasing in order to preserve basic social guarantees in conditions of increasing budget constraints and commercialization of its institutions. The role of sulfur surcharges and district coefficients in stimulating the influx of able-bodied population has decreased, and their values have decreased with the abolition of regional surcharges of the Soviet period (Yakutia). Weak correlation of poverty with employment. Among the long-term trends, it can be assumed that one of the most important factors determining the alignment and interaction of various forces in the XXI century will be the growth of geo-economic contradictions in the Arctic associated with its resource potential [4]. According to some estimates, numerous policy documents adopted to improve the demographic situation – in the country as a whole, in the Far East, in its Arctic zone - were not effective enough [1]. For three decades, many decisions have been made to improve in general and in the northern regions especially to stop the outflow of population, but a positive result has not yet been achieved. All promising areas of Arctic development will depend on demographic processes, opportunities to create their own demographic resources for economic growth. Only if the government's actions are aimed at introducing an optimal model of migration and demographic behavior for the Far East, one can hope for a positive development of demographic potential in the marginal territories of the Russian Federation, demographic priorities of social policy, and move from quantitative indicators of the birth rate to qualitative ones - ensuring high living standards of the population.

References

1. Avdeev Yu.A., Sidorkina Z.I., Ushakova V.L. (2020) *Trends of demographic development in the regions of the Russian Eastern Arctic // Population. – Vol. 23. - No. 3. – pp. 130-144. DOI: 10.19181/population.2020.23.3.12. (In Russ.)*.
2. Gareeva I.A., Zaksor O. V. (2018) *Modern problems and conditions of socialization of the small indigenous peoples of the North on the territory of the Khabarovsk Territory / Geography of childhood: interdisciplinary synthesis of research approaches and practices: materials of international relations. youth scientific school-confer. Vladivostok, May 29-31. 2018/Ed. by A.G. Filipov - St. Petersburg: Asterion. – pp. 62-65. (In Russ.)*.
3. *Health of the indigenous and alien population of the Chukotka Autonomous Okrug (2018) / Ed. Yu.P. Nikitin; Russian Academy of Sciences, Siberian Branch, Research Institute of Terapia and Preventive Medicine - branch of the Federal State Budgetary Institution "Federal Research Center Institute of Cytology and Genetics SB RAS". - Novosibirsk: Academic publishing house "Geo",– 622 p. (In Russ.)*.

4. *Modern Russia: a geographical description of our Fatherland. The Far East (2020)*, eds. V. M. Kotlyakov, P. Ya. Baklanov, Moscow, Paulsen, 464 p. (In Russ.).

5. *Regions of Russia. (2020), Socio-economic indicators. 2019: Stat. sat. / Rosstat. - M. (In Russ.)*.

6. Sidorkina Z., Ushakova V. (2019). *Questions of social-demographic development of the indigenous small- numbered peoples of the north of the Russian Far East / Arctic: History and Modernity: Works of the fourth International Scientific Conference, St. Petersburg, 17-18 April 2019. – St. Peterburg: POLYTECH-PRESS. –137 -147 p. (ang.)*

7. Sidorkina Z. I., Ushakova V.L. (2019). *Dynamics of demographic processes in the regions of the Eastern Arctic (on the example of the Chukotka Autonomous Okrug)/ Natural and Technical Sciences, , No. 4. – pp.104-111. (ang.)*

乌兹别克斯坦条件下冲洗高盐渍土壤的节水方法
**A METHOD OF SAVING WATER WHEN WASHING HIGHLY SALINE
SOILS IN THE CONDITIONS OF UZBEKISTAN**

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抽象的。实验室和现场实验证实,通过用用水 1:10 稀释的生物溶剂制剂喷洒检查内部的土壤,盐浸出增加。在供水冲洗之前。土壤层 0-70 cm 中离子和盐的浸出量增加:氯离子 - 增加了 42%,盐分的总量增加了 38%。结果表明,在土壤盐分较高的情况下,其海水淡化节水为 3000 立方米/公顷。

关键词:盐渍土,离子浸出,生物溶剂制备,洗涤,浸出率,节水。

Abstract. *Laboratory and field experiments established an increase in salt leaching by spraying the soil inside the checks with the Biosolvent preparation diluted with water 1:10. before supplying water for flushing. There was an increase in the leaching of ions and salts in the soil layer 0-70 cm: chlorine-ion - by 42% and the total amount of salts by 38%. It was found that with a high degree of soil salinity, water savings for its desalination is 3000 m³/ha.*

Keywords: *saline soils, ion leaching, Biosolvent preparation, washing, leaching rate, water saving.*

Introduction

About half of the irrigated lands in the Republic of Uzbekistan are subject to seasonal salinization and about 20% require soil leaching in the winter-spring period. Usually, saline lands are flushed according to checks, for this preparatory work is performed (leveling the surface of the field, cleaning the drainage, making rollers and temporary earthen channels for supplying water, etc.). In addition to labor costs, land leaching requires large volumes of water. The leaching rates for moderately saline lands are 4000-5000 m³/ha, and for highly saline lands - more than 6000 m³/ha. Water resources in Uzbekistan are limited, and therefore, in-

creasing the efficiency of leaching is urgent. Reducing the amount of water spent on flushing will allow them to be stored in reservoirs and used during the growing season.

The purpose and objectives of the study

The aim of the study is to search for methods and technologies to improve the efficiency of leaching of saline lands, ensuring water savings.

Tasks for achieving the goal: 1. Conducting a study to study the leaching capacity of the Biosolvent preparation, developed at the Institute of Bioorganic Chemistry, ASRUz. 2. Quantitative and qualitative assessment of the leaching capacity of the preparation, according to the data on changes in the ionic composition of the soil. 3. Establishing indicators of soil leaching and water saving when using Biosolvent for washing.

Materials and methods

The studies were carried out in the field at an experimental site located in the Syrdarya region of Uzbekistan (figure 1) [1,2,3].

The soils are homogeneous in texture, light loamy, with rare interlayers of sandy loam, average soil salinity for the site according to ECE in a layer of 0-100 cm, up to 18 dS/m. The experiments were performed in triplicate according to generally accepted methods. Soil analyzes before and after leaching were carried out by the method of full water extraction; statistical processing of the data was carried out according to the Student's method.



Figure 1. Location of the Syrdarya region on the territory of Uzbekistan and the location of the experimental sites

Flushing at a rate of 2000 m³/ha, carried out on checks of 25x25m², in the following options: "control", - normal flushing and "experiment", - washing with spraying the soil inside the check with Biosolvent diluted in a ratio of 1:10. Water was supplied to each check separately; water accounting was carried out with the help of the Chipoletti spillway. The efficiency of leaching was assessed by comparing the data of laboratory analyzes of the ionic composition of the soil "before" and "after" leaching.

The consumption of water for desalination of soils from a high degree of salinity to the level of non-saline, was determined by a calculation method (according to experimental data on soil leaching by a dense residue).

Results

The results of field studies of leaching of saline soils using Biosolvent are shown in Figures 2 and 3 and in table 1.

Under the influence of leaching, the ionic composition of the soil changed as follows:

- the content of HCO₃, and when washing with Biosolvent - decreases (horizons 0-30 cm), or increases to a lesser extent, and in the control after washing with ordinary water, it slightly increases.
- the chlorine ion is washed out very well, in the control in the layer 0-70 cm -17.7% of the initial content was taken out, and in the variant with Biosolvent 59.6%, the difference between the variants was 41.9%.
- the effect of Biosolvent is also noticeable when sulphates are washed out, which in the 0-70 cm layer was: 21.8% in the control and 35.2% in the variant with the preparation (difference -13.4%);
- washing out the calcium ion from the 0-70 cm layer, in the control was -32.5%, and in the experiment - 60.5% (the difference was 28%);
- the content of magnesium, in the 0-70 cm layer, in the control decreased by 2.9%, and in the experiment, increased by -74.7%, which can be explained by an increase in the dissolution of magnesium by the Biosolvent;
- there was also an increase in the washout of sodium ion in the soil layer 0-70 cm: in the control it, washed out, was -36.6%, and in the experiment with the preparation: -56.3% (difference -19.7%).

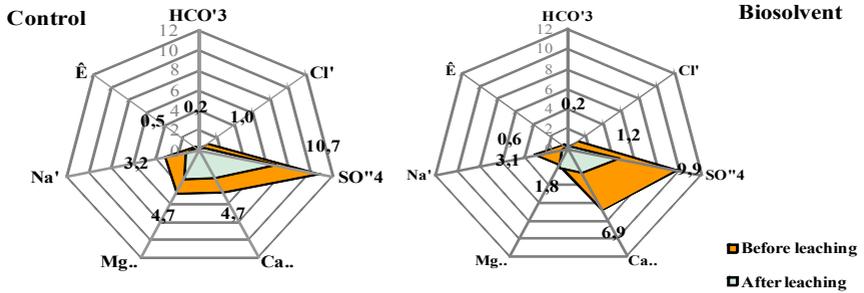


Figure 2. Comparison of the leaching of ions from the soil in the variants of the experiment

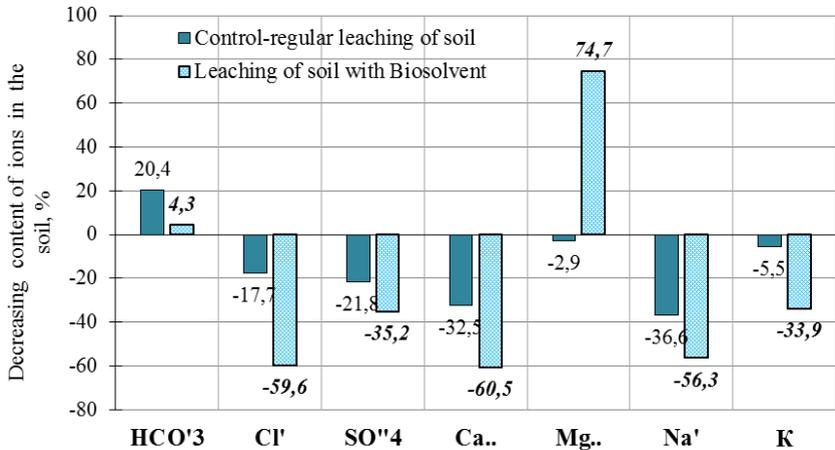


Figure 2. Influence of processing checks with Biosolvent on the efficiency of leaching of individual ions during washing (layer 0-70 cm)

Table 1.

Indexes of efficiency of salt leaching and calculated norms of water for strong saline soils in options of field research

Indexes	Options of field research		Differences (B-C)		Changing, times (B/C)
	Control (C)	Biosolvent (B)	Absolute value	%%	
Before leaching (TDS,%)	0,812	0,842			
After leaching (TDS,%)	0,644	0,499			

Changing (TDS,%)	0,168	0,343	0,175	104	More, than 2,0
Unit costs of water for decreasing of TDS to 0,1 %	1190	583	607	51	Less, than 2,0
Soil leaching, coefficient, α	1,99	0,88	-1,11	-56	Less, than 2,3
Calculated norm of leaching for strong saline soils, m ³ /ha	8549	5298	-3251	-38	Less, than 1,6

To clarify the values (volumes) of possible water savings during leaching with the use of Biosolvent, indicators of soil leaching were determined, based on actual data on soil desalination by conventional leaching and with Biosolvent in field conditions. The calculations were carried out according to the formula of V.R. Volobuev:

$$M_{LE} = 10000 \alpha \lg(\text{Sin}/\text{Sadd})$$

where:

M_{LE} – leaching rate, m³/ha;

Sin – salt content in the soil layer in need of washing, in% of the soil mass;

Sadd – permissible salt content in this layer, in% of the soil mass;

α – soil leaching coefficient, established according to the data of pilot production flushing.

The required leaching rates for highly saline soils, in the considered leaching options, are calculated using the same formula and the soil leaching coefficient indices established experimentally.

Conclusion

Experimental data have shown that the use of the Biosolvent preparation during flushing increases its efficiency in comparison with conventional technology and helps to save water by increasing the leaching of salts. The specific and total consumption of water for flushing is reduced. With conventional leaching, to reduce salinity (according to TDS) by 0.1%, 1190 m³/ha is required, and when using Biosolvent - 583 m³/ha, that is, almost half as much. Net leaching rates, calculated from the actual soil leaching coefficient α , for desalination of highly saline soils to the level of non-saline ones, with the use of Biosolvent less by 3000 m³/ha (by 38%).

References

1. Yulia Shirokova, Gauharay Paluashova, Farhod Sadiev. *Results of Testing the Leaching Ability of the Biosolvent Preparation on Salted Soils of the Middle Current of the Syrdarya River.* // Research Article. *Advances in Agriculture, Horticulture and Entomology, AAHE-128.* Volume 2020, Issue 04. ISSN 2690-1900. www.kosmospublishers.com contact@kosmospublishers.com DOI: 10.37722/AAHAE.202042.
2. Farhad Fatullaevich Sadiev, Yulia Illarionovna Shirokova, Gaukharai Kalbaevna Paluashova. *Investigation of the reclamation effect of the "Biosolvent" preparation on saline soils during leaching and irrigation.* // *Scientific journal of the Russian Research Institute of Melioration Problems.* 2021. V. 11, № 1. P. 24–46. doi: 10.31774/2222-1816-2021-11-1-24-46.
3. Sadiev Farkhod, Shirokova Yulia, Paluashova Gauharai. *A method for enhancing the leaching of salts from the soil during leaching and irrigation using the domestic preparation Biosolvent.* // *J. AGRO ILM.* № 1.[57], 2021. P.59-60.

植物和真菌多糖对动物低温贮藏过程中生殖细胞安全性的影响

**THE INFLUENCE OF POLYSACCHARIDES OF PLANTS AND FUNGI
ON THE SAFETY OF REPRODUCTIVE CELLS OF ANIMALS DURING
HYPOTHERMIC STORAGE**

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抽象的。保护动植物遗传资源的相关性需要寻找生物活性物质来保护生殖细胞。在低温储存条件下,多糖可以提供细胞外环境的渗透、细胞膜和细胞骨架结构的稳定。Xylotrophic Basidiomycete *Hericium erinaceus* (Bull.: Fr.) Pers. 是一种具有高生物活性的多糖来源。苹果果胶广泛应用于人类生活的各个领域。研究了不同浓度的多糖在低温 (+4°C) 储存条件下对荷斯坦公牛精子活力的影响以及对脂质过氧化 (LPO) 过程和抗氧化活性的强度的影响。工作中获得的数据表明,在低温 (+6°C) 储存条件下,使用猴头菌多糖作为一种成分来维持牛精子配子的功能有用性的前景。

关键词: 苹果果胶, 多糖, 猴头菇, 精子, 冷藏, 低温储存。

Abstract. *The relevance of preserving the genetic resources of the animal and plant world necessitates the search for biologically active substances for the preservation of reproductive cells. Under conditions of hypothermic storage, the osmosis of the extracellular environment, stabilization of membranes and structures of the cytoskeleton of cells can be provided by polysaccharides. Xylotrophic Basidiomycete *Hericium erinaceus* (Bull.: Fr.) Pers. is a source of polysaccharides with high biological activity. Apple pectin is widely used in various spheres of human life. The effect of polysaccharides of different concentrations on the viability of spermatozoa of Holstein bulls under hypothermic (+4°C) storage and on the intensity of lipid peroxidation (LPO) processes and antioxidant activity was studied. The data obtained in the work indicate the prospect of using H.*

erinaceus polysaccharides as a component to maintain the functional usefulness of bovine sperm gametes under hypothermic (+6°C) storage.

Keywords: *apple pectin, polysaccharides, Hericium erinaceus, sperm, refrigeration, hypothermic storage.*

Hericium comb (Hericium erinaceus (Bull.: Fr.) Pers.) - a representative of agaricoid xylotrophic fungi is known as a valuable edible and medicinal species in Europe and South America, artificially cultivated and used in traditional medicine in East Asia. More than 35 polysaccharides with anticancer, immunomodulatory, hypolipidemic, antioxidant and neuroprotective activity have been isolated from the fruit bodies and mycelium of this fungus [1, 2]. A large number of medical products and drugs are known, patented in China [3], USA, Japan and Korea [4], which contain only *H. erinaceus* as an active ingredient.

Apple pectin has found its application in many industries (food, aerospace, pharmaceutical). Its biological effect is also being studied. The introduction of apple pectin into the diet of rats reduces the degree of myocardial damage by inhibiting apoptosis [5]. Pectin is effective for normalizing weight in obesity [6].

Currently, research is actively continuing aimed at expanding the boundaries of the practical use of polysaccharides. The relevance of preserving the genetic resources of the animal and plant world necessitates the search for biologically active substances for the preservation of reproductive cells. Analysis of literature [7, 8] data suggests that polysaccharides can have a positive effect during hypothermic storage of reproductive cells. Under anaerobic and aerobic conditions, sugars are not only an energy substrate for the cell, but also stabilize the protein-lipid complexes of cell membranes and cytoskeleton structures upon cooling [9, 10].

The aim of this study was to assess the ability of the polysaccharides of the fungus *H. erinaceus* BP16 and apple pectin AU-701 to influence the preservation of the functions of bovine spermatozoa under hypothermic storage.

Objects and methods

In this work, we used a polysaccharide fraction from the fruit bodies of an artificially cultivated fungus *H. erinaceus* BP16 (natural isolate BP16, the nucleotide sequence of the ITS1_5.8S ITS2 fragment was deposited at NCBI under number MK809367), which was obtained as a result of extraction with hot water followed by ethanol precipitation. The dry matter mass yield is 2.8%. According to gas-liquid chromatography, carbohydrate chains consist of galactose (9.62%), glucose (9.14%), arabinose (6.79%), mannose (5.01%), rhamnose (2.35%), fucose (2.68%), xylose (0.3%) residues.

Used commercial apple pectin "Classic AU-701" (Herbstreith & Fox KG, Germany). The molecule has a linear structure and contains 91% galacturonic acid. The rest of the molecule (9%) consists of neutral monosaccharides. The percentage of each type of monosaccharide in apple pectin is: galactose - 2.4%, arabinose

- 0.3%, rhamnose - 1.4%, glucose - 1.6%, xylose - 2.9%. The degree of esterification of pectin is 38-40%.

Spermatozoa of bulls-producers of the Holstein breed were obtained in production conditions (JSC "KirovPlem"). Freshly obtained sperm with a mobility of 7-9 points was diluted 1:1 with lactose-citrate-yolk medium for bovine semen. After 5 minutes, lactose-citrate-yolk medium with glycerin (control group) or lactose-citrate-yolk medium with glycerol and polysaccharide (experimental groups) was slowly added dropwise to the resulting mixture in a ratio of 2:3. The final concentration of glycerol in the sperm medium was 4.4%, the polysaccharides of *H. erinaceus* 0.4%, or apple pectin 0.12%. The mixture was poured into polymer conical microtubes (0.5 ml each), which were kept at + 6°C from 1 to 11 days.

Sperm viability indices were determined before and after hypothermic exposure. The number of gametes was determined by microscopy in a Goryaev chamber (with the addition of 3% sodium chloride) according to the generally accepted method and was expressed in million/ml. The level of biological usefulness of gametes was determined by the method of light microscopy by the indicator of their mobility in 3% sodium citrate (10 points - all spermatozoa in the field of view move progressively forward). Sperm viability was assessed using the hypoosmotic swelling test (HOS test) for twisting and swelling of their tails (per 100 tested spermatozoa, expressed as a percentage). The intensity of lipid peroxidation in the sperm medium was assessed by the chemiluminescent method on a BKhL-07 biochemiluminometer (LLC "Medozons", Russia) for 30 sec. Recorded I max (mV) - the maximum intensity of a rapid flash, reflecting the potential ability of a biological object to free radical oxidation; S (mV×sec) - light sum for 30 sec, reflecting the content of radicals RO₂; tg(-2α) - the tangent of the slope of the time axis curve (characterizes the maximum slope of the curve, with the sign "-"), the higher the value of the tan (-2α) index, the higher the activity of the enzymatic systems of cells that regulate the content of hydroperoxides.

The results of the study were subjected to statistical analysis using the "BioStat 2009 Professional 5.8.4" software (AnalystSoft, USA). To assess the differences, the nonparametric Wilcoxon test was used at $p < 0.05$. The research results are presented as median, 25th and 75th centiles (*Me*, *Q1-Q3*).

Results and discussion

Using the chemiluminescent method, it was found (figure) that the presence of the polysaccharide fraction of *H. erinaceus* in the sperm medium contributes to an increase in the intensity of LPO processes (by the value of I max, S) and anti-oxidant activity (by the tg (2α) indicator) equally and through all storage periods. Apple pectin has no significant effect on the above processes. Probably, this difference in the effects of polysaccharides is due to the peculiarities of the structure of their molecules.

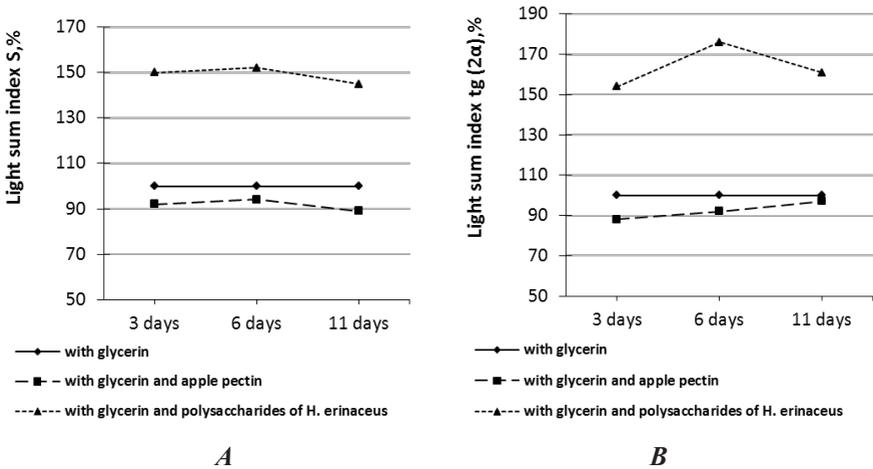


Figure. Indicator (in% to the level of glycerol) *S* of the intensity of lipid peroxidation (diagram A) and antioxidant activity tg (2a) of bovine spermatozoa (diagram B) subjected to hypothermic (+6°C) storage for 3, 9 and 10 days in the medium glycerin (4.4%) and polysaccharide fraction of *H. erinaceus* 0.4% or apple pectin 0.12%

In gametes stored in a glycerol medium (4.4%) at +6°C, the ability of sperm to progressively move at a level of 40% (allowable for fertilization) remained for 6 days, when the polysaccharide fraction of *H. erinaceus* was introduced into the glycerol medium 0.4% - 7 days, with the addition of apple pectin 0.12% for 5 days (table 1). Probably, this effect in the polysaccharide fraction of *H. erinaceus* is due to its revealed and described above antioxidant effect at the indicated concentration.

Table 1.

Motility index of spermatozoa (*Me*, *Q1-Q3*), subjected to hypothermic (+6°C) storage for 3-9 days in glycerol (4.4%) and *H. erinaceus* polysaccharides (0.4%) or apple pectin AU-701 (0.12%)

Series	Storage periods (days)				
	3	6	7	8	9
Glycerol	78 (62.5 – 83.5)	44 (25.0 – 67.0)	22 (15.25 – 53.0)	11 (0.0 – 29.75)	12 (0.0 – 44.0)
+ 0.4% polysaccharide fraction of <i>H. erinaceus</i>	78 (64.0 – 89.0)	50 (36.75 – 67.0)	44 (24.75 – 74.25) *	22 (8.25 – 51.5) *	18 (8.25 – 54.25)

+ 0.12% apple pectin AU-701	78 (67-89)	29.5 (22-56)	38 (19.75-61.5)	13 (11-61.5)	13 (13-52.5)
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Notes: data are presented as a percentage in relation to the level before storage, taken as 100%; * – the difference with the value of the indicator "sperm with glycerol" with the corresponding storage periods is statistically significant at $p < 0.05$

Sperm viability, according to the HOS test, at all storage periods corresponded to the level of sperm in glycerol, i.e. the presence of polysaccharides in the medium did not affect the effect of glycerol for this indicator (table 2). We believe that under conditions of hypothermic storage of sperm at + 6°C for 9 days, the membrane did not receive significant damage, therefore, under hypoosmotic stress, the inflow of fluid into the cell did not cause its uncontrolled swelling to the degree of rupture of the membrane.

Table 2.

Indicator of resistance of spermatozoa to hypoosmotic swelling (HOS-Test) (Me, Q1-Q3), subjected to hypothermic (+6°C) storage for 3-9 days in glycerol (4.4%) and H. erinaceus polysaccharides (0.4%) or apple pectin AU-701 (0.12%)

Storage solution	Storage periods (days)				
	3	6	7	8	9
Glycerol	83 (76.0-91.0)	69 (60.5 – 80.0)	40 (28.0-56.0)	35 (31.0-51.5)	45 (42.0-64.0)
+ 0.4% polysaccharide fraction of <i>H. erinaceus</i>	83 (78.75-98.5)	78 (45.5-84.0)	29 (27.0-69.5)	41 (39.75-48.75)	38 (35.0-55.0)
+ 0.12% apple pectin AU-701	71 (57.25-94.5)	70 (38-81)	43.5 (35-64)	51.5 (49-66)	50.5 (34-50.5)

Notes: data are presented as a percentage in relation to the level before storage, taken as 100%;

The composition and physicochemical properties of preserving media are decisive in the preparation of semen for hypothermic storage or freezing. In the light of modern concepts, the search for new effective components for preservative solutions should be focused primarily on natural compounds. The data obtained in this work indicate the possibility of using *H. erinaceus* BP16 polysaccharides as a component to maintain the functional usefulness of bovine sperm gametes under hypothermic (+6°C) storage.

References

1. Zan X., Cui F., Li Y., Yang Y., Wu D., Sun W., Ping L. *Hericium erinaceus polysaccharide-protein HEG-5 inhibits SGC-7901 cell growth via cell cycle arrest and apoptosis // International journal of biological macromolecules. 2015. V. 76. P. 242–253. doi: 10.1016/j.ijbiomac.2015.01.060*
2. He X., Wang X., Fang J., Chang Y., Ning N., Guo H., Zhao Z. *Structures, biological activities, and industrial applications of the polysaccharides from Hericium erinaceus (Lion's Mane) mushroom: A review // International journal of biological macromolecules. 2017. V. 97. P. 228–237. doi: 10.1016/j.ijbiomac.2017.01.040*
3. Friedman M. *Chemistry, nutrition, and health-promoting properties of Hericium erinaceus (Lion's Mane) mushroom fruiting bodies and mycelia and their bioactive compounds // J Agric Food Chem. 2015. V. 63(32). P. 7108–7123. doi: 10.1021/acs.jafc.5b02914*
4. Thongbai B., Rapior S., Hyde K. D., Wittstein K., Stadler M. *Heridium erinaceus, an amazing medicinal mushroom // Mycological Progress. 2015. V. 14 (10). P. 1–23. doi: 10.1007/s11557-015-1105-4*
5. Lim S.H. *Larch Arabinogalactan Attenuates Myocardial Injury by Inhibiting Apoptotic Cascades in a Rat Model of Ischemia-Reperfusion // J Med Food. 2017. V.20 (7). P. 691-699. https://doi.org/10.1089/jmf.2016.3886*
6. Samout N., Bouzenna H., Dhibi S., Ncib S., ElFeki A., Hfaiedh N. *Therapeutic effect of apple pectin in obese rats // Biomedicine & Pharmacotherapy. 2016. V-83. P. 1233–1238. doi.org/10.1016/j.biopha.2016.08.038.*
7. Holt W.V. *Basic aspects of frozen storage of semen // Animal Reproduction Science. 2000. V. 62. P. 3–22. doi: 10.1016/s0378-4320(00)00152-4*
8. Linnik T.P., Martynyuk I.N. *Approaches to Creation of Cryoprotective Media for Cryopreservation of Avian Sperm // Problems of Cryobiology. 2010. V. 20. No. 2. P. 109–122.*
9. Schrago M.I., Guchock M.M., Kalugin Yu.V., Khanina L.A. *Some ways to create cryoprotectants // Problems Hematol Blood Transfusion. 1981. No. 26. P. 3–6 (in Russian).*
10. Svedentsov E.P. *Cryoprotectants for living cell. Syktyvkar: Physiology Institute at the Komi Scientific Center of the Russian Academy of Sciences, 2010. 80 P. (in Russian).*

数字农业监测在俄罗斯联邦农作物种植中使用农药的可行性评估中的应用
**APPLICATION OF DIGITAL AGROMONITORING FOR THE
ASSESSMENT OF FEASIBILITY OF USING PESTICIDES IN
CULTIVATION OF AGRICULTURAL CROPS IN THE RUSSIAN
FEDERATION**

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抽象的。该文章根据国家分配对俄罗斯联邦领土上 2010-2020 年作物植物检疫状况审查中的数据进行了数学处理。近年来，俄罗斯全境因病虫害造成的农作物损失成倍增加。在集约化技术中大量使用各种农药是无法承受的。病原体对药物产生抗药性并变得更具攻击性。植物几乎处于持续的环境压力之下。然而，放弃农药是不可能的。当前的科学发展水平导致出现了使用数学分析来计算用于植物保护的最好农药剂量的评估方法。2020 年，开始开发和实施“数字植物监测”软件，用于植物监测结果的地理配准、研究数据的操作分析和接收到的植物检疫信息的可视化。数字化监测的重要任务之一是预测植保产品的可能用途，并计算出它们近期的最佳值。防护措施的预测量始终是初步的和经过调整的。

关键词：数字农业监测，数学模型，农业生态学，农业化学，环境压力

Abstract. *The article provides mathematical processing of data from reviews of the phytosanitary state of crops for 2010-2020 on the territory of the Russian Federation in accordance with the state assignment. In recent years, crop losses from diseases and plant pests have been increasing many times over the entire territory of Russia. The use of a significant amount of various pesticides in intensive technologies cannot withstand this. Pathogens become resistant to drugs and become more aggressive. Plants are under almost constant environmental stress. However, it is impossible to give up pesticides. The current level of development*

of science has led to the emergence of assessment methods using mathematical analysis to calculate the optimal doses of pesticides for plant protection. In 2020, the development and implementation of the "Digital Phytomonitoring" software began for georeferencing the phytomonitoring results, operational analysis of research data and visualization of the received phytosanitary information. One of the important tasks of digital monitoring is to predict the possible use of plant protection products and calculate their optimal values for the near future. The predicted volumes of protective measures are always preliminary and adjusted.

Keywords: *digital agromonitoring, mathematical model, agroecology, agrochemistry, environmental stress*

The doctrine of food security in Russia, approved by the President of the Russian Federation V.V. Putin, since 2010 provides for the provision of the country's population with high-quality plant-growing products of its own production and complete import substitution. The annual monitoring of the phytosanitary state of crops on the territory of Russia is one of the fundamental state services in the field of plant protection of the FSBI "Rosselkhoztsentr". According to the state assignment, specialists carry out phytosanitary monitoring of agricultural land in the territory of the Russian Federation, which makes it possible to timely assess the spread of pests, diseases and weeds on agricultural crops and prevent crop losses.

The management bodies of the agro-industrial complex of the constituent entities of the Russian Federation and all persons carrying out activities in the field of crop production are regularly provided by the specialists of the FSBI "Rosselkhoztsentr" with operational information on the spread of harmful objects and the need for protective measures.

In 2020, the development and implementation of the "Digital Phytomonitoring" software began for georeferencing the phytomonitoring results, operational analysis of research data and visualization of the received phytosanitary information.

One of the important tasks of digital monitoring is to predict the possible use of plant protection products and calculate their optimal values for the near future. Agrochemicals intended to increase the productivity of agricultural crops perform certain functions in complex natural systems on the territory of the Russian Federation. Often, the introduction of these chemical components creates new problems in soil biocenoses, which in turn reduce the productivity of products. Careful selection and calculation of the required quantities of these drugs is required.

The predicted volumes of protective measures are always preliminary and are adjusted during the spring and summer phytosanitary surveys. The main agrochemicals - pesticides, used in agricultural technologies in significant quantities - are fungicides, herbicides and insecticides. The results of mathematical processing

of forecast data for basic plant protection products for the last 10 years are shown in figure 1.

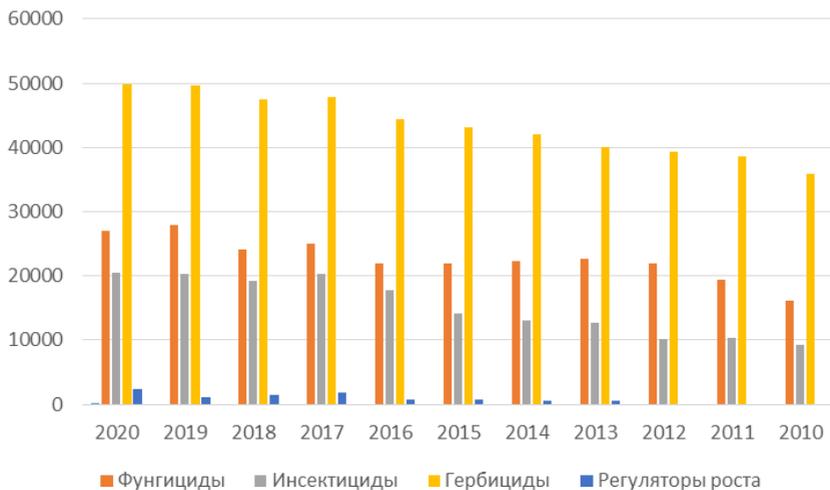


Figure 1. The volume of work on plant protection in the RF in 2010-2020, thous. he

Having studied the actual data on the total amount of use of various plant protection products over the past 11 years, a corresponding statistical mathematical model has been developed.

For definiteness and concreteness of presentation, we take the following relation as a mathematical model:

$$P_r = a_0 + a_1x + a_2y + a_3z + b_1x^2 + b_2y^2 + b_3z^2 + c_1xy + c_2xz + c_3yz,$$

P_r – relative total volume of pesticides, x – relative volume of fungicides, y – relative volume of herbicides; z – relative amount of insecticides

$a_0, a_1, a_2, \dots, c_3$ – constant coefficients determined from the actual data by the least squares method from the condition of the minimum sum of squares of deviations ΔP of the actual values of the objective function (P_r) from the corresponding calculated values of the objective function (P_c) according to relation (2), i.e. from the condition:

$$\Delta(x, y, z) = \sum_{i=1}^n (P_F - P_p)^2 \rightarrow \min,$$

n – total number of experiments.

The main preparations for increasing the productivity of agricultural crops are fungicides, herbicides and insecticides. Growth regulators are used in small amounts, but their use has increased in recent years. Organic growth preparations

are especially promising in this direction. The numerical values of the relative volumes are determined as the quotient of the actual volume to the corresponding area of application, in relation to the data for 2010 (table 1)

Table 1.
Relative values of the volume of protective equipment in the Russian Federation for the period 2010–2020. (dimensionless units)

№	P_{if}	x_i	y_i	z_i	Years	P_{ir}
1	1.000	1.000	1.000	1.000	2010	0.9999
2	0.794	0.850	0.786	0.757	2011	0.9740
3	0.848	0.972	0.786	0.783	2012	0.8483
4	0.940	1.058	1.027	0.835	2013	0.9399
5	0.955	1.032	1.046	0.869	2014	0.9539
6	1.031	1.065	1.180	0.938	2015	1.0320
7	1.031	1.001	1.401	0.907	2016	1.0310
8	1.110	1.097	1.541	0.943	2017	1.1103
9	1.130	1.105	1.518	0.976	2018	1.1298
10	1.165	1.234	1.549	0.981	2019	1.1649
11	1.183	1.208	1.583	0.999	2020	1.1828

P – relative total volume of pesticides; x – relative volume of fungicides;
 y – relative volume of herbicides; z – relative amount of insecticides.

The values of **ten** unknown constants $a_0, a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3$ are determined [14] from a system of **ten** linear algebraic equations of the form:

$$\frac{\partial \Delta}{\partial a_0} = 2 \sum [P_o(x_i, y_i, z_i) - P_p(x_i, y_i, z_i)] (1) = 0,$$

To solve a system of **ten** linear algebraic equations, you can use any known method (Gauss method, Cramer's formulas, etc.)

$$a_0 n + a_1 \sum x_i + a_2 \sum y_i + a_3 \sum z_i + b_1 \sum x_i^2 + b_2 \sum y_i^2 + b_3 \sum z_i^2 + c_1 \sum x_i y_i + c_2 \sum x_i z_i + c_3 \sum y_i z_i = \sum P_i,$$

After the values of the constant coefficients $a_0, a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3$, the function of three arguments $\Pi(x, y, z)$, have been determined, relation (1) allows us to find the "critical" (optimal) values of the parameters: x_{cr}, y_{cr}, z_{cr} from the system of three algebraic equations:

$$\frac{\partial P}{\partial x} = 0, \quad \frac{\partial P}{\partial y} = 0, \quad \frac{\partial P}{\partial z} = 0,$$

or:

$$\begin{cases} a_1 + 2b_1x_{cr} + c_1y_{cr} + c_2z_{cr} = 0, \\ a_2 + 2b_2y_{cr} + c_1x_{cr} + c_3z_{cr} = 0, \\ a_3 + 2b_3z_{cr} + c_3y_{cr} + c_2x_{cr} = 0. \end{cases}$$

Thus, after solving the system, the determination of the coefficients can be written down, you can write down the basic relationship in the form:

$$\begin{aligned} P_r = & 2,964729 + 1,312080x - 3,421988y - 2,231998z + \\ & + 0,222143x^2 + 3,700855y^2 - 1,517340z^2 - \\ & - 6,420543xy + 3,051072xz + 3,340871yz. \end{aligned}$$

we find the "optimal" (rational) values of dimensionless arguments:

$$x_{opt} \approx 0,959 \text{ (volume of fungicides)}, y_{opt} \approx 0,796 \text{ (volume of herbicides)}$$

$$z_{opt} \approx 1,105 \text{ (volume of insecticide)},$$

which determine the "optimal" (rational) value of the function:

Thus, based on the above, using the derived equations obtained during the mathematical processing of forecasts for the main plant protection products, it is possible to predict the required minimum and sufficient amount of pesticides for use on the territory of the agro-industrial complex of the Russian Federation.

References

1. Griguletskiy V.G. *Solution of nonlinear algebraic and transcendental equations and their systems: monograph* – Krasnodar.: KubGAU, 2019. – 367 P.
2. Kotlyarov V.V. *Application of physiologically active substances in agricultural technologies / V.V. Kotlyarov, Yu.P. Fedulov, K.A. Dotsenko, D.V. Kotlyarov, E.K. Yablonskaya.* - Krasnodar: KubSAU.-2013.-169 P.
3. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2010 and the forecast of the development of harmful objects in 2011.* M.: FSBI Rosselskhozcent, 2010.- 389 P.
4. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2011 and the forecast of the development of harmful objects in 2012.* M.: FSBI Rosselskhozcent, 2012.- 397 P.

5. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2012 and the forecast of the development of harmful objects in 2013. M.: FSBI Rosselskhozcent, 2013.- 389 P.*

6. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2013 and the forecast of the development of harmful objects in 2014. M.: FSBI Rosselskhozcent, 2014.- 389 P.*

7. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2014 and the forecast of the development of harmful objects in 2015. M.: FSBI Rosselskhozcent, 2015.- 389 P.*

8. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2015 and the forecast of the development of harmful objects in 2016. M.: FSBI Rosselskhozcent, 2016.- 501 P.*

9. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2016 and the forecast of the development of harmful objects in 2017. M.: FSBI Rosselskhozcent, 2017.- 389 P.*

10. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2017 and the forecast of the development of harmful objects in 2018. M.: FSBI Rosselskhozcent, 2018.- 389 P.*

11. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2018 and the forecast of the development of harmful objects in 2019. M.: FSBI Rosselskhozcent, 2019.- 653 P.*

12. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2019 and the forecast of the development of harmful objects in 2020. M.: FSBI Rosselskhozcent, 2020.- 717 P.*

13. *Review of the phytosanitary state of agricultural crops in the Russian Federation in 2020 and the forecast of the development of harmful objects in 2021. M.: FSBI Rosselskhozcent, 2021.- 717 P.*

14. *Podtyagin ME Mathematical processing of agronomic and zootechnical observations. – Krasnodar.: Proceedings of the Kuban Agricultural Institute, 1965, Iss. 12 (40). – 185 P.*

在俄罗斯联邦境内实施有机农业领域的创新技术

**IMPLEMENTATION OF THE INNOVATE TECHNOLOGIES IN THE
FIELD OF ORGANIC AGRICULTURE IN THE TERRITORY OF THE
RUSSIAN FEDERATION**

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抽象的。为了解决在农作物种植中尽量减少使用有毒和致癌农药的问题，俄罗斯联邦植物生理学和生物化学领域的顶尖科学家在各种 RFBR 赠款框架内进行了多年的广泛研究，文章简要总结了新型多功能药物呋喃蓝和Grivlag的数据，并描述了它们对植物的作用类型。

关键词：呋喃蓝，Grivlag，解毒剂，植物生长调节剂，免疫剂，诱导剂，环境安全

Abstract. *To solve the problem of minimizing the use of toxic and carcinogenic pesticides in the cultivation of agricultural crops, the leading scientists of the Russian Federation in the field of plant physiology and biochemistry within the framework of various RFBR grants conducted extensive research for many years and the article provides brief summarized data of new multifunctional drugs Furolan and Grivlag, and also describes the types of their effects on plants.*

Keywords: *Furolan, Grivlag, antidotes, plant growth regulators, immunizer, elicitor, environmental safety*

The market for organic products in the Russian Federation is more than 120 million US dollars, 0.12% of agricultural land (over 246 thousand hectares) is certified as organic according to international standards. In total, there are 20 certified organic agricultural producers in the field of crop production in Russia. Basically,

these are farms that grow grain and oilseeds. The prospects of the Russian Federation in the global organic market are estimated at 15-17% (about 130 million US dollars). The Russian domestic market is in its infancy, and for the development of organic agriculture, agricultural producers most of all need a symbiosis of planning, knowledge and investment. The potential of organic products in the domestic market is estimated at 10% of the food market, the level of implementation of agricultural biologization can potentially reach 50-80%. The introduction of organic agriculture and the biologization of agriculture will provide up to 70% of the healthy lifestyle of Russians through high-quality healthy food and a safe environment.

The agrobiological potential of lands in Russia is used by a little more than 2%. Organic agriculture provides a medium and long term impact on the agroecosystem. It aims to produce food in conditions of an ecological balance that prevents soil depletion or pest problems. Organic farming uses a proactive approach as opposed to solving problems after they have arisen.

In conditions of degradation of natural resources, the problem of studying the possibility of improving soil fertility was outlined at the beginning of the XVII century by the "father of scientific agronomy" Alfred Tower. Known are the scientific works of V.R. Williams, who created the doctrine of the small biological cycle of substances as the basis for the development of soils and expressed the idea of the unity of the development of inorganic and organic nature.

In this regard, leading Russian scientists with the support of the RF grants have developed 2 innovative drugs **FUROLAN** and **GRIVLAG**.

Furolan—a polyfunctional preparation, a plant growth regulator, allows increasing plant resistance to damage by phytopathogens, herbicide antidote, retardant, immunizer (RF Patents № 2284694, № 2356225, № 2475025, № 2492611, № 2370019). The drug is approved for use on the territory of the Russian Federation, it is environmentally safe and non-toxic to flora and fauna; residual quantities in agricultural products and environments are absent (Certificate of state registration 602-07-2530-1).

The drug **FUROLAN** is used in nanodoses (4-6 g / ha) and has a multifaceted effect as follows:

1. As an elicitor - getting into a plant, it corrects metabolism, which prevents infection with bacterial and fungal diseases or disrupts the course of pathogenesis and reduces morbidity. Provides environmental safety of products, reducing the cost of other pesticides of therapeutic and prophylactic action. Under its influence, protective substances in plants are formed faster and more intensively than when infected with pathogens. Induces natural mechanisms of resistance locally and systemically in the plant (reduction or elimination of the use of fungicides), reactivates the active centers of enzymes, oppressed by toxic substances; non-

specificity of immunization to any pathogens, multicomponent protection, stimulation of plant growth, immunization with elicitors combines the advantages of contact and systemic fungicides.

2. As an antidote - it is used for the prevention and treatment of lesions with toxic substances (herbicides, insecticides, excessive fertilization, etc. Provides activation of seedling growth, maintaining the intensity of growth and reducing the suppression of growth processes, activates the synthesis of amino acids, increases the content of IAA, chlorogenic and caffeic acids, proline, pigments, internode wall thickness, nucleic acids and protein.

3. As growth regulators - it is used as a biotechnology tool, used in the selection of highly productive varieties of agricultural crops resistant to adverse environmental conditions, and is a mandatory technique in intensive technologies that maximize the potential of plant productivity. It is also used to reduce lodging of grain crops and grain runoff; increasing the productivity of agricultural crops; improving setting and keeping the ovary; improving vegetative reproduction; acceleration and synchronization of maturation; increasing frost and drought resistance of plants; phytoimmunocorrection, which activates a complex nonspecific resistance in a plant to many diseases of bacterial and viral and fungal origin; reducing the content of radionuclides, nitrates in the grown products, increasing its safety.

Unique advantages of using the drug furolan:

- Complete environmental safety;
- Lack of resistance in pathogens;
- Improving the sowing qualities of seeds of grain and leguminous crops and increasing the resistance of seedlings to water deficit and to damage by phytopathogens;
- Reducing the negative impact of herbicides on growth, photosynthetic activity and resistance to plant pathogens damage during the growing season;
- Improving the setting and preserving the ovary on fruit - berry and vegetable crops.
- Formation of conjugate nonspecific resistance, allowing plants to withstand the effects of adverse environmental factors of various nature;
- Increasing yields and obtaining high quality agricultural products;
- Increasing the profitability of production and increasing the economic efficiency of agricultural production.

The new growth substance **GRIVLAG** of natural organic origin has the following properties:

- high physiological activity;
- long-term preservation of properties;
- the ability to create water-soluble combinations;
- environmental friendliness, etc.

The main components of the organic growth substance GRIVLAG are a mixture of organic alicyclic monobasic and dibasic carboxylic acids containing five- and six-membered saturated carbon cycles, as well as their salts.

Treated vegetable oils are added to reduce volatility and increase penetration.

The proposed preparation is obtained by the interaction of organic acids with naphthenic olefins in the presence of an initiator of di-tertiary butyl peroxide. In order to enhance the stimulating activity, sodium salt of synthetic individual naphthenic acids of the cyclohexane series was used as a plant growth stimulator. To establish the effectiveness of the sodium salt of six-membered naphthenic acids as a growth substance, the effect of them in the form of aqueous solutions of various concentrations on the bends of individual coleoptiles of oat seedlings by the Vent method and in the modification of Zedding and on the growth of winter wheat roots was studied. Experiments made it possible to establish the optimal dose of this growth stimulator – 5-10 g/ha. According to the research results, a patent for invention № 2713902 was received.

Organic growth substance GRIVLAG can be used in conjunction with other fertilizers and plant protection products:

- introduction into the soil during the pre-sowing period for a specific area and a specific agricultural crop;
- soaking (soaking) plant seeds in the pre-sowing period, etc.
- applying to the soil together with known organic and/or mineral fertilizers in different phases of plant growth;
- spraying plants during the growing season and flowering and pest control.

The research was carried out by leading scientists of the Russian Federation in the field of plant physiology and biochemistry within the framework of RFBR grants on the basis of the leading universities of the Russian Federation FSBEI HE Kuban State Agrarian University named after I.T. Trubilin, FSBEI HE Kuban State Technological University and FSBSI "North Caucasian Federal Scientific Center for Horticulture, viticulture, winemaking", and the introduction of technologies for the use of these drugs was carried out throughout the territory of the Russian Federation and the Republic of Crimea in different soil and climatic conditions.

References

1. *Yablonskaya E.K. Ecological assessment of the grape gene pool by the variety of heat resistance components/ Yablonskaya E.K., Ilyina I.A., Nenko N.I., Kiseleva G.K., Sokolova V.V. /Polythematic network electronic scientific journal of the Kuban State Agrarian University. 2021. № 170. P. 68-79.*

2. Yablonskaya E.K. *Application of exogenous elicitors in agriculture* / E.K. Yablonskaya // *Polythematic network electronic scientific journal of the Kuban State Agrarian University (Scientific journal KubSAU) [Electronic resource]*. – Krasnodar: KubSAU, 2015. – №05(109). P. 1247 – 1263. – IDA [article ID]: 1091505087. – Access: <http://ej.kubagro.ru/2015/05/pdf/87.pdf>, 1,062 u.p.l.

3. Yablonskaya E.K. *Means for treating seeds of grain and leguminous crops affected by fusarium* / V.V. Kotlyarov, Yu.P. Fedulov et al. // RF Patent № 2475025 dated 20.02.2013.

4. Yablonskaya E.K. *Cultivation of winter wheat using plant treatment with exogenous regulators* / V.V. Kotlyarov, Yu.P. Fedulov et al. // *Proceedings of the Kuban State Agrarian University, Krasnodar, KubSAU, Iss.3, 2012, P.81-87.*

5. Yablonskaya E.K., Kotlyarov V.V., Fedulov Yu.P. *Molecular mechanisms of action of herbicide antidotes, prospects for use in agriculture. Monograph.-Krasnodar.: KubGAU, 2013.-181 P.*

6. Yablonskaya E.K. *Influence of 2,4-d herbicide and furolan antidote on growth and synthetic processes in winter wheat seedlings* / E.K. Yablonskaya, V.K. Plotnikov // *Polythematic network electronic scientific journal of the Kuban State Agrarian University (Scientific journal KubGAU) [Electronic resource]*. – Krasnodar: KubSAU, 2006. – №08(024). P. 314 – 320. – Informregister code: 0420600012\0230, IDA [article ID]: 0240608031. – Access: <http://ej.kubagro.ru/2006/08/pdf/31.pdf>, 0,438 u.p.l.

7. Yablonskaya E.K. *The effect of the combined use of the herbicide 2,4-D and its antidote furolan on the formation of grain quality in winter soft wheat during ripening.* / E.K. Yablonskaya, E.V. Surkov, V.K. Plotnikov and others // *university bulletins. Food technology. Iss. 1, 2007., P. 15–18.*

8. Nenko n.i. *The stability of grapes varieties to drought* / Nenko N.I., Ilyina I.A., Petrov V.C., Sundireva M.A., Yablonskaya E.K. // *Research journal of pharmaceutical, biological and chemical sciences. 2019. V. 10. № 1. P. 1903-1910.*

9. Nenko n.i. *Lowerature stress tolerance of grapevine varieties of different ecological and geographical origin* / nenko n.i., ilyina i.a., kiseleva g.k., yablonskaya e.k./ *proceedings of the latvian academy of sciences, section b: natural, exact, and applied sciences. 2019. V. 73. № 1. P. 56-65.*

10. Yablonskaya E.K. *Influence of the antidote of the herbicide 2,4-d preparation furolan on the grain quality of winter wheat* / E.K. Yablonskaya, V.K. Plotnikov, V.V. Garage, N.I. Nenko // *news of universities. Food technology. Iss.1,2007., P.103*

11. Yablonskaya E.K. *Wheat metabolism under the influence of the 2,4-d herbicide and its antidote furolan. Monograph. Lap lambert academic publishing gmbh & co.kg. Germany, 148 P.*

12. Yablonskaya E.K., Nenko N.I., Surkova E.V., Plotnikov V.K. *A method for reducing the toxic effect of a group 2,4-d herbicide on the quality of winter wheat grain* /RF Patent № 2356225 dated May 27, 2009 bull.№15

13. Yablonskaya E.K., Kotlyarov V.V., Bagryantsev E.S., Donchenko D.Yu., Fedulov Yu.P. *Means for treating seeds of grain and leguminous crops affected by fusarium*. RF Patent № 2475025 dated 20.02.2013.

14. Kvashin A.A., Neshchadim N.N., Yablonskaya E.K. *Crop yield and the quality of sunflower seeds in the use of fertilizers and growth regulation substances*

15. Nenko N.N., Neshchadim N.N., Yablonskaya E.K. *The effect of the growth regulator furolan on the biology of sunflower plants/monograph/ saarbrucken, 2017.*

16. Nenko N.I., Yablonskaya E.K. *Innovative technology for growing sunflower using the elicitor furolan in the collection: . Conference proceedings. Scientific public organization "professional science". 2017. P. 79-101.*

17. Nenko N.I., Ilyina I.A., Vasiliev E.N., Yablonskaya E.K. *The influence of elicitors on the resistance of vitis vinifera to the leaf form of phylloxera in the collection: Collection of scientific papers on materials v international scientific conference. International research federation «science public». 2017. P. 40-47.*

18. Nenko N.I., Ilina I.A., Yablonskaya E.K. *Physiological and biochemical characteristic of elicitors impact on the vitis vinifera plants' phylloxera-resistance* /Eurasian journal of analytical chemistry. 2017. V. 12. № 7b. P. 1421-1427.

19. Griguletskiy V.G., Ivakien R.A., Ivakina Yu.V. *Organic growth substance*/ RF Patent 2713902 CL dated 27.08.219.

20. Griguletskiy V.G. *The effectiveness of the use of energized fertilizers GVG on crops of spring barley Vakula in the Krasnodar Territory* / Griguletskiy V.G. // *International Agricultural Journal*, 2018.-№5, P.35-38.

21. Griguletskiy V.G. *The effectiveness of the use of complex energized fertilizers GVG on winter wheat crops Brigade on low-humus weakly alkaline soils of the north-east of Krasnodar Territory* / Griguletskiy V.G. // *International Agricultural Journal*, 2018, №6, P. 63-67

22. Griguletskiy V.G. *Field trials of a new growth substance in sugar beet crops* / Griguletskiy V.G., Astakhov A.N. // *Sugar beet*, 2019.-№3, P.27-31

23. Griguletskiy V.G. *The effectiveness of the use of a new complex organic growth substance GVG when sowing rice on low-humus soil forest-like clays and heavy loams of the Priirkuban depression* / Griguletskiy V.G., Zelenskiy A.G., Zelenskiy G.L. // *International Agricultural Journal*, 2020, №2, P.48-52.

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