



# 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

Materials of the  
International Conference

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国际会议

参与者的英文报告

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“Scientific research of the SCO  
countries: synergy and integration”

Part 1: Participants' reports in English

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这些会议文结合了会议的材料 – 研究论文和科学工作者的论文报告。它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。

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## Foreword

*We thank all participants of our conference "Scientific research of the SCO countries: synergy and integration" for the interest shown, for your speeches and reports. Such a wide range of participants, representing all the countries that are members of the Shanghai Cooperation Organization, speaks about the necessity and importance of this event. The reports of the participants cover a wide range of topical scientific problems and our joint interaction will contribute to the further development of both theoretical and applied modern scientific research by scientists from different countries. The result of the conference was the participation of 56 authors from 7 countries (China, Russia, Uzbekistan, Kazakhstan, Azerbaijan, Tajikistan, Kyrgyzstan).*

*This conference was a result of the serious interest of the world academic community, the state authorities of China and the Chinese Communist Party to preserve and strengthen international cooperation in the field of science. We also thank our Russian partner Infinity Publishing House for assistance in organizing the conference, preparing and publishing the conference proceedings in Chinese Part and English Part.*

*I hope that the collection of this conference will be useful to a wide range of readers. It will help to consider issues, that would interest the public, under a new point of view. It will also allow to find contacts among scientists of common interests.*

**Fan Fukuan,**

*Chairman of the organizing committee of the conference*

*"Scientific research of the SCO countries: synergy and integration"*

*Full Professor, Doctor of Economic Sciences*

## 前言

我们感谢所有参加本次会议的“上海合作组织国家的科学研究：协同作用和整合”，感谢您的演讲和报告。代表所有上海合作组织成员国的广泛参与者都谈到此次活动的必要性和重要性。参与者的报告涵盖了广泛的主题性科学问题，我们的联合互动将有助于不同国家的科学家进一步发展理论和应用的现代科学研究。会议结果是来自7个国家（中国，俄罗斯，乌兹别克斯坦，哈萨克斯坦，阿塞拜疆，塔吉克斯坦，吉尔吉斯斯坦）的83位作者的参与。

这次会议的召开，是学术界，中国国家权力机关和中国共产党对维护和加强科学领域国际合作的高度重视的结果。我们还要感谢我们的俄罗斯合作伙伴无限出版社协助组织会议，准备和发布中英文会议文集。

我希望会议的收集对广大读者有用，将有助于在新的观点下为读者提供有趣的问题，并且还将允许在共同利益的科学家中寻找联系。

范福宽，  
教授，经济科学博士，中国科学院院士，会议组委会主席“上合组织国家科学研究：协同与融合”

大公司对国家经济发展的影响的系统方面  
**SYSTEMIC ASPECTS OF THE INFLUENCE OF LARGE  
COMPANIES ON THE DEVELOPMENT OF THE COUNTRY'S  
ECONOMY**

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抽象。在这项研究中,任务是在分析大型企业对于许多指标的基础上,确定表征宏观区域不对称的当前水平和发展趋势的参数的定量关系。

最重要的研究问题之一是通过确定发展重点确定俄罗斯经济空间的宏观区域分层。许多科学家已经研究了这些方面。

在本文中,我们使用了科学研究的方法和工具技术,尤其是经济和统计团体(类型,结构,分析),专家评估。

考虑到俄罗斯和其他国家未来经济政策的不确定性,得出了在世界统计中提高俄罗斯公司评级,减少大型公司投资活动的结论。

关键词:大型企业,经济政策,大型企业与小型企业的比例,大型企业的收入,利润和投资的动态。

**Abstract.** *In this study, the task is to determine the quantitative relations of parameters characterizing the current level and development trends of macroregional asymmetry, based on the analysis of large business for a number of indicators.*

*One of the most important research problems is the macro-regional stratification of the economic space of Russia with the identification of development priorities. Many scientists have studied these aspects.*

*In this article, we used the methods and instrumental technologies of scientific research, in particular, economic and statistical groups (typological, structural, analytical), expert assessments.*

*Conclusions are made about increasing the rating of Russian companies in world statistics, reducing the investment activity of large companies, taking into account the uncertainty of the economic policies of Russia and other countries for the future.*

**Keywords:** *large business, economic policy, the ratio of large and small businesses, the dynamics of revenue, profits and investments of large companies.*

The process of structuring the economic space of Russia is particularly dynamic and is determined by a combination of factors of a production, resource, social and political nature. The optimality of the reproductive proportions of Russia is determined, first of all, by the ability to effectively use its natural conditions and the competitive advantages of the territorial production and economic potential in order to improve the living standards of the population. The competitiveness of the economy is determined by the effectiveness of the use of unique territorial resources, economic specialization and structural organization of the economy, the development of economic relations, its stability and prospects for resistance to emerging risks.

The main economic players in the market of modern Russia are large enterprises. It is big business that produces a large share of GDP and has a decisive effect on the country's economy. On the agenda in the discussion processes, including the problems associated with the crisis in connection with the coronavirus, there is an acute problem of the state of many small and medium-sized enterprises. In addition, the government decided to support systemically important enterprises, including large business. The Economic Policy Commission has expanded the list of backbone enterprises. Their number has tripled in comparison with the previous list - now 600 enterprises are included in the list. Among them are Domodedovo, Utair, Sportmaster, IKEA, "Gloria Jeans", "McDonald's", "Burger King", "Vkusville", "Auchan", "M.Video". These enterprises may turn to the authorities for help in a pandemic and currency fluctuations.

Let's take a short digression into the analysis of the role of small business in Russia. In Russia, the contribution of small and medium-sized businesses is relatively small. According to the latest data from Rosstat, the share of SMEs in the Russian economy for 2017 is about 2% [1], but it is planned to increase this indicator by 2024 to 32.5% using the national project "Small and medium-sized enterprises and support for individual entrepreneurial initiatives".

Without a doubt, this sector of the economy is very important. In developed countries, the share of small and medium-sized businesses in GDP exceeds 50%, and in developing countries an average of 33%. For example, in Italy, the percentage ratio of the share of large business to the share of small and medium-sized businesses is 32% versus 68%, in Switzerland 41% to 59%, in Germany 47% to 53% [5].

According to World Bank estimates, it is expected that in the next 10-15 years, four out of five jobs will be created by small and medium enterprises [2].

The process of formation of corporations in Russia proceeded extremely unevenly and at all stages was accompanied by a lack of detailed study of the most

important issues, incorrect terminology, a high degree of government interference and the recommendation and study of Western experience [3].

The President of Russia announced support for small and medium-sized businesses in the context of the 2020 pandemic in a speech to the nation. The deferral for small and medium-sized businesses for all taxes, except VAT, for the next six months, the deferral of insurance contributions to social funds for microenterprises. Insurance premiums for small and medium enterprises will decrease from 30% to 15%. Also, small and medium-sized businesses, microenterprises, which find themselves in a difficult situation, should receive an extension of loans for the next six months. For the same period, the President introduced a moratorium on filing bankruptcy petitions.

Worldwide, the share of corporations among all existing firms is approximately 10%. However, they produce more than half of world GDP. Their contribution both to the economy of a particular country and to the world economy is also huge from the point of view of strong financial influence in regional, state and world markets, their contribution to the development of scientific and technical progress, survival in conditions of economic instability, the possibility of large investments and constant modernization of their own infrastructure.

According to the conclusions of rating agencies, the list of the largest companies in Russia is relatively stable and lends itself to an annual rotation of no more than 1/3. Currently, the largest 625 corporations account for: 401 private companies, 81 state-owned companies, 7 private companies with significant government participation, 7 companies with state control and foreign participation, 4 private companies with a large share of foreign ownership. Large corporations are represented in 33 industries [6].

The territorial location of a large business has its own objective factors, such as the resource component, the attractiveness of individual regions as consumers of products, the composition, availability of skilled labor, etc.

Researchers of the problems of large business location proposed a classification of regional distribution and industry specifics, identified 7 types of regions depending on the diversification of the industrial structure of large business, presence in raw materials and manufacturing industries, with the sharp dominance of individual industries, with the functioning of large business only in the raw materials sector where large business owns a number of enterprises only in manufacturing industries, a special type of allocation territories in transport activity, since the importance of transport in recent years has increased sharply due to the increased export orientation of the activities of a large part of companies, regions where there is no large business due to the lack of attractive enterprises for companies in their territories, were called “economic deserts” by the author [11]. All instruments of state regulation contribute, to one degree or another, to the growth

of company revenues, however, at the regional level, support is more related to the tasks of stabilizing employment and maintaining the production of products purchased by the state.

If we analyze the place of the largest companies in terms of net revenue, then we should single out the largest companies located in a number of regions (table 1) [6].

**Table 1**  
*Largest companies by regions of Russia for 2018*

<b>Region of Russia</b>	<b>Revenues (trillion rubles)</b>	<b>Number of companies (pcs)</b>	<b>Largest company</b>
Moscow	52,8	223	”Gazprom”
Krasnodar Krai	3	14	”Magnit”
St. Petersburg	2,4	28	”Lenta”

Thus, almost 70% of total revenue falls on the capital. Also, half of the rating participants were registered in Moscow. Such a large gap in comparison with the 2nd place has been maintained for the past five years.

Forbes annually compiles a rating of the largest companies in the world based on an assessment based on a combined assessment of revenue, profit, assets and their market value. When Forbes first published the global ranking in 2003, the United States represented 776 companies, while China and Hong Kong represented only 43 companies. In 2018, 25 Russian companies were included in the Forbes Global 2000 rating, and now their number has dropped to 22. “Polyus”, “Uralkali” and “Aeroflot” dropped out of the largest ratings. In 2019, in the global ranking, traditionally the largest number of companies from the USA is 575. Next are China and Hong Kong (309 companies), then Japan (223 companies). The first place in the ranking of global companies in the world according to Forbes is held for the seventh consecutive year by the Chinese bank ICBC [8].

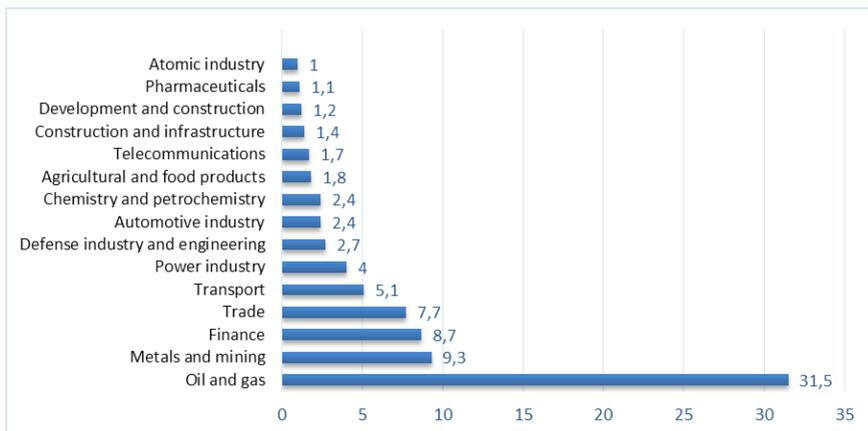
Modern large business in the context of globalization is impossible without the participation of foreign capital. Foreign participants are actively entering the Russian market, where at present more than half of the proceeds come from the USA, Germany, and France. For several years in a row, the leader's place belonged to the French “Auchan” retail chain, which in 2019 went down to sixth position. Now Japanese companies are on the first lines. 1 place is occupied by “Toyota Motor”, owned by Toyota, 2 place - “J. T. I. Russia”, owned by the Japanese tobacco giant JTI. Information characterizing the role and foreign capital is presented in Table 2. The Top - 100 largest companies rating presented in the Forbes rating is used [7].

**Table 2**

*Foreign companies in Russia in 2019*

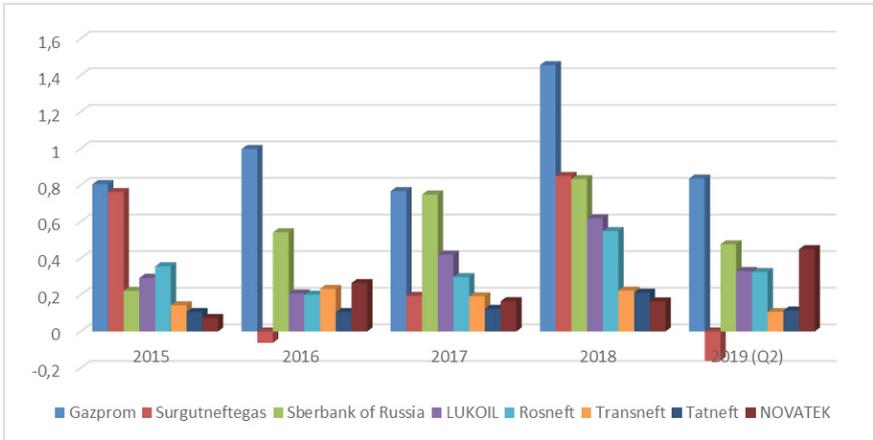
Country	Revenues (billion rubles)	Number of companies
USA	1688,04	25
Germany	1539,42	21
France	1159,02	12
Japan	908,71	9
The Republic of Korea	559,19	4

According to the analysis of the revenue structure of the largest companies by industry [12], it can be concluded that the first place is usually occupied by the oil and gas sector, which accounts for 36.9% of the total revenue of rating companies. The second place is taken by the Metals and Mining sector with 10.8%. The "Finance" sector came down to third place, reducing the share of revenue to 10.2%. Thus, the first three largest industries account for 57.9% of the total revenue of the rating. Such high positions of industries are primarily associated with the number of companies included in them. Revenue rose in all sectors except the "Consumer Product Manufacturing industry". The greatest dynamics of 89.1% were shown by bookmakers and lottery organizers. Behind them is the "Media and Internet" sector - 37%. These indicators reflect the focus of the modern economy and the increasing introduction of media into our lives.



**Fig. 1.** *Distribution of total revenue by industry for 2018, in trillion rubles.*

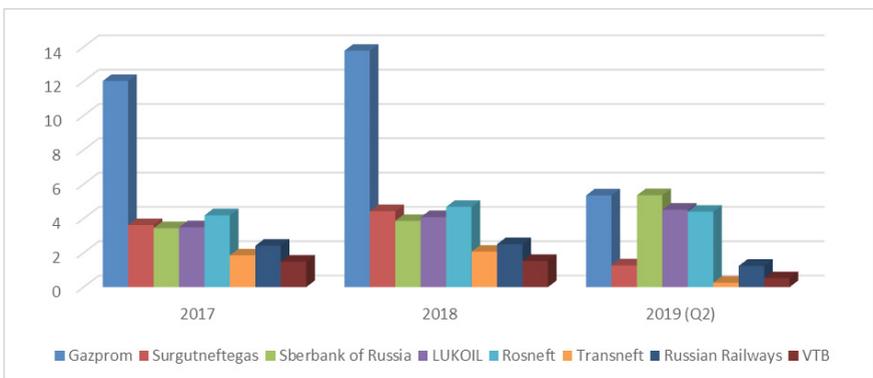
The next most significant indicator of the effectiveness of the company is profit. Consider what changes have occurred in the most profitable corporations in Russia, starting in 2015 [12].



*Fig. 2. Profit of the largest Russian companies in 2015-2019, in trillion rubles.*

PJSC “Gazprom” invariably takes the lead in the list. Today it is the leader of the Russian economy in terms of basic economic indicators. The corporation is state controlled. It has the world's largest gas transportation complex, which includes the longest “Nord Stream” gas pipeline.

When analyzing the state of the organization, an important step is the assessment of its value. To correctly assess the ratio of assets and liabilities of the company, it is necessary to calculate the capitalization, an indicator of the total value of the company. Increased capitalization leads to increased financial stability, increased attractiveness of the company, and an increase in its credit rating.



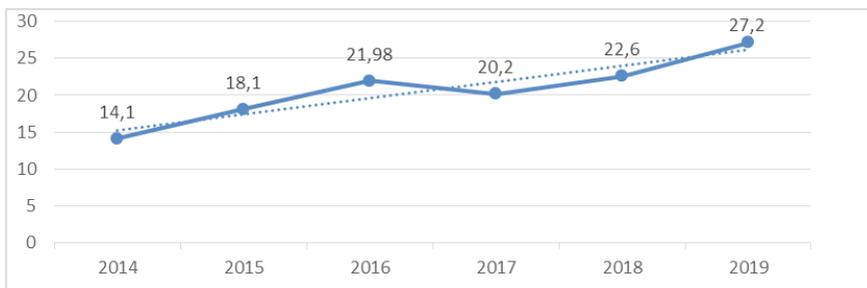
*Fig. 3. Capitalization of the largest Russian companies in 2017–2019, in trillion rubles.*

In accordance with the data on the indicator "capitalization" we have:

- "Gazprom" has been the leader in terms of assets for 5 years now. By the 3rd quarter of 2019, assets are equal to 5348 billion rubles;
- "Gazprom", "Rosneft", "Surgutneftegas", "LUKOIL", "Sberbank of Russia" traditionally share the top of the list.

Analysis of changes in the rating helps to better understand where the economy is moving. The constant growth of such indicators as: revenue, profit, capital of most large corporations in Russia should be an impetus to an increase in investment activity, but an analysis of this side of the state of large business in recent years suggests the opposite.

According to statistics from the Central Bank, as of January 1, 2019, corporate accounts and bank deposits of Russian companies accumulated 27.2 trillion rubles. [10]. This is 20% more than a year earlier. Consider the dynamics of changes in the accounts of organizations for the period of 2014-2018 (Fig. 4).



**Fig. 4.** The dynamics of changes in the accumulations of Russian companies for the period of 2014-2018, in trillion rubles.

According to economists, sustainable economic growth in the country requires an investment level of 25% of GDP and higher. Until 2012, investments grew, but even at the peak, big business invested 22% of its revenue. In 2017, this indicator among the observed participants of the RAEX-600 rating amounted to only 12% [9]. This problem is caused, first of all, by the instability of the economy.

Uncertainty in economic policy affects the corporate investment of Russian manufacturing companies. Scientists using the evaluation of models on panel data with fixed effects determined that with an increase in the level of uncertainty in economic policy, companies reduce investment activity [4]. The strongest effect is manifested for large companies.

Thus, the study confirms that the macroeconomic status of Russia is ensured by the state and development of large business, which has great potential to solve many aspects of economic development, in particular, investment in innovation. Modern risks of reducing the safety margin can be addressed, in particular,

through government support and large companies, and not just small and medium-sized enterprises.

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在实施工业特定的进口替代策略期间, 俄罗斯天然气工业股份公司获得竞争优势

**OBTAINING COMPETITIVE ADVANTAGES BY GAZPROM NEFT  
DURING THE IMPLEMENTATION OF INDUSTRY-SPECIFIC  
IMPORT SUBSTITUTION STRATEGIES**

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**Stebnyaeva Tatyana Viktorovna**

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抽象。这篇文章公开了一种根本的新方法“Gazprom Neft”,它是碳氢化合物的提取和加工的领导者之一,可以在实施石油和天然气工业的工业进口替代策略的措施时获得额外的竞争优势。基于这样一个事实,在现代俄罗斯经济中,几乎在任何行业中都有大量创新和技术先进的公司。为了获得更多的竞争优势,“俄罗斯天然气工业股份公司”认为让这些公司对生产所需创新产品和技术的前景感兴趣是合适的。为了满足潜在的需求量,想要持续获得额外利润的制造商迅速将其能力转移到创新产品和技术的发展和生产上。这种方法的结果是,俄罗斯制造商以前未生产过的越来越多的创新产品和技术将出现在国内市场上。

关键词: 进口替代, 产业战略, 竞争优势, 新方法。

**Abstract.** *The article discloses a fundamentally new approach of "Gazprom Neft", one of the leaders in the extraction and processing of hydrocarbons, to obtain additional competitive advantages in the course of implementing measures for industrial import substitution strategies in the oil and gas industry. It is based on the fact that in the modern Russian economy there is a fairly large number of innovative and technologically advanced companies in almost any industry. To obtain additional competitive advantages, "Gazprom Neft" considers it appropriate to interest these companies in the prospects for the production of innovative products and technologies that are in demand. To meet the potential demand volumes, manufacturers who want to sustainably receive additional profit quickly shift their capacities to the development and production of innovative products and technologies. As a result of this approach, more and more innovative products*

*and technologies that were not previously produced by Russian manufacturers will appear on the domestic market.*

**Keywords:** *import substitution, industry strategies, competitive advantages, new approach.*

### **Introduction**

"Gazprom Neft" is one of the leaders in the extraction and processing of hydrocarbons in the oil and gas industry. The structure of "Gazprom Neft" includes more than 70 oil producing, oil refining and marketing enterprises in Russia, countries of near and far abroad. The company demonstrates one of the best mining and processing ratios in the Russian industry. In terms of hydrocarbon production, "Gazprom Neft" is one of the three largest companies in Russia. "Gazprom Neft" seeks to implement advanced oil exploration, production and refining techniques in its work. Thanks to this, the company sets the momentum for the technological development of the entire Russian oil industry.

The formation of import substitution strategies in the industry was the response of the Russian economy to the sanctions restrictions on the supply of high-tech components and equipment. At "Gazprom Neft", it began with an analysis and identification of stock items of high-tech components and equipment for which there was no competition from Russian manufacturers. As part of the implementation of import substitution strategies, priority was given to the development of a domestic production system so that any asset of a mining or processing company always had a supplier of the necessary equipment and components for it nearby. This is a fundamentally new approach to gaining competitive advantages in the implementation of import substitution strategies - the development of a new business through technological and supply security, as well as combining hydrocarbon production and processing with a number of technological industries. In other words, the essence of the implementation of import substitution strategies is, above all, ensuring the rapid development of Russian manufacturers of high-tech components and equipment. At the same time, it is important that these suppliers are located on Russian territory and produce the equipment and components that the company needs in a particular place and at a specific time.

### **Main part**

In modern conditions, almost every company in the oil and gas industry in terms of the percentage of purchases of components and equipment of domestic production has indicators exceeding 90-95% [1]. The missing 5-10% are high-tech components and equipment that have never been produced in our country before. This so-called hi-tech is a high-tech production, the purchases of which before the introduction of sanctions restrictions were made in countries with developed economies. Oddly enough, it is precisely these 5-10% of high-tech components

and equipment that largely ensure the overall efficiency of the entire industry - from exploration to drilling and industrial processing of hydrocarbon raw materials. This is a good example of the fact that measuring the effectiveness of the implementation of import substitution strategies in percent is not entirely correct and accurate.

The fundamentally new approach to the implementation of import substitution strategies proposed by "Gazprom Neft" is based on the fact that the modern Russian economy has a fairly large number of innovative and technologically advanced companies in various areas of production. It is possible to interest these companies in the production of innovative products and technologies through the volume of potential demand, which seriously motivates manufacturers who want to sustainably receive additional profit, quickly change their capacities to develop and manufacture these products and technologies to meet existing demand. Thus, in implementing import substitution strategies, "Gazprom Neft" actively supports the creation and development of new Russian products and technologies, ensuring economic attractiveness and the effectiveness of their production.

Import substitution - the creation of full-fledged Russian counterparts or the localization of the best foreign industries with R&D in Russia to obtain the following target effects: ensuring technological independence from imported equipment and components, implementing healthy competition, diversifying approaches to get better solutions, reducing capital and operating costs. The implementation of import substitution strategies at "Gazprom Neft" is aimed at creating full-fledged Russian counterparts or localizing the best foreign R&D facilities in Russia. To do this, 23 roadmaps have been developed in three main areas of development of the company's production: onshore hydrocarbon production, offshore hydrocarbon production, and hydrocarbon processing.

Since 2015, "Gazprom Neft" has operated the Department of Technological Partnerships and Import Substitution, one of the main tasks of which is systematic monitoring of the Russian market of goods and materials to replace imported analogues with domestic products. Over the past 5 years, the company conducted more than 120 tests of the latest Russian equipment and created about 50 unique products that replace foreign analogues, and about 170 are under development. In addition, "Gazprom Neft" supported applications from development companies to attract external financing in excess of 6 billion rubles, including subsidies from the Industrial Development Fund.

Import substitution of high-tech solutions for the Russian oil industry is a large and rapidly developing high-margin market, which, for any company, means gaining opportunities for guaranteed additional profit. Indeed, if the market volume of traditional heavy engineering in 2017-2025 implies cumulative demand in the amount of 2 trillion rubles with a margin level of 5%, then the market size for

import-independent high-tech technologies and products implies cumulative demand in the amount of 1 trillion rubles with a margin level in the range of 10-40%. For all interested enterprises and companies this is called feel the difference and make your decision [2].

If an enterprise, by its technological capacities, is ready to master the production of a specific new product, then it receives support from "Gazprom Neft" in various ways. Moreover, the company itself is not included in the capital of such an enterprise and does not allocate financial resources to it. It provides fundraising by providing its facilities for R&D and project support throughout the entire development cycle of a new product. So, at present, "Gazprom Neft" provides its facilities free of charge for testing the following import-substituting products: rotary controlled systems, base oils and fuel additives, cutters for drill bits, satellite communications, guar gum, compressors and generating equipment.

As a result, an increasing number of innovative products and technologies that have not been previously produced by Russian manufacturers appear on the domestic market. First of all, it is necessary to say about base oils for drilling fluids, the production of which was mastered by one of the enterprises owned by "Gazprom Neft". Previously, this company was engaged in the production of various types of oils. As part of the import substitution strategy, a sufficiently large demand was revealed for base oils for drilling fluids, which can be quickly mastered and new competitive advantages are obtained for "Gazprom Neft", since only foreign manufacturers are represented on this market, and its volume is about 7- 9 billion US dollars annually [1]. The production capacities of the enterprise have been modernized and at present it is increasing the production volumes of base oils for drilling fluids. At the same time, the qualitative characteristics of the new product were higher than their foreign counterparts. Therefore, American companies that are leaders in oilfield services are already showing interest in purchasing significant volumes of base oils for drilling fluids produced in Russia.

Among the innovative technologies being developed, rotary controlled systems that are used to select the optimal drilling paths and obtain all the necessary information about the drilling process itself should be noted. In the development and production of technological equipment sector, "Gazprom Neft" supported a number of projects that are currently undergoing the final stages of pilot testing. This means that in the very near future the latest Russian technologies will appear on the market, the qualitative characteristics of which will not be inferior to foreign analogues.

Perhaps the most interesting is the mutually beneficial cooperation of "Gazprom Neft" with agricultural enterprises. However, there is a fairly simple explanation for this. The company has organized cooperation with enterprises that produce guar gum - gluten for solutions used in the extraction of hydrocarbons.

Before the imposition of sanctions, guar gum was not produced in our country and entered Russia in the required volumes for import. But, at present, with the support of "Gazprom Neft", breeding work has been launched to create the gene pool of the Russian guar bean, and production technology is being set up to produce this product at agricultural enterprises in Russia in volumes that completely replace its import supplies [1].

"Gazprom Neft" is developing chemical enhanced oil recovery technologies for depleted fields in Western Siberia. The significance of this initiative is due to the high proportion of mature deposits in the portfolio of the Company's assets. In 2018, the final results of the pilot project of soda-surfactant-polymer flooding at the West Salym field were summed up. The increase in oil recovery ratio was 17%, which indicates the high efficiency of the technology. The primary task is to reduce the cost of reagents to improve the economic performance of chemical waterflooding projects.

At the same time, "Gazprom Neft" does not create any preferences for certain suppliers. In principle, the most important questions for a company operating in a particular industry are: will it be able to find in the public domain in the market those innovative products and technologies that will enable it to increase its competitiveness; whether it will be able to acquire and use them in its activities. These issues must be supported by the presence of a sufficient level of knowledge of highly qualified specialists who are able to use this knowledge to implement innovative products and technologies in order to obtain additional competitive advantages. This set of issues is intended to solve the implementation of measures provided for in import substitution strategies.

The priority issues for "Gazprom Neft" from this complex are the development of a domestic base of manufacturers and suppliers of innovative products and technologies that provide not only a complete replacement of imported equipment, but also obtain additional competitive advantages due to the quality characteristics of first-time domestic products.

In 2018, "Gazprom Neft" managed to introduce more than 15 new import-substituting products that were not previously produced in Russia. The Company entered into strategic partnership agreements with "Roscosmos" Group of Companies, "Severstal" PJSC, "GEOENERGOMASH" LLC, "Betsema" CJSC and "Neftegazavtomatika" JSC, as well as a partnership agreement on cooperation in the development of oilfield services using import-substituting equipment and technologies for High-tech drilling services with PJSC "LUKOIL" and PJSC "Tatneft". Work continued in joint working groups with "Gazprombank" (JSC) and JSC "HMS Group".

"Gazprom Neft", on a systematic basis, develops and launches import-substituting products created in partnership with leading scientific institutions. Examples of such products include:

- low viscosity base oils for drilling fluids using proprietary technology (Gazpromneft Drilline brand);
- new superhard materials for drill bit cutters, which "Gazprom Neft" is developing together with the Skolkovo Institute of Science and Technology;
- new modification of the cracking catalyst with an active matrix, which provides advantages over western analogues with an inert matrix (the development was carried out jointly with the Institute of Hydrocarbon Processing Problems of the Siberian Branch of the Russian Academy of Sciences).

In 2018, scientists from the Omsk Institute of Hydrocarbon Processing Problems of the Siberian Branch of the Russian Academy of Sciences, together with specialists from the Omsk Oil Refinery, completed the development of a new modification of the cracking catalyst - a compound that accelerates chemical reactions to produce high-octane gasoline and other products of the processing of oil fractions. The essence of the changes in the catalyst lies in its matrix - a porous carrier of the active substance, which should ensure the preservation of its catalytic properties at high temperatures. The matrix may be inert, performing the functions of supplying to the catalyst molecules of raw materials and removal of cracking products from it, or active. In the latter case, preliminary cracking of large molecules of raw materials is carried out on it. The active matrix of the new catalyst gives the product significant advantages over its Western counterparts, which use inert matrix technology. During 2018, the new product gradually replaced the old catalyst at the catalytic cracking units of the Omsk Oil Refinery and fully proved its effectiveness. Now it will lead the line of catalysts for high-quality motor fuels.

### **Conclusion**

In the future, the implementation of the import substitution strategy will enable "Gazprom Neft", together with partners, to create over 100 new high-tech products of Russian production. These will include drilling complexes, equipment and reagents for hydraulic fracturing, generating, compressing and downhole equipment, marine equipment and equipment for offshore projects, personal protective equipment and much more.

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制裁和西方国家因俄罗斯实行食品禁运而给俄罗斯经济造成的经济损失

**FINANCIAL LOSSES OF THE RUSSIAN ECONOMY FROM  
SANCTIONS AND WESTERN COUNTRIES FROM THE  
INTRODUCTION OF A FOOD EMBARGO BY RUSSIA**

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抽象。尽管对俄罗斯经济实行了制裁，但我国在经济方面仍继续与所有国家互动。这种互动的特点使评估参与制裁战争的所有国家的经济损失的方法具有高度的相关性。这项研究的主要目的是对制裁和禁运政策对欧盟和俄罗斯经济造成的财务损失进行比较评估，以及俄罗斯食品禁运对欧盟国家及其经济体的影响。盟国。作为研究的对象，选择了制裁限制及其对参与国经济的影响。该研究的主题是对制裁对发起国和实行制裁的国家的经济的负面影响的比较分析。该研究的方法学基础是收集和处理统计信息，经济指标的分析和比较，结果指标的概括和比较的方法。在研究过程中，有可能发现，实行制裁限制所造成的财政损失不仅对制裁所针对的国家的经济产生负面影响，而且对发起制裁的国家的经济也产生负面影响。已经确定，就价值而言，迄今为止，俄罗斯经济的金融损失超过了西方国家的经济损失。但是，俄罗斯对西方国家的制裁限制采取了食品禁运，这是对国内农业部门的发展和现代化的激励，也有助于加快解决食品市场进口替代问题的速度。最终，这导致了粮食独立性和国家安全的增强。

关键词：制裁限制，食品禁运，经济损失和损害赔偿，比较分析。

**Abstract.** *Despite the imposition of sanctions against the Russian economy, our country continues to interact with all countries in economic terms. The features of this interaction make approaches to assessing financial losses for the economies of all countries participating in the sanctions wars highly relevant. The main objective of this study is a comparative assessment of the financial losses of the economies of the EU and Russia from the policy of sanctions restrictions and prohibitions, as well as the impact of the Russian food embargo on the economies of the EU countries and their allies. As an object of research, sanction restrictions and their consequences*

*for the economies of the participating countries were selected. The subject of the study is a comparative analysis of the negative impact of sanctions on the economies of the initiating countries and the countries against which they were introduced. The methodological basis of the study was the methods of collecting and processing statistical information, analysis and comparison of economic indicators, generalization and comparison of the resulting indicators. In the course of the study, it was possible to establish that financial losses from the introduction of sanctions restrictions negatively affect not only the economies of the countries against which they are directed, but also the economies of the countries that are their initiators. It has been established that, in value terms, the financial losses of the Russian economy so far exceed the losses of the economies of the Western countries. However, the introduction of a food embargo by Russia in response to the sanctions restrictions of Western countries was an incentive for the development and modernization of the domestic agricultural sector, and also contributed to an accelerated solution to the problem of import substitution in the food market. Ultimately, this led to increased food independence and the security of our country.*

**Keywords:** *sanctions restrictions, food embargo, financial losses and damages, comparative analysis.*

### **Introduction**

The leading Western countries continue to wage an “sanction war” against Russia with enviable consistency. For more than six years, they continue to find new pretexts for introducing new packages of sanctions restrictions against the Russian economy, state structures of the country, large enterprises and influential individuals. The true inspirers of the imposition of sanctions restrictions are the US Congress and Senate. Among the EU member states, Germany is an active supporter of tougher sanctions against Russia. This position remains a priority and is annually reinforced by the introduction of new prohibitions and restrictions.

Since the sanctions restrictions are systematically increasing and tightening, Russia was forced to impose its own counter-sanctions, the so-called food embargo, which extended to the ban on imports of certain types of agricultural products, raw materials and food (meat, sausages, fish and seafood, dairy products, vegetables and fruits, etc.) from countries that have imposed sanctions against Russia.

However, historical experience clearly demonstrates that there are no winners in sanctions wars, since both the countries against which the sanctions restrictions are directed and the countries initiating their introduction have to suffer irreparable economic damage. Moreover, while the United States, using its geographically advantageous position, to a lesser extent felt the economic consequences of sanctions, the damage to the EU countries from the imposition of sanctions restrictions on the Russian economy only for 2014 - 2017, according to various estimates, was

in the range from 100 to 120 billion US dollars. According to estimates by international statistical agencies, this is almost twice the loss that the Russian economy suffered. However, many analysts believe that the main share of financial losses for the EU countries was not caused by the Russian food embargo, but by the imposition of sanctions against Russia, which resulted in a sharp reduction in mutually beneficial contracts and the withdrawal of enterprises of these countries from the Russian market.

### **Purpose of the study**

The main objective of the study is to determine and assess the financial losses of the EU and Russia from the policy of sanctions restrictions and prohibitions, as well as the impact of the Russian food embargo on the economy of these countries.

### **Results of the study**

#### ***1. Assessment of the overall impact of sanctions restrictions on the economies of the West and Russia***

The Western countries' policy of sanctions against the Russian economy looks rather strange and unreasonable. This is evidenced by many facts. However, EU countries continue to obey the dictates of the United States and, following them, annually introduce new prohibitions and restrictions.

So, on April 28, 2017, in a special UN report on the negative impact of sanctions restrictions, it was noted that, “the monthly loss of income of the countries initiating the introduction of sanctions is 3.2 billion US dollars. In the three-year period (2014-2017), the volume of these losses amounted to 100 billion US dollars, "which is twice the loss of the Russian economy, which, according to the same source, is 52-55 billion US dollars, which is equivalent to 1 % Of Russia's GDP. The same report indicates that measures taken in the Russian economy to counteract the sanctions restrictions helped to maintain the free exchange rate of the Russian currency, reduce inflation, and also begin to actively diversify the Russian economy [1].

The “UN Comtrade data” report [2] in the UN report on commodity trade used monthly data provided by French companies to analyze the impact of the ban on food exports to Russia. Based on them, it was concluded that 78.1% of the total lost profits for EU member states came from products not covered by the Russian food embargo. In other words, the bulk of the losses of EU member states is directly related to the imposition of sanctions against Russia.

In addition, the “Center d'Etudes Prospectives et d'Informations Internationales”, a French research center, calculated that for 2.5 years (from 2014 to June 2016) the economies of 37 countries that had adopted sanctions against Russia lost profit in the amount of 60.2 billion US dollars [3]. At the same time, a large share of all losses (up to 82%) was generated from the export of goods that do not fall under the Russian food embargo.

Thus, the reverse effect of the imposition of sanctions restrictions is confirmed by at least three independent sources. They testify in favor of the fact that the main losses for the economies of the Western countries were the result of the introduction not of the Russian food embargo, but of sanctions against the Russian economy.

The largest financial losses are suffered by the economies of developed countries in Europe, which account for 76.7% of all losses from the introduction of sanctions against Russia. The loss leader was the German economy, which lost more than 830 million US dollars per month. It continues to suffer losses at present. Moreover, in the political arena, Germany is an active supporter of the continuation of sanctions against Russia.

This situation is explained quite simply. Before the imposition of sanctions, Germany and Russia had one of the largest turnover in Europe, which from the German side was represented by high-tech goods. In addition, large German enterprises took part in a number of Russian infrastructure projects, most of which had to be frozen. As a result of the imposition of sanctions restrictions, German business, which was actively expanding its position in the Russian market, received a serious blow. At the same time, the greatest damage was caused to automobile companies Volkswagen and BMW, which opened joint production in Russia. Thus, the German economy suffered significant financial losses not only from restricting access to the Russian market, but also from the reduction of this market due to the introduction of sanctions prohibitions on cooperation with Russian enterprises.

In this situation, Russia maintains a clearly expressed constructive position and stands for normal economic interaction with German business. Thus, the implementation of the plans for the construction of the “Nord Stream-2” gas pipeline is also focused on Germany.

In addition to Germany, financial losses from the introduction of sanctions against the Russian economy affected the economies of other large European countries. So, in particular, the French economy accounted for 5.6%, and the UK economy - 4.1% of all losses.

Ukraine’s desire to stand on a par with the leaders in imposing sanctions against the Russian economy cost her dearly. The financial losses of the Ukrainian economy from the introduction of anti-Russian restrictions were comparable to the losses of the German economy, and significantly exceeded the losses that the economies of other EU member states suffered. Meanwhile, Ukraine is not a member of the EU, and the imposition of sanctions against Russia was, to put it mildly, an ill-conceived policy. Its consequence was direct losses to the Ukrainian economy, the size of which in 2016 alone exceeded 1 billion US dollars.

In the relative gain from the introduction of sanctions restrictions were their initiators - the United States. For the American economy, the imposition of sanc-

tions did not affect the supply of Russian-made rocket engines and titanium for the production of Boeing aircraft. As a result, sanctions against the Russian economy caused more damage to European economies than the US economy, which accounted for only 0.4% of the total loss.

According to various estimates, for Russia, financial losses from the imposition of sanctions restrictions amount to 140 billion US dollars. In reality, this indicator is likely to be larger, because along with the main negative consequences of the imposition of sanctions and an insufficiently effective policy of economic management institutions, a number of events have occurred in the country, each of which can contribute to increased damage. These include:

- the annual outflow of capital after the imposition of sanctions restrictions up to 96 billion US dollars;
- severe restrictions on access to external credit resources while compressing the domestic lending market for enterprises in the real sector of the economy;
- reduction in revenues from the sale of hydrocarbons;
- departure of foreign companies, reduction of foreign assets;
- falling incomes of the population;
- tightening the monetary policy of the Central Bank and the massive outflow of deposits of individuals.

Thus, the preliminary assessment of the financial losses of the Russian economy from sanctions restrictions is certainly underestimated. To obtain more accurate estimates, it is necessary to take into account the impact of sanctions on all spheres of state activity [4]. However, many Russian economists believe that the introduction of sanctions restrictions on interaction with foreign banks prevented the Russian economy from unfavorable development. Russian enterprises could not get large loans, which, if the ruble depreciated, would have made them bankrupt.

## ***2. Assessment of the impact of the food embargo of Russia on the economy of Western countries and the economy of our country***

Before the introduction of the food embargo, Russia was the second largest market for agricultural products for EU member states. However, the introduction of the food embargo led to a reduction in the export of EU agricultural products to Russia from 11.8 billion euros in 2014 to 5.6 billion euros in mid-2017 [5]. In Russia, the main consequence of the introduction of the food embargo was the increase in prices for many food products, which caused discontent among the population. However, targeted subsidies to agricultural production and reorientation of the procurement of necessary products to other countries quickly stabilized prices and served as an impetus for increasing the volume of Russian-made products. Therefore, despite the recession in the economy in 2015 and 2016, respectively, by 2.8% and 0.2% of GDP, the agro-industrial complex in these years maintained

growth rates, respectively, by 3% and 3.6%. The introduction of the food embargo had a positive impact on the Russian economy by accelerating the pace of development of agricultural production, the establishment of farms, the opening of medium-sized enterprises, and the successful implementation of import substitution programs in large agricultural complexes. Currently, a wide assortment of high-quality food products of domestic production is presented in grocery stores.

The situation is different in the EU countries, where many agricultural sectors have not recovered after Russia imposed a food embargo in response to sanctions. Since the economy of most EU countries is focused on agricultural production and the supply of products to the Russian market, for the vast majority of EU farmers, the response from Russia was clearly unexpected. European farmers not only lost the opportunity to export their goods to Russia, but also failed to timely reorient themselves to other markets. Due to a sharp drop in agricultural exports from the EU to Russia, the production of dairy and meat products, and the supply of fruits, vegetables, and oils were at risk. In 2014-2017, the volume of financial losses exceeded 20 billion euros, which can be considered significant damage to the EU economy.

In 2015, the European Commission allocated 30 million euros to restore agricultural production and compensation to farmers in addition to 60 million euros annually allocated for these purposes. However, this was not enough, and in 2016-2017 another 500 million euros were allocated to diversify the markets for agricultural products. In addition, the European Commission has initiated the creation of a fund for compensatory payments to farmers and agricultural producers, which accumulates about 400 million euros. The limited nature and apparent insufficiency of these measures is evidenced by the fact that the Russian food embargo blocks food exports from the EU to the amount of more than 7 billion euros [6]. The figures given are self-explanatory.

The most vulnerable to the Russian food embargo was Italy's agri-food sector, which, due to export restrictions to Russia, lost about 11-12 billion euros and more than 200 thousand jobs. Italian farmers failed to adapt to the new situation and quickly find new markets.

For the Netherlands, the financial loss from Russia's imposition of a food embargo amounted to approximately 300 million euros. But if the agro-industrial sector of the Netherlands was still somehow able to resist, then the food embargo of Russia was a tangible blow to agriculture and the entire Greek economy. Russia's food embargo negatively affected the production of Greek canned goods and juices, a significant share of which was produced specifically for export to Russia.

In January 2017, the Latvian leadership recognized that financial losses from the food embargo of Russia cost the economy of this country 250 million euros. Losses of the Latvian economy from sanctions against Russia by the end of 2016

exceeded 200 million euros. Together, this result makes Latvia the most affected EU country. Along with Latvia, the authorities of the other Baltic countries recognized the inability to recover losses for the economies of their countries from the sanctions restrictions that they so actively supported [7].

According to statistical estimates of the Federal Customs Service of Russia, the annual loss of the EU countries from the introduction of the food embargo is approximately 8.3 billion US dollars [8]. Of course, this amount for the entire EU can be considered small. However, the whole point is that even a small amount can become very noticeable, since it characterizes the damage that is concentrated in individual industries, where it seems to be very significant. Therefore, the volume of financial losses causes serious concern precisely for these industries. Today, for most agricultural producers, the problem is not in their production, but in new markets, which are very difficult to find. Russia warned former partners that their withdrawal from the Russian market virtually eliminates the possibility of a return, since their products will be replaced either with Russian-made products or with products from countries that did not impose sanctions against Russia.

### **Conclusion**

The results obtained during the research allowed us to formulate the following conclusions.

1. Historical experience indicates that from the introduction of sanctions restrictions, irreparable financial losses are suffered not only by the economies of the countries against which they are directed, but also by the economies of countries introducing such restrictions.

2. In response to the imposition of sanctions by the West, Russia was forced to impose its counter-sanctions - the food embargo. The import of certain types of agricultural products, raw materials and food products from countries that imposed sanctions against our country fell under the ban.

3. From 2014 to June 2016, the financial losses of the economies of 37 countries that imposed sanctions against Russia amounted to 60.2 billion US dollars. At the same time, a large share of all losses (up to 82%) is associated with the export of goods not covered by the Russian food embargo.

4. According to various estimates, Russia's financial losses from the sanctions restrictions amounted to 140 billion US dollars. In reality, this amount is likely to be greater.

5. For the economies of the EU member states, financial losses for 2014-2017 exceeded 20 billion euros, which can be considered significant damage. The annual losses of the EU countries from the introduction of the food embargo by Russia amount to about 8.3 billion US dollars.

6. The introduction of the food embargo by Russia became an incentive for the development and modernization of the domestic agricultural complex, and the so-

lution of the problem of import substitution in the food market, which, ultimately, will contribute to increasing food independence and security of the country. Therefore, it is premature to assert that the sanctions restrictions against the Russian economy have achieved their goals.

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评估医疗服务的质量和可及性，将其作为该地区可持续发展的一个因素

**ASSESSMENT OF THE QUALITY AND ACCESSIBILITY OF  
MEDICAL SERVICES AS A FACTOR IN THE SUSTAINABLE  
DEVELOPMENT OF THE REGION**

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注解。 本文考虑了医疗质量及其可及性的概念，并描述了其标准和目标值。根据秋明州地区公共卫生和医疗机构状况的年度报告以及统计数据，对表征2016–2018年医疗质量和可及性的标准进行了分析，并与实际情况进行了比较。 有条件的值。 评估了医疗服务的质量和可及性对该地区社会经济的影响。

关键词：医疗服务，医疗服务，医疗服务质量，医疗服务可及性，该地区的可持续发展。

***Annotation.** The article considers the concepts of the quality of medical care and its accessibility, characterizing their criteria and target values. Based on the annual reports on the state of public health and healthcare organization in the Tyumen region and statistical data, an analysis of the criteria characterizing the quality and accessibility of medical care for 2016-2018 is carried out, as well as a comparison of actual values with criteria. The impact of the quality and accessibility of medical services on the socio-economic development of the region is evaluated.*

***Keywords:** medical service, medical care, quality of medical services, accessibility of medical services, sustainable development of the region.*

Providing quality and affordable medical care is one of the main tasks of any country in the field of healthcare. According to Article 2 of the Federal Law of 21.11.2011 No. 323-ФЗ “On the Basics of Protecting the Health of Citizens in the Russian Federation”, a medical service is a medical intervention or a set of medical interventions aimed at the prevention, diagnosis and treatment of diseases, medical rehabilitation, and having its own independent significance. Medical assistance - a set of measures aimed at maintaining and (or) restoring health and including the provision of medical services [1].

Without dwelling on the intricacies of terminology and the ongoing discussion, we will use the concepts of medical service and medical care for the purposes of further research as equivalent.

The quality of medical care in the above law is a set of characteristics that reflect the timeliness of medical care, the correct choice of methods of prevention, diagnosis, treatment and rehabilitation in the provision of medical care, the degree of achievement of the planned result. Accessibility of medical care refers to the real possibility of obtaining patients with the necessary medical care, regardless of social status, level of well-being and place of residence. Accessibility of care is a characteristic of the quality of care.

Decree of the Government of the Tyumen Region dated December 25, 2017 No. 676-п “On the Territorial Program of State Guarantees for the Free Provision of Medical Assistance to Citizens in the Tyumen Region for 2018 and the Planning Period of 2019 and 2020” defines the criteria for the availability and quality of medical care, their target values [2]. Based on the annual reports on the state of public health and healthcare organization in the Tyumen region and statistical data, we analyzed the dynamics, for 2016-2018, of the criteria for accessibility and quality of medical care [3,4,5].

One of the criteria is the number of births per 1,000 population. In total, during the period under review, the population increased by about 41,000 due to migration and natural growth. In the Tyumen region, natural growth has been recorded for 12 consecutive years, in 2018 it reached a value of 3 per one thousand people.

The dynamics of the second criterion, the number of deaths per 1,000 people, is characterized by the following data. In 2018, the overall mortality rate was 0.4 percent lower than it was in 2016. Most of the regions of the Russian Federation in the period 2016-2018 recorded a decrease in the birth rate. It should be noted that there remains a difference in the quality and accessibility of medical care in the city and village. The mortality rate among the rural population reached the target only in 2017. While the same coefficient for the city since 2016 gradually approached the target value, and in 2018 not only reached the plan, but also improved it. This all suggests that the negative trend in the development of the social sphere of rural territories, which arose at the beginning of the 2000s, still has an effect on the situation.

The quality and accessibility of medical care is also assessed by the criterion of mortality at home. For 2018, the statistics of the Tyumen region in the number of deaths at home decreased. The value of the indicator in 2016 was more than 2018 by 9.4%. The largest proportion of those who died at home are people who belong to the population older than working age -78.8%.

Infant mortality (per 1,000 live births), as a criterion for the quality and accessibility of medical care, indicates the following. In 2018, infant mortality decreased

by 29 people compared to 2016. For the period under review, annual targets were achieved in the region. Over the three analyzed years, infant mortality decreased significantly due to a decrease in mortality in the state of the perinatal period, by 38%. Congenital anomalies, which in 2016 and 2017 were in second place rank - now occupy the first, then the state of the perinatal period and after - other reasons. Another positive fact is that respiratory diseases and infectious diseases, which were in third place in previous years, are now treated more effectively and are not the leading causes of infant mortality.

The criterion of “maternal mortality per 100 thousand live births” is characterized by the following data. Maternal mortality indicators reached their target values of 5.0 (2016-2017) until 2018, and in the analyzed period, not a single case of maternal mortality was recorded. The situation can hardly be called critical due to the constant and minimal number of maternal deaths in the region over the previous 2 years and their complete absence in 2018, which indicates an improvement in the care of motherhood and childhood and an increase in the quality of medical care. On the other hand, in 2016-2017, the coefficient is deteriorating, obviously due to a decrease in the birth rate, and this can already be called a negative trend with full confidence. In 2018, the indicator reached its minimum for the entire “post-Soviet” time, and not only in the Tyumen region, but throughout the country. A probable reason for this is the project “Technologies and comfort for mothers and children”, which consists in improving the organization of medical care for newborns and women during pregnancy and after childbirth (including the development of a network of perinatal centers in the Russian Federation) and has been operating since mid-2016 years to the end of 2018.

Another criterion for the quality and accessibility of medical care is the number of births in obstetric care facilities. The analysis showed a decrease in the number of births in obstetric care facilities. This is a negative trend, there may be several reasons. Firstly, the overall decline in the birth rate (for the period 2014-2017, the number of women of childbearing age decreased by 841). Secondly, the increase in the number of births outside the walls of health facilities, for example, home delivery. Inadequate medical preparation of women in labor and assisting women increases the risk of death of the infant or mother from complications during and after childbirth. Regarding childbirth, there is another negative indicator in the Tyumen region: despite the fact that the proportion of normal births is 52% in 2018 (in Russia this is about 40%), it should be noted that this indicator worsened by 6% in 2016.

Over the period under review, the number of complications of childbirth and the postpartum period due to bleeding increased, but the frequency of difficult births decreased (over all three years, the indicator decreased by 32.5%). The frequency of violations of labor activity decreased slightly by more than 4% over the

entire period, and in general one can notice a large number of positive changes in this indicator over three years.

Information on one more criterion - the proportion of the primary incidence in the amount of total incidence for various classes of diseases, allows us to draw the following conclusions. Over the three years studied, the overall incidence and primary incidence increased by 7.5 and 3.2%, respectively.

One of the important characteristics of the accessibility of medical care is the number of medical organizations. As of January 1, 2019, 57 public health institutions were operating in the Tyumen region. This is less than 2017 by 1 organization, and 2016 - by 4. The decrease in the indicator is associated with a decrease in the number of resorts.

The number of medical personnel is characterized by the following data. In general, over the past three years, indicators have improved in almost all areas: the number of doctors in the urban population increased by 2.8% compared to 2016, and in the rural population by 0.7%. With regard to the provision of nursing staff, the trend is somewhat different, in the city there is a decrease of 0.4%, but for the rural population an increase of 2.8%. These positive changes can be associated with the policy in the region, which helps to maintain and develop the human resources potential of the healthcare industry, increase the level of professionalism and optimize the number and composition.

The bed capacity of the region, which characterizes the quality and availability of medical care, is lower than the average for Russia (in 2018 - 72.2). Despite the fact that the bed capacity increased in 2018 by 112 beds compared to 2017.

The average number of visits per inhabitant of the region shows a positive trend: the population is increasingly turning to doctors for preventive purposes and disease prevention.

The appeal of the population for emergency medical care is characterized by the following data. In 2018, the total number of calls decreased by 6.6% compared to 2016, the number of calls where it was necessary to provide an ambulance decreased by 14.1%, and the number of people who were delivered to the emergency departments decreased by 11.9%. In 2018, there are 0.3 ambulance calls per person. Another positive factor: more than 90% of those calling for an ambulance waited for the brigade for less than 20 minutes.

It is important to assess the volume of high-tech medical care (HTMC). The total number of operations with the use of VMP in 2018 increased by 16.8% compared to 2017, compared to 2016 - by 21.7%. Residents of the region can receive HTMC of 20 different types out of 21 possible without priority (except for 5 months of waiting for knee replacement).

Health care costs in the region allow us to conclude that the systematic work that is being carried out in the Tyumen region is related to strengthening control

over compliance with treatment standards, equipping with modern equipment in accordance with the procedure for providing medical care, staff development, and intensification of diagnostic and treatment processes.

In the region, a decent ratio of cash incomes and a living wage, the number of people living below the poverty line and crime are also steadily decreasing. Retail turnover is growing and the unemployment rate in the region is getting lower, more and more often a person with a corresponding higher education takes a job. However, in the region the depopulation coefficient increases in the study period, which ultimately leads to a decrease in the share of economically active population. Over the past three years, the rate of commissioning of residential buildings in the region has significantly decreased, which is a negative trend, despite the fact that the rate is still twice as high as the national average. The development of the social sphere in the region is stable - positive. The quality of drinking water in the Tyumen region complies with the standards, which positively affects the epidemic situation and the health of residents. Indicators of air pollution decreased in the total mass, but increased near roads. Absolutely positive indicator in the Tyumen region regarding reforestation - over the study period, the rate of forest restoration has steadily increased.

Accessibility and quality of medical care in the region received 64% of positive assessments of the population. The fact that the assessment of the sustainability of the development of the region and the quality and accessibility of medical care are on the same level gives the right to conclude that health care is an essential factor in regional development. After analyzing the indicators for three years, it can be noted that not only the quality of the provision of medical services affects the development of the Tyumen region, but also vice versa - the stable state of the region directly affects the healthcare sector. This is primarily due to financing. In the state program "Healthcare Development" in the Tyumen Region dated December 3, 2018, one can analyze the sources and volumes of financing the program for 2019-2025: out of 143,424.99 million rubles, 141,382.4 million rubles (or 98.6% total funding) was allocated from the regional budget (of which 45 052.1 million rubles from the funds of the Territorial Compulsory Health Insurance Fund) and only 2 042.5 million rubles from the federal budget [6]. The economic component has the greatest impact. Secondly, this is the quality of the patient flow (this item is significantly affected by the environmental and social components). Poverty is associated with hard work, poor living and working conditions, lack of time for treatment, or a marginal way of life and the emergence of bad habits and addictions. This worsens the situation with socially significant diseases, with the degree of neglect of diseases. The environmental component also affects the state of public health: for example, in areas with excess pollutants in the air, lung and respiratory diseases are more often recorded.

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管理创新领域的投资项目

MANAGING INVESTMENT PROJECTS IN INNOVATION SPHERE

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抽象。文章强调了在创新领域投资项目的项目管理程序中使用理论和实践方法的重要性。作者介绍了各种评估效果，计算和分析投资项目财务指标的方法。他们还提出了一种开发和实施当前业务模型的变体，用于评估创新领域的有效性投资项目。

关键词：投资项目，创新项目，商业化，创新，项目管理，知识产权成果。

**Abstract.** *An article emphasizes the importance of using theoretical and practical methods in project management procedures for investment projects in innovation sphere. Authors present various methods of evaluating effectiveness, calculating and analyzing financial indicators of investment projects. They also propose a variant of developing and implementation current business model evaluating effectiveness investment project in innovation sphere.*

**Keywords:** *investment project, innovative project, commercialization, innovation, project management, intellectual property results.*

The issues of creating project management systems for investment projects in innovation sphere, developing project, using various methods for evaluating project effectiveness, calculating and analyzing financial indicators are more relevant now than ever before. Methods and procedures for innovation management, their improvement and adaptation to the current situation in organizations, development new systems of indicators for managing investment projects in innovation sector is a priority task facing enterprises in various industries and sectors of economy. In accordance with the tasks of building project management skills, it's necessary to create investment projects models in innovation sphere for enterprises; learn how apply

the principles and methods of investment management; use methods for evaluating economic efficiency of innovations, draw up business plans for projects; get risk management skills to initiate and conduct procedures for project implementation.

The article will consider the procedure for create such models, as well as legal issues of their implementation. The paper is based on the research D.Adler, N.Abramov, E.Larsen, N.Motovilov, N.Naumov, J.Pollak, B.Sharnopolsky and other scientists and on authors' own developments. In accordance with the chosen direction of research, the issues of investment and innovation project management for small and medium-sized enterprises and start-up projects that have an innovative idea will be considered.

First of all, we will define the scope of the study; the category "project management" will mean "creation of a management mechanism that will allow for maximum consideration of the specifics of innovation and the most effective implementation" including entire set of procedures for bringing an innovative idea to implementation in the format of a project product for investment projects in innovation sphere. At the same time, you should indicate the initial differences between "investment project" and "innovation project": an investment project involves predetermined milestones, amounts, and the scale of the project. "Investment projects" category includes projects for which the goal, costs, completion date and duration are defined and fixed; the required resources and the actual cost of project depend primarily on progress of work and progress of each project; the required capacity must be provided in accordance with the schedule and deadline for completion of project stages. "Innovative project" has a significantly higher degree of uncertainty in the initial parameters and the idea itself, and most often belongs to startup category. It seems that the sources of innovation in this case are the results of fundamental and / or applied research; acceptable solutions from the innovation bank; transfers from other subject areas; the results of a completed innovation project, which become the beginning of another, etc.

At the same time, it is important to observe such criteria of product innovation as registration as an invention, industrial design, with the receipt of a patent, license, or other document confirming authorship, uniqueness; a positive impact confirmed by experts on domestic scientific, technical, and technological development level; the presence of improved product characteristics compared to previously released or its complete uniqueness (lack of analogues).

Value creation of intellectual property requires in this case is due to a separate consideration first costs to create/acquire/bring to readiness state intellectual property results for the purposes of the proper preparation of project passport. Project must also be created a method of planning and execution budgets of expenditures procedure and criteria for recognition of intangible assets as an intellectual property result.

A common approach in the case of investment and innovative design is: 1) creating a pool of funds necessary for implementation of innovative idea; 2) developing a current business model to generate current revenue and profit and, if necessary, reinvest in project; 3) applying a two-part evaluation methodology (analyzing deviations of the main indicators with and without the project and dynamics of discounted project performance indicators).

Indicators are wrapped up in the appropriate financial models of projects that allow to analyze variable scenarios of project development and integrate the results of evaluation into the accounting and management accounting system. The basis of management and financial information for project evaluation is:

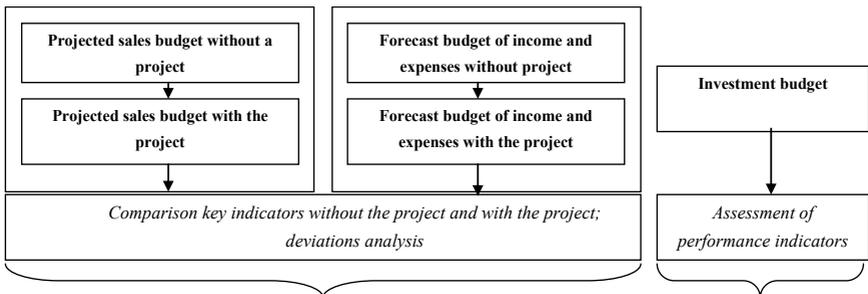
- project product sales budget with forecast components;
- project revenue and expenditure budget with forecast components;
- investment budget, investment programs, documentation on purchases of fixed assets.

At the same time, the cost of intangible assets in the process of creating intellectual property results is estimated using the methods listed above; the resulting cost indicators are the basis of investment budgets and are used to assess the economic efficiency of innovative projects. We use criteria such as net discounted income (NPV); internal rate of return (IRR); the need for additional financing; return on investment (ROI); payback period (PP); a group of indicators that characterize financial condition of the enterprise participating in the project.

Then the expert makes the following actions:

- gets the net effect indicator by subtracting the forecast budget indicators of income and expenses: 1) without the project and 2) with the project;
- gets a system of indicators for effectiveness of innovation project based on a group of indicators.

It seems that financial planning systems of enterprise should include valuation methods look like given below.



**Figure 1.** *Methods for evaluating investment projects in innovation sphere*

Figures are issued in the relevant financial model that allows, firstly, to conduct a rapid assessment of financial feasibility, and secondly, to analyze the variation scenarios of development projects; thirdly, to integrate assessment results in financial accounting that pass the company stage startup become the base of financial and management accounting.

As for the legal aspects of managing projects with intellectual property result, it should be identified as the most relevant the following issues:

1. The importance and attention to the issues of legal protection of the obtained intellectual property result increases every year with information technologies development. Article 1225 of The Civil Code of the Russian Federation currently provides an exhaustive list of intellectual property result. Legal protection procedure is shown in The Civil Code of the Russian Federation: for patent rights objects in article 1349; for objects of copyright in articles 1259-1261 and for trade secrets (know-how) in article 1465. The choice of legal protection type is a procedure for determining method of legal registration and legal protection of intellectual property results in accordance with current legislation, depending on the conditions and characteristics of an object.

At the heart of ensuring legal protection of intellectual property results is the strategy of legal protection, which should be determined by the business model and the strategy of commercialization of intellectual property results. To make the appropriate decision when choosing a strategy for legal protection of the obtained results of intellectual activity, the company's management must first determine the procedure and prospects for use intellectual property results. The basis for making the appropriate management decision is the result of scientific and technical analysis of intellectual property results, which allows us to make the following conclusions:

- an optimal variant of legal protection of intellectual property results (filing a patent application, protection as a secret of production (know-how) in the commercial secret mode, or a mixed nature of legal protection combining different methods of protection);
- about the prospects of commercialization of intellectual property results (conclusion of an exclusive/non-exclusive license or alienation of exclusive rights);
- about the status of intellectual property results for transfer to mass production (definition the degree of readiness of innovative products and its compliance with the requirements of technical regulation of the target sector of application according to standards).

2. Inseparably linked with protection of rights to created intellectual property objects is the issue of protection of exclusive rights to intellectual property and, first of all, the methods of protection – measures or a set of measures taken by

copyright holders when violating or challenging their rights to the results of intellectual activity.

Remedies usually aimed at stopping actions that violate the law, either for recovery or declaration intellectual property rights and protection of rights and legitimate interests of rightholder to ensure rights.

The source of information about the legal protection rules is civil, administrative and criminal legislation; however, the project manager must provide risks of liability for violation of rights and ways to protect exclusive rights to them at the stage of creating intellectual activity result.

3. The result of projects to create intellectual property objects is the receipt of the declared (expected) result of intellectual activity that meets the requirements of readiness technological product, namely:

- 1) technological readiness;
- 2) engineering readiness;
- 3) production readiness;
- 4) operational readiness;
- 5) market readiness.

Thus, analyzing the possibilities of managing investment projects in innovation sphere, it should be emphasized that the methods and procedures for managing innovation activities, their improvement and adaptation, the development new systems of indicators for managing investment projects in innovation sphere is today a priority task facing enterprises in various industries and sectors of economy.

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高等教育是俄罗斯经济发展的一个因素  
**HIGHER EDUCATION AS A FACTOR IN THE ECONOMIC  
DEVELOPMENT OF RUSSIA**

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抽象。拟议文章的相关性是由于通过财务机制的关键要素实现了高等教育系统的发展。为此，确定了研究分期方法的主要方法。构成高等教育发展基础的主要要素是：法规；方法；基础设施；融资。

关键词：教育创新融合融资全球化经济发展

**Abstract.** *The relevance of the proposed article is due to the development of the higher education system through the prism of key elements of the financial mechanism. For these purposes, the main approaches to the methodology of periodization of the study are identified. The main elements that make up the foundation for the development of higher education are: regulation; methodology; infrastructure; financing.*

**Keywords:** *educational innovations, integration, financing, globalization, economic development*

The formation of a global system of higher education that meets the growing need for intercivilized understanding, caused by the global nature of the latest means of communication, local educational markets, etc. has positive effects. However, it is important to take into account the fact that the openness of educational systems and the academic mobility of participants in the educational process leads to a kind of outflow of “brains”, which negatively affects the economic development of different countries. This phenomenon is characterized by the depreciation of human capital, which is a hallmark for developing countries. This is caused not only by this process, but also by the fact that highly developed and developed countries conduct a favorable migration policy for these processes. Undoubtedly, the integration of higher education in the global educational system should be coordinated and regulated by the world community.

The global system of higher education retains signs of integrity, autonomy with respect to economic, political and other national systems. The basis for these

changes is the application of the regulated rules of academic freedom, which traditionally regulate the activities of classical universities [1].

A significant role in the study is played by various documents adopted at international forums that have regulation value, which in turn predetermined the further vector of development of higher education. The emerging global system of higher education has the characteristic features of an associative type. It should be noted that the determining principles for the development of all educational systems will be international, local and regional features.

The global higher education system is endowed with such a sign as equilibrium, which is achieved through the continuous reproduction of human capital, with the presence of legal content. At the same time, equilibrium is manifested through a constant positive transformation of the higher education system, its ability to adapt to changes in the modern world.

The internalization of knowledge is based on the internalization of higher education. This is manifested both in increasing indicators of the academic exchange of students, researchers and teachers, cooperation in the activities of local educational organizations, and in the creation of regional organizations, programs and funds [2].

The main trends in international integration affecting the higher education system are the globalization of economic life, the complicated forms of the international division of labor and the increase in the flexibility and openness of national economies.

In particular, these changes have led to the requirement for the training of universal specialists acquiring professional education in local universities. Thus, this led to the fact that the content of national higher education systems, through accreditation rating mechanisms, was brought to uniform world standards, erasing the boundaries and mentality of national higher education systems of individual countries.

Today, the innovations used in education make it more accessible, ensuring the dissemination of knowledge throughout the world educational space. This, in turn, changes the structure of the cost of education, its cost and, as a result, the sources of financing. All this, in turn, changes not only the structure of higher education, but also transforms approaches to its organization.

Along with this, the manifestation of key trends, demonstrating the strengthening of the importance of human capital in the development of society through the growth of higher education ranges, the complexity of the forms and types of educational services, and the development of international integration in higher education is mediated.

It should be noted that expanding the range of higher education is based on the development of the idea of a "knowledge-based economy" and the transition from "education for life" to "education through life".

In turn, the crisis in the world economy led not only to a decrease in GDP, but also sharply reduced the volume of budget expenditures on education, including higher education. It also affected the solvency of the population, thereby leading to a reduction in the number of people who graduate.

An important trend, which has been forming and developing especially actively since the second half of the last century, is the synergy of the components of higher education in the established format, levels and information content. At the same time, with the increasing diversity of higher education institutions providing competencies and skills through training based on the principles of self-education, the importance of classical universities has not only not weakened, but also intensified. We can say that a certain global system of higher education with its characteristic features has formed [3].

The global higher education system has the following characteristics:

- an open market for educational services, including some local educational institutions;
- preservation of traditional elements characteristic of a particular local educational system;
- implementation of the principles of international educational integration.

Global higher education is an organism consisting of interconnected and interacting components that have certain characteristic features, as well as endowed with any properties that contribute to the integration of world higher education into a single global system. In particular, these include educational institutions that form stable ties with foreign partners and organizations, as well as individual local systems that, together with various international educational organizations, develop a joint development strategy for the entire international educational space.

Educational organizations operating in the local educational services market have all the characteristics of companies operating in the real sector of the economy, such as interaction or competition, developing the main directions of the global system. At the same time, the principles of the global educational system are gradually being introduced into the activities of national educational systems, thereby erasing borders in the international educational space.

Important is the universalization of the content of education. Moreover, the universalization of education is caused by the needs of the development of human capital, the intensification of the crisis in education, which in turn is expressed by dissatisfaction with its results.

Over the years of the evolution of the higher education system in the world economy, public interest in the quality of content and the process of forming human capital has been steadily growing, although the main indicators of its dynamics were achieved in the late 90s. So against the background of an increase in the number of students in academic exchange, there has been a decrease in the volume

of national educational systems over the past five years. Under the influence of integration processes, the transformation of national educational systems entails both favorable and negative consequences.

As world practice shows, an increase in the scale of higher education has indicated the problem of the quality of education observed in different years of the periodization of higher education.

Actual for modern society is the need for highly educated and mobile personnel. It is society that can and must influence high-quality higher education, stimulating the youth labor market. Always relevant is the problem of financing the progressive needs of the higher education system. The increase in the number of students and the technological costs of their education creates negative prerequisites for educational institutions, in terms of reducing the cost of upgrading infrastructure, library funds, international cooperation, teaching staff, etc.

Against this background, the diversification of higher education has created difficulties in its compliance with existing standards, and thereby the presence of qualitative differences in different types of educational institutions. For Russia, these difficulties are manifested in the qualitative characteristics of the contingent of students and faculty, and, thereby, in the level of training in state and non-state universities.

Since the beginning of the 90s, international cooperation in the field of education has acquired new forms and types, creating promising opportunities for solving the following problems:

- development the intellectual potential necessary for the development of modern international society;
- erasing the boundaries of local educational systems;
- human resources training for the needs of the national economy.

At the same time, the preservation of national traditions and accumulated experience should be a key condition in the process of integration of higher education in Russia into the world educational space. In addition, this process must be carried out taking into account changes in time and using international experience, which in turn will ensure the prospects for the country's development in the new millennium.

Currently, the main vector of transformations taking place in the higher education system is its improvement. The changes affected all aspects of the functioning of the higher education system, this is the organizational and legal basis, and the institutional basis of higher education. Along with this, one should include changes in the requirements for training personnel, thereby putting its qualitative characteristics at the forefront. These changes have led to the need to change approaches to financing higher education.

We regard regulation as the adoption and cancellation of legal acts that determine the procedure for financing, the entry and / or creation of regional and international associations for integration purposes, which have changed the volume or instruments of financing.

The methodology is considered as a single mechanism for organizing the activities of the higher education system, applying new approaches to organizing the activities of universities, identifying and applying new approaches to the organization of the educational process, which determine the further policy of training [4].

Influence of infrastructure is considered through the study of such achievements in development as the introduction of academic freedoms and democratic approaches to management; extension of authority of higher education institutions; restructuring the network of universities and research centers; official legitimacy of autonomy of universities as one of the key criteria for the social effectiveness of higher education.

Special requirements are imposed on financing, which include the coordination of all elements of periodization. In this case, their mutual influence, an integrated approach, i.e. consistency of activities carried out at each stage of the reform by focusing on the implementation of the main tasks, as well as ensuring close correlation between its constituent parts – regulation, methodology, infrastructure and the financing itself.

Thus, the reforms carried out in the system of higher education are caused not only by the global processes of globalization, but also by the need to become part of the global educational space.

The state and development of higher education in Russia is largely determined by international integration processes that have occurred and are taking place in the global system of higher education.

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堪察加领土垄断市场的竞争  
**COMPETITION IN THE MONOPOLY MARKETS OF THE  
KAMCHATKA TERRITORY**

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注解。 本文分析了在自然垄断范围内在堪察加领土上石油产品和能源市场中主要经济行为者的行为。 该研究提出了自然垄断经济实体的活动类型的比较特征及其运作的地理边界。 分析其产品的结构和垄断企业的有效性。 找出阻碍企业发展的问題，并提出解决方法。 研究的方法论基础是俄罗斯和外国科学家在系统理论和系统分析以及评估公司市场集中度方面的基本概念和规定。

关键词：自然垄断市场市场集中度效率

**Annotation.** *This article analyzes the behavior of key economic actors operating in the Kamchatka Territory in the markets for oil products and energy resources within the framework of natural monopolies. The study presents the comparative characteristics of the types of activities of economic entities of natural monopolies and the geographical boundaries of their functioning. The analysis of the structure of their products and the effectiveness of the monopoly enterprises. The problems hindering the development of firms are identified, and ways to solve them are proposed. The methodological basis of the study was the fundamental concepts and provisions of Russian and foreign scientists in the field of systems theory and system analysis, as well as assessing the market concentration of firms.*

**Keywords:** *natural monopoly markets, market concentration, efficiency*

The development of competition is an essential condition for the functioning of a market economy. The result of the activities of any firms depends not only on the costs of production, but also on the type of market in which these firms have to operate. A company that enters the market with its goods or services is increasingly faced with competition from other companies that are already in this market. They also want to sell the maximum amount of goods. Due to lack or limited resources, all firms that are on the same market are forced to compete among them-

selves in order to survive in a competitive environment. One of the main resources will be the funds of buyers, which they have and spend in this market.

The market for any product or service has its own specifics, which does not change, however, the essence of competition itself. As a phenomenon, it is not new, but the variety of its manifestations requires constant study, including estimates of dynamics or intensity, especially in sparsely populated territories, such as the Kamchatka Territory.

Of particular importance is competition in oligopolistic markets, in particular petroleum product markets. In the Russian economy, such markets are characterized by the manifestation of economic dominance of companies in the regions or regional monopolism.

Studies of the problems of competition and monopoly were carried out by such scientists as E. Chamberlain, A. Landry, G. Myers, C. Russell, J. Robinson, O. Efferts and others.

The following scholars are among the domestic authors who devoted their work to the study of competition and, in particular, the competitive environment of the oil products and energy market: SB Avdasheva, A.F. Baryshev, A.N. Bulkatov, N.A. Matveeva, S.E. Smolina, S.Ya. Chernavsky, A.V. Yakovlev et al.

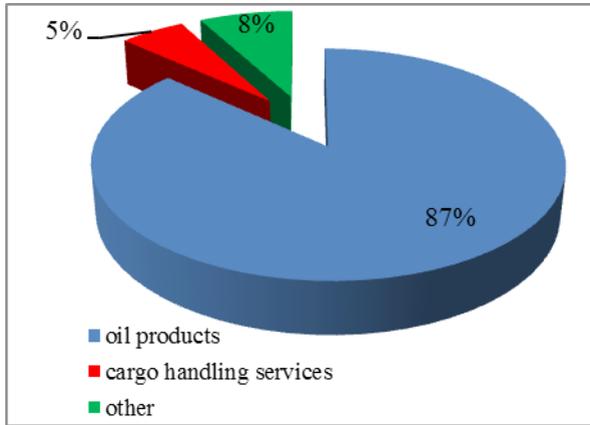
In the Kamchatka Territory, the monopoly markets for oil products and energy supply in the territory are represented by two main enterprises: NNK-Kamchatnefteproduct JSC established in 1994 and Kamchatskenergo PJSC, a subsidiary of RAO Energy Systems of the East OJSC established in 1992. The essential tasks of the functioning of enterprises is to meet the needs of the population through those activities that are provided for by their charters (table. 1)

*Table 1 - Comparative characteristics of the activities of enterprises of monopoly markets in the Kamchatka Territory*

<b>JSC NNK «Kamchatnefteproduct»</b>	<b>PJSC «Kamchatskenergo»</b>
<ul style="list-style-type: none"> <li>- storage of oil refined products;</li> <li>- wholesale and retail sale of oil refined products;</li> <li>- operation of gas stations;</li> <li>- export of petroleum products;</li> <li>- transportation of goods by sea;</li> <li>- carriage of goods by road;</li> <li>- fuel supply for ships and aircraft.</li> </ul>	<ul style="list-style-type: none"> <li>- production of electric energy;</li> <li>- production of thermal energy;</li> <li>- transmission of electrical energy;</li> <li>- transfer of thermal energy;</li> <li>- sales of electrical energy;</li> <li>- sales of thermal energy.</li> </ul>

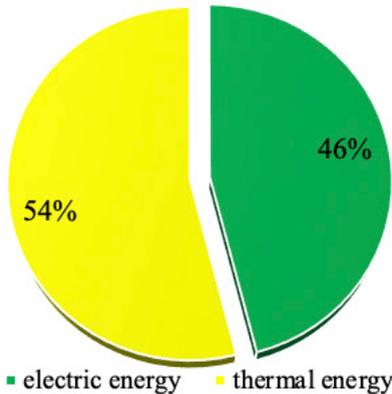
Source: compiled by the author

Owing to their territorial isolation, enterprises are natural monopolies. The structure of their products is shown in figures 1,2.



Source: compiled by the author

**Figure 1.** The structure of manufactured products of NNK Kamchatneftproduct JSC



Source: compiled by the author

**Figure 2.** The structure of manufactured products of Kamchatskenergo PJSC

While Kamchatskenergo PJSC operates within the framework of an isolated electric system only in the territory of Kamchatka Krai, NNK-Kamchatneftproduct JSC declared its presence in other regions of the Russian Federation. The market share occupied by the enterprise in Russia is presented in Fig. 3.



Source: compiled by the author

**Figure 3.** Market share occupied by NNK-Kamchatnefteproduct JSC by sales in Russia, %

Thus, NNK-KNP JSC and Kamchatskenergo PJSC dominate the market for the retail sale of manufactured goods, works and services within the geographical borders of the Kamchatka Territory.

The scientists consider the differentiation of the product, that is, those changes that cannot be fully compensated by substitute goods, as the decisive condition for the exclusive possession of the product. However, product differentiation is not the only condition for monopoly. Comparing the behavior of companies in conditions of perfect and imperfect competition, it should be noted that large companies are able to maintain a higher price than they would be in conditions of perfect competition [7]. In the conditions of this market, the monopolist gains the opportunity to split the market for his goods into separate segments and to set a special price for each of them so that the total profit is maximum. However, the question arises - why does not the monopolist charge an equally high price on all markets? It was revealed that this is impractical, because in conditions of imperfect competition, different groups of buyers have different price elasticities of demand, and if a high price is set everywhere, demand can be sharply reduced.

However, economic laws within the framework of the isolation of the territory do not always work. The range of fuel prices in remote areas is higher than the Petropavlovsk-Kamchatka - Yelizovo agglomeration. This is explained by the fact that, at stable selling prices of NNK-Kamchatnefteprodukt JSC, retailers (gas stations), due to high logistics costs, are forced to offer petroleum products at prices that compensate for the cost of their delivery.

The price level for electric and thermal energy cannot be called low for the Kamchatka Territory, but also the highest in the Far Eastern Federal Circle. The most expensive at the cost of these services are Chukotka Autonomous Okrug and Magadan Oblast.

Using the Herfindahl-Hirschman Market Concentration Index (HHI), a study was made of the markets for oil products, electric and heat energy in the Kamchatka Territory, which revealed that;

- JSC NNK-Kamchatnefteprodukt is a highly concentrated market enterprise, as The coefficient of market concentration CR-3 in the retail markets of automobile gasolines of the Kamchatka Territory either exceeds 70% or approaches the specified value. The Herfindahl-Hirschman Market Concentration Index (HHI) exceeds 2000.

- PJSC Kamchatskenergo is a moderately concentrated market enterprise, as the coefficient of market concentration CR-3 in the retail electricity and heat markets of the Kamchatka Territory exceeds 65%. The Herfindahl-Hirschman Market Concentration Index (HHI) exceeds 1800.

Thus, market concentration indicators characterize the studied markets as markets with a high level of concentration.

Due to the fact that the studied enterprises form the markets of natural monopolies, they are subjects of constant control by the regional service at tariffs and prices, as well as by the Federal Antimonopoly Service [4]. However, monitoring the economic feasibility of prices does not ensure the implementation of geopolitical tasks - improving the quality and standard of living of the population.

The monopolistic market enterprises under study are classified as markets with undeveloped competition. The emergence of new manufacturing enterprises in the oil market, the active introduction of alternative energy sources should help transform monopoly markets into monopolistic ones.

The current situation affects the performance of the studied companies (table. 2).

*Table 2 - the Dynamics of the functioning of monopolistic enterprises in the Kamchatka Territory*

The name of indicators	JSC «NNK-KNP»			PJSC «Kamchatskenergo»		
	2016	2017	2018*	2016	2017	2018
Revenue from the sale of marketable products, thousand rubles	7 152 873	7 233 535	10 363 230	14 204 161	15 017 978	17 265 569
Cost of sales	6 141 812	no inform.	no inform.	13 270 466	14 273 599	16 142 425
Gross profit (loss)	1 011 061	no inform.	no inform.	933 695	744 379	1 123 144
Net income (loss)	365 269	230 420	225 512	333 605	215 044	233 681

\* - forecast indicators

Source: compiled by the author

Studies have shown that despite the fact that enterprises operate in monopoly markets, the current economic situation does not allow them to develop properly. Profit for both companies for the analyzed period decreased by 38.27% for NNK-KNP JSC and 29.95% for Kamchatskenergo PJSC.

The problems of the development of the market for petroleum products, electricity and heat can include an insufficient level of development of institutionalization, including regional legislation and antitrust policy, imperfection of entrepreneurship assistance programs implemented in this field of activity [5].

An obstacle to the development of the oil market is:

- geographical distance from oil refineries;
- high cost of logistics;
- the need to bunker oil products in close proximity to the water area of Avacha Bay;

- lack of free land permitted for this activity, type of use, as well as the duration, and in some cases the impossibility of changing it.

Barriers to the development of the energy market are:

- regulatory barriers to the use of alternative energy sources by consumers in the retail market;

- lack of highly qualified specialists with competencies in the installation and maintenance of alternative energy sources.

The creation of conditions by state authorities to expand the market for petroleum products and energy resources will contribute to the development of competition, and therefore increase the efficiency of firms.

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组织财务稳定性分析

ANALYSIS OF FINANCIAL STABILITY OF THE ORGANIZATION

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注解。 本文讨论了用于分析组织在数字经济中的财务稳定性以及防止信息泄漏的实际信息来源。 现代世界是一个消费社会，在这个社会很难在市场上占据领先地位。 那些设法建立自己的业务的人必须面对维护已经建立的声誉和维持组织的稳定性的问题。

关键概念：企业的财务状况，财务稳定性，经济竞争，数字经济，信息泄漏。

**Annotation.** *This article is discussed the actual sources of information for analyzing the financial stability of an organization in a digital economy, as well as preventing information leakage. The modern world is a consumer society, where it is difficult to gain a leading position in the market. Those, who manage to build their business, have to deal with maintaining an already established reputation and maintaining the organization's stability.*

**Key concepts:** *financial position of enterprise, financial stability, economic competition, digital economy, information leak.*

Currently, the problem of analyzing the financial stability of an organization is given important attention, namely in the organization's management system. After all, it is necessary to maintain a stable financial condition of the organization in an unstable external environment, in opposition to exogenous factors, and to minimize risks. After all, the successful achievement of this goal leads to an increase in the financial stability of the organization [1].

From the above, it follows that the financial Department of any organization faces the task of improving financial stability and financial results, which leads to an increase in the financial condition of the enterprise as a whole.

It is no secret that in a rapidly changing world, the main goal of financial management is to maintain a dynamic financial balance, increase the investment attractiveness of the company, as well as increase its creditworthiness and stable solvency.

To maintain competition and financial standing, as well as to grow the organization in any industry, organizations must find the best way to meet customer needs by bringing products to market that create new value for existing and new customers.

From the above, we can conclude that value is a quality and unique product or service that determines the degree of customer satisfaction and applicability to solving customer problems. Creating new value is the goal of innovation. And that is why innovation is a key factor in the growth, profitability and competitiveness of an organization.

The expert method is to determine the type of financial stability based on financial reporting data, using a set of relative indicators (coefficients).

Financial stability analysis includes the following steps:

- assessment and analysis of absolute and relative indicators of financial stability;
- ranking of factors by significance, qualitative and quantitative assessment of their impact on the financial stability of the organization;
- making management decisions to improve the financial stability and solvency of the organization.

The information base for analyzing the financial condition is the financial (accounting) statements of the organization.

Innovations in our time are digital technologies. In the face of constant competition for new technologies, many organizations forget to take care of the most important thing – the stability and independence of the organization's data, so that information does not leak.

The modern digital economy provides fast and easy access to services, data, and reports via the world wide web. The advantage of digital technologies is low costs, which affects the reduction of the cost of goods and prices for the final consumer.

Taking into account the mass transfer of documents and communications to digital media, it seems quite logical to transfer communication with the state to an electronic platform. E-government and E-government will create a significant share of e-services and products for their citizens.

As we know, information that enters the world wide web stays there forever. That is, almost anyone can view, make changes to documents, thereby distorting reality, as well as use the information obtained for self-serving purposes. Therefore, all companies that respect themselves and their work, before transferring all

information to digital media and, especially, to the Internet, strive to secure and protect their data.

Information leakage is a serious danger for many businesses. It may occur as a result of the intent of third parties or due to the negligence of employees. Deliberate organization of leaks is committed with two goals: the first of them is to cause damage to the state, society or a specific enterprise, this goal is characteristic of manifestations of cyberterrorism; the second goal is to gain an advantage in competition [2].

In order to ensure financial stability in the digital economy, the following conditions must be met, which are divided into two main groups of actions: organizational and technical measures.

The development of a set of organizational information security tools should be the responsibility of the security service. Most often, security professionals:

- develop internal documentation that sets rules for working with computer equipment and confidential information;
- conduct training and periodic inspections of personnel; initiate the signing of additional agreements to employment contracts, which specify the responsibility for disclosure or misuse of information that has become known for work;
- delineate areas of responsibility to avoid situations when the most important data is at the disposal of one of the employees; organize work in common document management programs and make sure that critical files are not stored outside of network drives;
- implement software products that protect data from copying or destruction by any user, including the top management of the organization;
- make plans to restore the system in case of failure for any reason.

The group of technical means of information protection combines hardware and software. Main:

- backup and remote storage of the most important data sets in the computer system-on a regular basis;
- duplication and redundancy of all network subsystems that are important for data security;
- creating the ability to reallocate network resources in cases of failure of individual elements;
- enabling the use of redundant power systems;
- ensuring safety from fire or water damage to equipment;
- installing software that protects databases and other information from unauthorized access. These recommendations will ensure that information is preserved in the digital economy. Nowadays, all major organizations have an active specialist responsible for digital media, because information leakage is a frequent occurrence in the history of the world economy.

Employees of organizations that interact with contractors, perform outsourcing, audit, and consulting services always sign agreements on confidentiality and

independence of procedures to ensure the quality of the contract.

Risk management is an integral part of enterprise management, and the risk management system (strategy and tactics) forms risk management.

In real economic situations, in conditions of a large number of risk factors, various ways can be used to reduce the final level of risk that affects certain aspects of the company's activities. Therefore, their correct choice plays an important role in the risk management system [6].

Thus, knowing where the source information for financial analysis is located, it is possible to identify this area of difficulties and leaks in a timely manner, develop measures to improve the security of information and as a consequence of increasing information data for analyzing the financial condition of the organization.

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在国际运输通道中应用系统定义的可能性  
**POSSIBILITY OF APPLYING THE DEFINITION OF SYSTEM TO  
INTERNATIONAL TRANSPORT CORRIDORS**

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抽象。 文章证明了国际运输走廊是一个系统。 作者在系统的主要属性和国际运输走廊的属性之间进行了类比。 在本文中，作者以“东西方”国际运输走廊为例，展示了国际运输系统的静态、动态和综合特性。 基于对国际运输走廊系统特性的审查结果，作者得出结论，有可能使用系统分析来研究国际运输走廊的有效性。

**关键字：**系统，系统属性，物流系统，国际物流系统，国际运输走廊“东西方”

**Abstract.** *The article proves that international transport corridors are a system. The author made an analogy between the main properties of the system and the properties of international transport corridors. In the article, the author shows static, dynamic and synthetic properties of international transport systems on the example of the International transport corridor "East – West". Based on the results of the review of the system properties of the international transport corridor, the author concludes that it is possible to use system analysis to study the effectiveness of international transport corridors.*

**Keywords:** *system, system properties, logistics system, international logistics system, international transport corridor "East – West"*

In the process of developing the Russian economy, the formation of the Russian transport and logistics infrastructure, including international transport corridors, is of increasing interest.

Despite the lack of a unified approach to the problem of forming and developing international transport corridors that takes into account various political, economic and other aspects, United Nations experts have adopted the following definition of international transport corridors: "International transport corridors are part of a national or international system that provides significant international cargo and passenger transport between certain geographical areas, including rolling stock and stationary devices of all types of transport working in this direction, as well as a set of technological, organizational and legal conditions for the implementation of these transportations" [3].

Since this definition positions international transport corridors as part of the system, the author of the article attempts to correlate the properties inherent in all systems with the properties of international transport corridors [10].

In complexity all systems are divided into simple, complex, large, change in time – static and dynamic, on the relationship with the environment as open and closed, foresight development – deterministic and stochastic, in response to changes in the environment – adaptive and non-adaptive [5]. A logistics system in the scientific literature is most often defined as a dynamic, open, stochastic, adaptive complex or large system that performs a set of logistics functions. The logistics system consists of several subsystems that are interconnected with each other and the external environment, while its intra-system connections are more developed and cyclical than those with the external environment. The elements of the logistics system are enterprises that directly provide transportation of goods, warehouse and distribution centers, wholesale and retail businesses[13].

In fact, any system has static, dynamic and synthetic properties. Static properties are properties of the system at a particular time. The static properties of the system include integrity, openness, internal heterogeneity and structuredness. Dynamic properties reflect how the system changes over time [6]. Dynamic properties include functionality, stimulability, time variability and existence in the environment. Synthetic system properties generalize static and dynamic properties, but emphasize integrity in the overall understanding and interaction of the system with the outside world. Synthetic properties include emergence, indivisibility into parts, inertia and expediency [11].

A brief description of the listed system properties is provided below:

- integrity – the elements of any system are the same and different from the environment;
- openness – if a system is separable from the world around it, then the system itself is not isolated from the world around it; the system and the environment are interconnected and have a mutual influence on each other;
- internal heterogeneity – parts of any system are distinguishable, subsystems and elements are distinguished;
- structuredness – objects and subjects of management of any system are interconnected and make up its structure;
- functionality – any system can be characterized, and the ratings will differ depending on the position from which it is evaluated;
- stimulability – any system is subject to changes from external influences;
- variability in time – over time, the composition, structure of any system, its elements change. System changes are characterized by the speed of changes (slow, fast, very fast, etc.), by the functioning of the system (when replacing

some elements, the structure of the system does not change), by the quality of the system (there is a development, growth, functioning, decline or degradation of the system);

- existence in the environment – to exist and function successfully any system must change under the influence of environmental changes;
- emergence – individual parts of any system have their own properties; when combining parts into a system, a new property appears that is not inherent to individual parts of the system;
- indivisibility into parts – if you exclude at least one part, the composition and properties of any system change, and a completely new system is formed;
- inertia – means that any system is adaptable to its environment;
- expediency – each system has its own purpose for its existence [7].

The international logistics system, being a system in its essence, has all the above properties.

Returning to the definition of the international transport corridor as a part of the system by United Nations experts, the author suggests that it is possible to consider international transport corridors as a separate system. To confirm this thesis, the author has compiled a table of generalizations of the properties of the system, the international logistics system, and the international transport corridor (table 1).

**Table 1.** *Properties of the system, logistics system, international logistics system, international transport corridor*

Designation	Properties											
	integrity	openness	internal heterogeneity	structuredness	functionality	stimulability	variability in time	existence in the environment	emergence	indivisibility into parts	inertia	expediency
System	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Logistics system	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
International logistics system	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
International transport corridor	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

To describe the correspondence of international transport corridors to the general properties of the system shown in table 1, the author considers all the prop-

erties of the international transport corridor on the example of the International transport corridor "East – West". Pan-European transport corridor 2 "East – West" (hereinafter – the International transport corridor "East – West") is the main route connecting Europe and Asia, with a length of 1,830 km. It can replace the sea route used for shipping containers from Asia to Europe, thanks to access to the Railways of China, Kazakhstan, Mongolia and North Korea in the East and to Europe through the ports and crossings of Russia in the West [1]. The Coordinating Council on Trans-Eurasian Transportation (CCTT) coordinates the movement of goods along the International transport corridor "East – West". The Coordinating Council on Trans-Eurasian Transportation includes representatives of transport ministries of various countries, representatives of transport carriers, freight forwarders, state organizations, etc. It manages the entire transport corridor and its subsystems.

The Central part of the International transport corridor "East – West" is located on the territory of Russia, its Western part is the European transport network, and its Eastern part is the transport networks of China and Korea. The international transport corridor "East-West" is designed to transport cargo to China, Kazakhstan, North Korea and Mongolia in the East and to Europe in the West [14].

The basis of the International transport corridor "East – West" are the Trans-Siberian railway (TS) and the Pan-European transport corridor 2 (route Berlin-Nizhny Novgorod via Warsaw, Minsk and Moscow). The Trans-Siberian railway runs in three directions (Yekaterinburg-Moscow via Perm and Nizhny Novgorod; Yekaterinburg-Moscow via Kazan; Chelyabinsk-Moscow via Ufa and Syzran), and connects to the networks of Railways, highways, rivers and airports in the European part of Russia. The main direction of the Trans-Siberian railway: Berlin – Vladivostok / Nakhodka via Warsaw, Minsk, Moscow and Yekaterinburg. The Trans-Siberian railway consists of main railway (TS) and automobile (TSA) routes connecting Krasnoe (the border with Belarus) with Vladivostok or Nakhodka, branches from the main routes, as well as inland waterways (TS): the rivers Irtysh, Ob, Yenisei, Lena and Amur [4].

In the West of Russia, the International transport corridor "East – West" connects to the transport network of Pan-European corridors that provide access to European countries.

The International transport corridor "East – West" has access to the countries of the Asia-Pacific region through the ports of Vladivostok and Nakhodka through the developing International transport corridors "Primorye-1" and "Primorye-2". The concept for the development of the International transport corridors "Primorye-1" and "Primorye-2" was approved by the Government of the Russian Federation in December 2016 based on the results of a study of economic demand for transportation conducted by experts from Russia, China, Mongolia, South Korea and Japan at the Japanese Institute ERINA as part of the "Extended Tumangan Initiative".

Routes of International transport corridors "Primorye-1" and "Primorye-2" through the territory of Free port of Vladivostok and join Chinese provinces Heilongjiang and Jilin with the sea ports of Primorsky Krai. The main direction of the International transport corridors "Primorye-1": Harbin-Suifenhe – Grodekovo (Russia) – ports of Vladivostok, Nakhodka, Vostochny – ports of the Asia-Pacific region. The main direction of the International transport corridors "Primorye-2": Changchun-Jilin – Hunchun-Kamyshovaya (Makhalino) – Posyet-Zarubino – ports of the Asia-Pacific region.

The International transport corridor "East – West" has the following properties:

1. The integrity of the international transport corridor is expressed in the fact that it is a single whole, separated from the surrounding world. A certain independence of the International transport corridor "East – West" from the environment is expressed in the fact that the transport corridor has the ability to self-organize, is independent of other systems, within this system there is a certain dependence and properties of each element of the international transport corridor on its place and functions within the transport corridor. In addition, the international transport corridor itself can develop and change regardless of the environment.

2. The openness of the International transport corridor "East – West" is that it is not isolated from the environment, although inseparable from it, and the international transport corridor and the environment are linked, and links are directed: how the environment affects international transport corridor and international transport corridor has an impact on the environment.

As an example of the environmental impact on the international transport corridor, the Russian government decided in 2017 to approve the Strategy for the development of ports in the Caspian basin, as well as railway and road approaches to seaports in the Caspian basin. The adopted strategy will increase cargo traffic along this route. In turn, an example of the impact of the International transport corridor "East – West" on the environment can be found in the activities developed and implemented by the Coordinating Council on Trans-Eurasian Transportation, aimed at selecting the International transport corridor "East – West" as a priority route, which leads to attracting additional transit cargo. Another example of the relationship between the International transport corridor "East – West" and the environment is the development of the International transport corridors "Primorye-1" and "Primorye-2", which ensured the establishment of sustainable links between European countries and countries of the Asia-Pacific region.

3. The internal heterogeneity of the International transport corridor "East – West" is expressed in the fact that its parts are distinguishable, and the subsystems and elements are different (enterprises engaged in freight forwarding activities, maintenance of transport routes and structures on them, production of vehicles, performing research and training, providing support services (insurance, security, information firms and companies, banks and other institutions) [2].

4. Structuredness. The International transport corridor "East – West" is a structured system, its parts interact with each other. For example, freight forwarders, transport carriers, warehouse and distribution centers and insurance companies interact with each other.

5. The functionality shows changes in the environment that have occurred as a result of the operation of the International transport corridor. The functionality of the International transport corridor "East – West" depends on the position from which it is evaluated. For example, for a carrier, an International transport corridor performs the main function, for a resident of a territory not included in the zone of activity of this corridor – neutral, and for a specialist studying the negative impact on the environment, undesirable. The negative impact of transport corridors on the environment is shown in table 2 [12]. Compliance with environmental quality standards should ensure the environmental safety of the population and the rational use of natural resources. Thus, if the subsystems of the International transport corridor "East – West " comply with the environmental quality standards developed by the regulatory authorities, the position of the ecologist evaluating the activities of the transport corridor as a whole may change in a positive direction.

**Table 2.** *Factors and their impact on the environment [9]*

<b>The factor</b>	<b>The impact on the environment</b>
Dangerous particles, such as fuel and chemicals, that are emitted by vehicles, rail transport, river and sea transport, air transport, or ports and airports	These particles lead to contamination of rivers, lakes, wetlands and oceans. Exhaust gases contain toxic and carcinogenic substances that negatively affect human health, as well as carbon dioxide, which is a greenhouse gas.
High noise and vibration levels	High levels of noise and vibration can cause stress and poor health for people who live or work near busy roads, railway facilities, ports, and airports.
Gasoline leaks that occur when it is pumped; chemicals used to treat sleepers on railway tracks	The ingress of chemicals, medium and heavy fractions of gasoline into the sewer or directly into the soil causes significant physical and chemical changes that worsen the agrochemical properties of the soil.
Waste generated by ship operations at sea or in ports	Waste generated by marine vessels can contain very high levels of bacteria, which are dangerous to public health and also affect marine ecosystems. Some types of waste contain metals and plastics that are practically non-biodegradable. Oil spills resulting from accidents on oil-loading cargo ships are also a very serious problem of environmental pollution [8].
Ballast water	It may contain invasive aquatic species from other regions that may populate a new water area and disrupt the existing marine environment.
Increased consumption of natural resources and electricity	Transport consumes a large amount of natural resources, mostly non-renewable, and electricity.

6. International transport corridors not only interact with the surrounding world, but are also subject to changes from external influences. Changes in the behavior of the International transport corridor "East – West" under the influence of external incentives are characterized by stimulability. For example, the activities of the International transport corridor will change after the Russian government decides to organize the exit of cargo flows from the Trans-Korean highway to the Trans-Siberian highway through the Khasan – Tumangan border crossing. The implementation of this plan will create a direct link between Russia and the Republic of Korea, which is the shortest transit corridor "Asia – Europe – Asia".

7. The variability of the system over time. Over time, the composition and structure of the International transport corridor "East – West" and its elements change. The change in the structure of the International transport corridor "East – West" is influenced by the work on the modernization of old tunnels and the construction of new tunnels, bridges and ports of the Baltic, Black and Azov seas, marshalling yards, etc. These works, as well as the electrification of the Trans-Siberian railway, contribute to increasing the speed of cargo transportation along this route, developing container transport technologies, implementing block train technology, creating a powerful transport and logistics infrastructure along the corridor, forming and developing an information communications system.

8. Existence in the environment. Given the constant changes in the external environment, international transport corridors should change, lagging behind or ahead of external changes, depending on their nature. Ignoring changes in the external world and economic factors, the International transport corridor "East – West" will not be able to function successfully.

9. Emergence. Separate parts of the International transport corridor "East-West" have their own properties. When combining parts in the system, a new property appears that is not inherent to its separate parts. International transport corridors have this property, since international transport corridor structures that handle processing, storage, insurance, loading and unloading, transportation, and other operations will not be able to provide international transport separately.

10. Indivisibility into parts. To work effectively, the system must contain all the source elements. If any part is excluded, the composition and properties of the system change, and a new system is formed. For example, the organization of cargo exit from the Trans-Korean highway to the Trans-Siberian highway, through the Hasan – Tumangan border crossing, will create a direct connection between Russia and the Republic of Korea and will form a new, shortest transit corridor "Asia – Europe – Asia".

11. Inertia. It is characterized by the adaptability of the system to the environment, its consistency with the environment. The coherence of the international transport corridor is reflected in such processes as upgrading the corridor's in-

frastructure, developing container transport technologies, electrifying the Trans-Siberian railway, developing an environmental protection strategy, simplifying customs procedures, reducing fees by developing a unified approach to calculating the customs value of goods, etc.

12. The International transport corridor "East – West" has a specific goal: attracting foreign trade goods to the national transport network, increasing the volume of cargo transit, expanding foreign economic relations, and improving the competitiveness of the country's transport enterprises. Currently, the volume of traffic on the Trans-Siberian railway is about 100 million tons. After the measures planned by the Russian government to modernize the International transport corridor "East – West", the volume of traffic is expected to increase by 55 million tons.

To sum up, the international transport corridor "East – West" has all the properties of the system. The article also notes that all international transport corridors differ from each other, interact with each other and, in turn, are a subsystem of the international logistics system. At the same time, a systematic approach can be applied to international transport corridors in order to identify individual characteristics of this system, identify problems and develop measures aimed at solving them and improving the efficiency of international transport corridors.

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竞争力是企业战略形成的基础

## COMPETITIVENESS AS THE BASIS FOR THE FORMATION OF AN ENTERPRISE STRATEGY

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抽象。提出的研究分析了关于竞争力的科学观点的演变,这是影响企业战略形成和有效实施的关键类别。对竞争力进行了因素分析和主要特征分析,对竞争力进行了分类。作者从公司战略形成的角度提出了竞争力的观点。这项工作基于国内外作者的概念,他们为竞争力的概念和理论基础的科学证实做出了重大贡献。

关键字: 战略, 竞争, 威胁, 优势

**Abstract.** *The presented study analyzes the evolution of scientific views on competitiveness, as a key category affecting the formation and effective implementation of an enterprise strategy. The analysis of factors and the main features of competitiveness is presented, the classification of competitive forces is carried out. The author's view of competitiveness is presented from the perspective of the formation of a company's strategy. The work was based on the concepts of domestic and foreign authors who made a significant contribution to the scientific substantiation of the conceptual and theoretical foundations of competitiveness.*

**Keywords:** *strategy, competition, threats, advantages*

In modern market relations, the main content of the functioning of the economic system is competition. This is the key category that allows you to maximize customer satisfaction and the best use of available resources, and also contributes to the competent formation and effective implementation of the enterprise strategy.

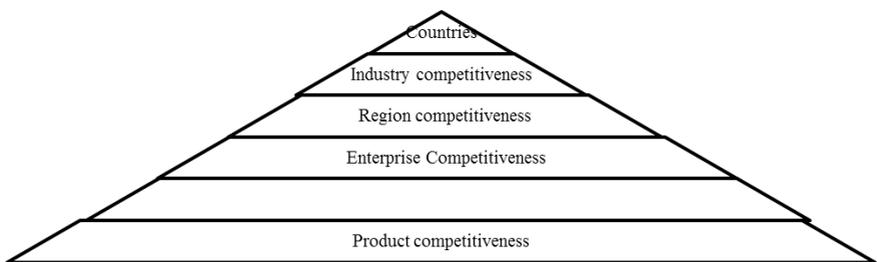
The purpose of this study is to systematize scientific views on competitiveness, as a key category that affects the formation and effective implementation of an enterprise strategy.

The role of competition in the functioning of a market economy was generalized back in the eighteenth century by A. Smith in the principle of «invisible hands». A. Smith drew attention to the difference between the subjective goals of businessmen and the objective results of their activities and noted that each business entity in the market seeks only for its own benefit [2]. However, ultimately, along with their own interests, the interests of society are simultaneously realized. Competition is that «invisible hand» that coordinates the activities of market participants, ruthlessly culling firms engaged in the production of products that are unnecessary for the market. Competition is the most important mechanism for ensuring the efficiency, proportionality and dynamism of a market economy.

According to A. Smith, «competition is fair competition between sellers for more favorable conditions for the sale of their goods». It is rivalry that allows us to consider competition from the perspective of a behavioral approach. The behavioral interpretation of competition is the struggle for the buyer's money by satisfying his needs [3]. The neoclassical theory adheres to this approach.

C. McConell and S.L. Brue define competition as «the presence on the market of a large number of independent buyers and sellers to freely enter the market and leave it» [11]. This interpretation of competition determines the structural approach.

In the modern world, the term «competitiveness» is used to define different levels, namely, country, industry, region, region, company and product, Figure 1 [8].



*Figure 1. The competitiveness pyramid*

The basic level of the pyramid is the competitiveness of the goods, which is understood not only as consumer goods and industrial and technical purposes, but also services, information, ideas. The remaining four levels of the hierarchy of concepts of competitiveness are formed by enterprises producing products at the

regional, industrial markets and at the country level. The basic basis for the level of competitiveness of goods in this system is the competitiveness of the enterprise.

Khan A. V. proposes to divide the whole variety of competitive relations arising in the economic sphere with a certain degree of conditionality into three levels [8]:

- micro level (specific types of products, production, enterprises);
- mesoscale (branches, corporate associations of enterprises and conglomerate-type firms);
- macro level (country and international organizations).

The most complete concept of “competitiveness” by economists has been studied and structured at the micro level, which is traditionally understood as the ratio of price and quality of goods produced and sold by an enterprise. To determine the economic content of the concept of competitiveness, we will analyze the literature in which a high level of theorization and a low level of practical applicability of the definition are traced, table 1 [1].

**Table 1 - Overview of the definitions of the economic category «enterprise competitiveness»**

<b>Definition</b>	<b>Author</b>
Ability to manufacture and market products with greater competitiveness than that of a competitor	Khan A.V. [6]
Property of an object, characterized by the degree to which it satisfies a specific need in comparison with similar objects presented on this market	Arbatskaya E.A. [5]
Property of the object, characterized by the degree of satisfaction of the need in comparison with similar objects presented on this market. Competitiveness determines the ability to withstand competition in comparison with similar objects in a given (internal or external) market.	Gilmitdinov Sh. G. [3]
The property of an object having a certain share of the corresponding market, which characterizes the degree of conformity of the technical, functional, economic, organizational and other characteristics of the object to the requirements of consumers, determines the market share belonging to this subject and prevents the redistribution of this market in favor of other objects	Shcherbakova L.V. [4]
The company's ability to develop, produce and sell its products on the market at a price that ensures the full implementation of its financial and economic obligations, as well as qualitative and quantitative growth of its potential	Golovko-Marchenko I.S. [6]
A set of managerial and marketing actions used to effectively achieve the goals and objectives of the enterprise, allowing him to take a strong position in the fight against competitors	Pogonev S.V. [5]

The multiplicity of formulations of the concept of competitiveness is conditioned by the following factors:

- poorly developed methodological and methodological approaches, which leads to different initial positions of researchers;
- multivariance of the concept (from technical to economic characteristics of a product, enterprise, industry);
- the relativity of this category (one and the same product may be competitive in one market and uncompetitive in another).

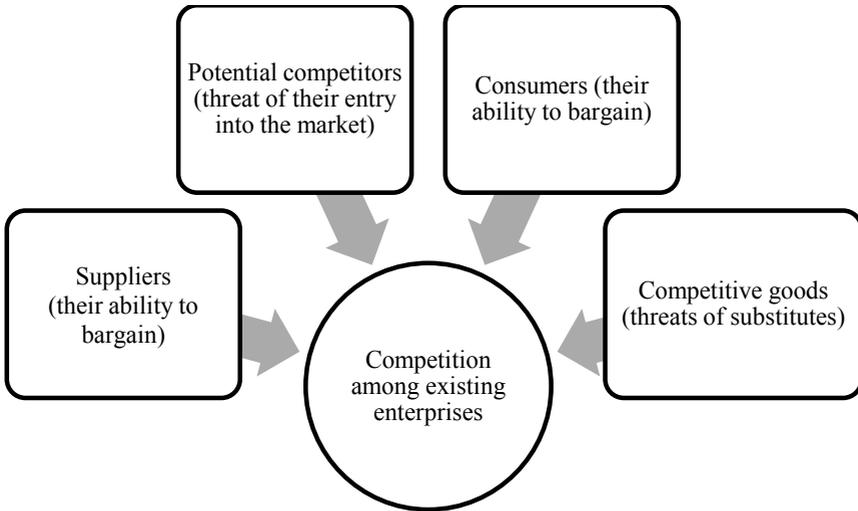
Having analyzed the above-mentioned scientists to determine the competitive ability of the enterprise, we can distinguish similar features [3]:

- a hallmark of any definition of the category of competitiveness is the ability to withstand competition. The differences are due to the properties due to which the subject of market competition can withstand competition;
- the competitiveness of the enterprise is mainly determined by the competitiveness of products; the manufacturer's competitiveness is higher, the higher the competitiveness of its products;
- Competitive is an enterprise that produces competitive products. Consequently, the competitiveness of the enterprise is manifested in commodity markets and is mediated by the competitiveness of goods;
- competitiveness is not a constant, it is constantly influenced by external and internal factors;
- definitions of competitiveness come from the classic marketing concept, the essence of which is very simple: customer satisfaction.

The competitiveness criteria of an enterprise are its competitive advantages. Their presence and implementation provide the enterprise with superiority over competitors. Competitive advantage is only potential opportunities for the production of competitive products, associated primarily with the efficient use of resource potential (climatic, technological, technical, human, organizational and other factors) [10].

The creation by enterprises of competitive advantages is the basis of non-price competition as a fundamentally new type of competition. An enterprise can beat its competitors only if it is able to provide itself with some difference from others and can subsequently save it.

An important condition for increasing the competitiveness of an enterprise is a comparative advantage either in the form of lower costs, or in the production of a wide range of goods characterized by parameters that meet the most demanding consumer requirements. The most famous model for managing competitive advantages is the M. Porter model [7], in which market competitiveness is determined by five main forces - rivalry among competing suppliers, threats from substitute products, threats from new market participants and threats from the market power of suppliers of goods and services in the consumer market, Figure 2 [11].



*Figure 2. Five competitive components (forces) of M. Porter*

Market forces affect the prices of goods of an enterprise, the costs of producing and selling products, and the consumer properties of the final product. The threat of competition in the industry is the competition of sellers in the market. If the industry has strong and aggressive competitors of similar products, then such competition reduces the profitability of the industry.

To increase the rate of profit, firms have to either go to price wars, although the profit goes to the buyer by lowering them, or they increase the cost of advertising, marketing, developing new products, etc.

The threat of substitute products. The availability of substitute products sets the market low prices and low cost of «switching». If firms set a high price for their products, then they would encourage the buyer to turn to substitute goods and reduce the volume of production in the industry. The threat to processing enterprises from substitute goods stimulates them to produce non-traditional dairy products and improve traditional ones [5].

The threat of the emergence of new competitors arises when high barriers to market penetration are set (high costs for achieving an efficient scale of production, customer loyalty, difficulty in accessing sources of raw materials, to a distribution system). The threat of new competitors in the industry reduces the overall potential for profitability of the product market. After all, with the advent of new firms in the industry, supply increases and prices drop.

The threat of increased market power for buyers. Buyers force the seller to lower the price, provide more favorable terms of payment, improve the quality of services, thereby reducing their potential profit. The threat from buyers is limited in conditions of heterogeneity, high importance of the product, low sensitivity of buyers to price, lack of a large buyer.

The threat of increasing the bargaining power of suppliers. Strong suppliers can, through their actions (increase supply prices, reduce the quality and volume of supply of products) affect the rate of profitability of the company. In this regard, in the market of each product, it is important to build mutually beneficial relations of a processing enterprise with producers, create partnerships, participate in an integrated supply system [9].

Thus, these five forces determine the profitability of the industry, because they affect the prices that enterprises can dictate, the costs that they have to bear, the amount of investment needed to compete in the industry.

Based on the foregoing, it can be concluded that the competitiveness of an enterprise requires the ability to adapt its activities to market requirements, based on its own motive for activity and the availability of necessary resources, using its competitive advantages in the formation and implementation of an enterprise strategy.

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俄罗斯远程学习的大规模组织的第一次经验  
**THE FIRST EXPERIENCE OF MASS ORGANIZATION  
OF DISTANCE LEARNING IN RUSSIA**

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注解。 本文分析了教师对俄罗斯学校准备转向远程教育的评估。 考虑了将圣彼得堡市的学校大规模转移到远程组织教育过程的第一天的经验。 显示了各种可能性，并对访问门户网站俄罗斯电子学校的经历表达了个人判断。

关键字。 远程学习，信息和通信技术，复数，俄罗斯电子学校。

***Annotation.** The article analyzes the assessment by teachers of the readiness of Russian schools to switch to remote forms of education. The experience of the first day of the mass transfer of schools of the city of St. Petersburg to the remote organization of the educational process is considered. The possibilities are shown and a personal judgment is expressed about the experience of accessing the portal Russian Electronic School.*

***Keywords.** Distance learning, information and communication technologies, complex numbers, Russian electronic school.*

In the first half of the 21st century, a problem arises with professional education. The education system in Russia, traditional for the 20th century, turned out to be destroyed, and a new one has not yet been formed. It is known that the education system cultivated in any country is the most conservative component of the state system. And the realities of modern Russian reality are such that, in conditions of the need for a technological breakthrough, the training of specialists on whose shoulders this difficult task rests is carried out within the framework of outdated content, methods and educational equipment in the vast majority of educational organizations.

Thus, we can state a contradiction between the need of society for graduates of schools and universities that are able to function without additional training in rapidly developing technological processes and the inability of educational organizations to respond flexibly to changes in the content and tools when organizing training.

The resolution of this contradiction is associated with two enlarged contexts: the technological equipment of educational organizations that correspond to the modern level of developed production and the willingness of teachers to implement educational programs using information and communication technologies (ICT) based on a wide range of educational portal offers.

Given that more than 40% of teachers in Russia are older than 50 years, as well as the fact that the teaching profession is not prestigious for Russian youth, as evidenced by the fact that teachers who have not overcome the age of twenty-five are only 4%. (Konyukhova K.). In these conditions, teachers' continuing education courses in the direction of mastering modern ICT become popular, and in the situation of the epidemiological situation in which the Russian educational system found itself updating the need for organizing distance learning is another argument in favor of mastering the means and methods of organizing the educational process by teachers requirements of the digital economy.

At the beginning of April 2020, we can state the fact that the Russian education system is not ready for the implementation of educational programs in the distance learning mode (Research).

According to the results of this study, 68% of teachers believe that the school is not ready to provide educational services remotely. Among teachers of higher education, a smaller number of recipients - 53%, speak out negatively about the readiness of the transition to distance learning.

Quite a few teachers praised the technical equipment of their educational organization - 15%, most - gave a satisfactory rating - 61%.

Of interest is also the opinion of teachers regarding the number of students who do not have the technical equipment necessary for distance learning, 19% of teachers said that almost half of the students can not study at a distance for this reason. Moreover, this phenomenon is also characteristic of large megacities, for example, for St. Petersburg. So on April 5, the press addressed the governor Alexander Beglov to the population of the city "to help schoolchildren on the "distance" with computers" (A. Prsyaniuk), which states that 16904 children do not have a computer and Internet access (this is more than 3% of the total schoolchildren).

So, on April 6, in St. Petersburg, distance learning of schoolchildren began.

The media reacted as follows to this event: «"The Apocalypse Today". In St. Petersburg schools ended the first day of distance learning. This is a failure» (Ivan-tei E.).

It can be concluded that as a fundamental reason for this state of affairs is the lack of thought in the procedure for mass connection to educational resources and the inability of the education committee to build a strategy and tactics for switching to distance forms of organization of the educational process. It is interesting that Fontanka.ru correspondents “were unable to contact either the press secretary, or the head of the committee, either by phone or via messengers” and obtain information on the results of the first day of the implementation of the distance educational “marathon” (Ivantey E.).

What portals does the Ministry of Education of the Russian Federation offer to use for teachers and students to carry out training in the "distance"? Consider one of them.

Russian Electronic School (RES) is a platform developed as part of the instructions of the President of the Russian Federation dated 02.01.2016 No. Pr-15GS. The portal contains interactive lessons of the best teachers (indicating authorship) in almost all subjects of the school course from the first to eleventh grades (Russian Electronic School).

We describe the experience of accessing the resource.

The user is offered the tabs: subjects, classes, student, teacher, parent, school.

We are immediately interested in subjects and choose “Algebra and the beginning of mathematical analysis”. The course is focused on grades 10-11 and is divided into fifteen sections. We give preference to section 14 - Complex numbers. These are four lessons for the eleventh grade. We open lesson 38 - Definition of a complex number. Actions with complex numbers.

The first perplexity about the preposition “c” used by the author, instead of “over”.

We are interested in the site of the Mathematical Portal (Mathematical Portal) - we read "Actions on complex numbers." We look into the mathematical dictionary (Kaazik Yu.Ya.) - we read “operations on complex numbers”.

The second observation concerns the fact that the author of the compendium uses the term “action”, which is accepted in elementary school, in high school the term “operation” is the most common, moreover, in the literature recommended as basic literature, the authors use the word “operation”.

Next, open the Summary tab.

We review the list of issues addressed in the topic.

The first question asked was "The concept of an imaginary unit." We are looking for an answer to it, but it turns out that in the glossary with which the lesson begins, this concept is absent.

The second question is the definition of a complex number, identified with its algebraic form of notation.

But the wording of the third issue under discussion does not hold water, see for yourself: "Actions with complex numbers and actions on them."

At this point, the author somehow doubted the preposition and used both at once.

But, let's start the lesson. On the tab, the main part contains more than a fifteen-minute video. Spectacular RES screensaver, subject name, class, lesson number and its theme. The author is Elena Mikhailovna Naumova, teacher of the highest qualification category School No. 463, Moscow. Naturally, the next minute, I want to hear the voice of Elena Mikhailovna, or another woman who voiced the video, but... the voice is produced by a man. In the first minute you feel some discomfort.

In fairness, we note that the scoring of a slide with a two-level heading is carried out according to the heading of the second level - "Actions on complex numbers", while the heading of the first level is formulated as follows: "Actions with complex numbers".

Each lesson comes with exercises and test assignments.

After mastering the material of the main part, go to the Training tasks tab. There are a lot of training exercises, though it is not clear whether the correct answer has been received, there is no system response to entering the answer.

The next stage of training - Control tasks B1 and B2. We go to the appropriate tab and get the message "To pass the verification tasks you need to register." And here you can see the inconsistency of the descriptions of the capabilities of the RES portal on the tabs of the Student and the Teacher. In the Student's section, it's said that registration is not required for exercises and verification tasks, and in the Teacher's section, verification tasks are available only for registered users.

So, register. The registration procedure did not take much time, but you can register only as a student, parent or teacher, indicating the school. And if a person does not belong to any of these groups, if he, for example, is a pensioner or a student who wants to recall or update material, then he is forced to enter inaccurate information.

Registration is completed, we proceed to the implementation of control tasks. Tab B1 has three questions: the first is theoretical, the next two are practical, in which three examples need to be resolved. However, in fact, it is only necessary to solve two problems, the third example and the third answer can be correlated without solution. In control tasks B2 a similar situation.

Unfortunately, it seems that the material offered by the students was not subjected to examination. Errors are encountered in the tasks, for example, in the section of control tasks B2, the following complex numbers  $-2 \pm 2i$  are accepted as the correct roots of the equation  $x^2 - 4x + 8 = 0$ , which is incorrect.

The result of lesson 38 was the message: You successfully completed the lesson.

What conclusions can be drawn after the first call to the portal Russian Electronic School. The theoretical part of the lesson is frankly boring, an off-screen

voice with an expression reads the text of the slide, but every eleventh grader can read it himself and it will take less time to read the proposed text. Of course, it is necessary to conduct an examination of the material proposed for posting on the website, to include not only teachers, but also teachers of higher education in the expert group.

Of course, the portal is quite “young”, it is clear that there is a process of improvement, it is currently unstable, a message “502 Bad Gateway” often pops up, while the pages of the site do not open and there is no way to organize work on the RES resource. As you know, such an error occurs as a result of problems in the operation of the server on which the site is currently inaccessible. The developers of the portal and those who fill it with content have a lot of work to improve its work. Undoubtedly, the implementation of the idea of a portal for schoolchildren, with the help of which you can organize distance learning forms and the process of independent study of school subjects, is deserving of approval and is archiacal. We wish the portal owners success and further development of this area in the Russian educational space.

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现代职业教育的人文传统

## HUMANISTIC TRADITIONS OF MODERN VOCATIONAL EDUCATION

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注解。 本文的问题查找性质取决于以下事实：大学的学生准备工作是一个非常复杂的世界观过程，在这个过程中，学生必须接受世界与人类统一的最初的全球观念。 但是，社会意识和个人意识的人性化是非常困难的。 本文讨论了职业教育组织的新方法，从逻辑上讲，这需要整个教育政策的人性化。

关键词：高等技术教育，人性化，科学与普世价值，佛教世界观。

**Annotation.** *The problem-searching nature of this article is determined by the fact that the preparation of students at a university is a very complicated world outlook process, where students have to accept the initial global ideas of the unity of the world and the human race. However, the humanization of social and individual consciousness occurs with great difficulty. The article discusses new approaches to the organization of vocational education, which logically require the humanization of the entire educational policy.*

**Keywords:** *higher technical education, humanization, science and universal values, Buddhist worldview.*

The recognition of the priority of universal human values and human rights as a fundamental principle in the modern development of society objectively necessitates the need for such a cardinal direction of fundamental transformations in the training of specialists as the humanization of vocational education. The relevance of the study of the problems of humanization of higher technical education is due to a number of factors characteristic of the current state of social life in Russia and world civilization as a whole. The close attention to this problem is largely connected with the evolution of modern philosophical views, according to which a person is currently moving to the center of the scientific picture of the world. The totality of knowledge about man and society, the prospects for their development is increasingly becoming a factor in the integration of various spheres of hu-

man activity. This is due to the awareness of the one-sidedness and futility of the technocratic bias in the development of civilization. In the technical version, the scientific and technological revolution is being replaced by a humanitarian one. This means that in order to solve a whole series of modern problems of human life, a different formulation of issues related to the interaction of science and universal values, social and technological progress, culture and education is needed.

The technocratic style in education is based, first of all, on the fact that a modern person (a student, in particular) quite often is able to realize himself as a subject of material production, but rarely as a subject of spiritual activity.

The modern domestic school of all levels is still focused on education, that is, on giving their pets knowledge. Other essential elements of social experience (skills; experience in creative activities; experience in emotional-evaluative activities) are virtually ignored in programs. A lot of disciplines are taught, but a holistic picture of the world does not add up.

The humanization of professional training of specialists should presuppose, first of all, a two-pronged goal-setting: firstly, the formation of professional competence; secondly, personal development. The basis for the implementation of these goals in a university should be a thorough study and knowledge of the student's personality.

It is no secret that our education system is Eurocentric. In this regard, it is interesting to orient, in particular, Buddhist understanding of the world, one of the most important principles of which is the requirement to accompany the comprehension of new knowledge with appropriate behavior. In the West, it is customary to believe that there may be knowledge that is not directly related to human behavior, that knowledge can be acquired without internal change, without appropriate actions. In the Buddhist tradition, it is believed that such knowledge should not be, that any development requires from a person changes in his life, behavior, mood.

The basis, the main principle of the Buddhist mentality is considered to be the principle of non-duality of thinking, that is, a holistic view of the world. This principle is most difficult for the perception of «Western» culture: the place of the familiar «one and the other» here is occupied by a fundamentally different type of communication – «one in another», more precisely, «one in all and all in one». The nature of everything is fundamentally indivisible: everything is both a microcosm (a single manifestation of the world, its individual expression), and a macrocosm (receptacle of the world). Eternity is enclosed in every instant, how the ocean is concentrated in every drop of sea water [1, p. 31].

For this reason, a philosophy of man could not have arisen in the Buddhist spiritual tradition, because in order for a person to become an object of consideration, he must be torn away from the world around him. The Buddhist mentality perceives any rejected dharma as false, having lost its nature. On the other hand, if

a person is a microcosm, if he contains the whole world, then, therefore, to know him, his true «I» means to know «world law». Indeed, «dharma», the teaching of which the greatest Russian Buddhologist F. I. Shcherbatsky called «the central concept of Buddhism» [2, pp. 112-198], means any single element of being, and «cosmic law».

In the Buddhist East, science did not stand out for a very long time as an independent form of knowledge; scientific discoveries did not lead there to the «heyday of science». This paradox, inexplicable to the «Western» mind, is explained by the fact that in Buddhism there are three levels of knowledge: ignorance (avidya); conceptual, «scientific» knowledge (vijñana); omniscience (prajna). In the «western» language, the first level corresponds to prelogical thinking, the second to logical, and the third to supra logical. Approaches to the truth, as they say here, can be as many as there are people on Earth, and this absolute Truth itself can be understood by everyone in their own way. But in any case, its cognition presupposes a «way out» to the third level of knowledge: experiencing (and not just understanding) one's unity with the world, «entering» into the rhythm of the Universe, «passing the world through oneself».

Scientific knowledge (vijñana) has never been an end in itself here. It was only a means of spiritual experience. Vijñana, which was the highest level of knowledge for the ancient Greeks, for the eastern sage was only an approximation to prajna. The mastery of the latter implied getting rid of all formal knowledge. And if the ultimate goal is to achieve the level of «omniscience», then this also presupposes the corresponding method of cognition – not a logical, but a «prelogical», intuitive. If for a European the method of cognition is analysis and synthesis, then for Eastern thinkers it is a method of an undivided, holistic approach to the world, perceiving the world directly, «as it is».

The task of Buddhist science has always consisted not in knowing the world, but in understanding how one can live in the world without violating the «world law», without deviating from the «Way». If a person feels the world in himself and himself in the world, then it is very difficult for him to make the world the subject of consideration, analysis. Any analysis borders on destruction, and if «it is you», will you «destroy» it? After all, destroying something outside, you destroy yourself.

Buddhist science is a science of a different type, built on different principles of cognition and a different attitude to the knowledge gained. The science of the Buddhist region does not refute the «Western» one: natural and technical sciences arose very early in the East and today they are developing no less fruitfully. However, if the «Western» science preferred the physical world, leaving spirituality to the lot of religion, then the «Eastern» science was engaged, first of all, in the spiritual and spiritual (mental) world, trying to coordinate human behavior with the laws of nature, the Cosmos as much as possible.

The problems «science and religion», «knowledge and faith» are a purely «Western» phenomenon; their formulation in the context of Buddhist cultural tradition makes no sense. In the East, the opposition of science and religion is impossible: this is hindered by the basic worldview of the eastern cultural paradigm – the principle of non-separation of the one. Science and religion have a common goal – changing human consciousness, freeing it from illusions, ignorance (avidya), and spiritual blindness. Buddhist science proceeds from the idea of the balance of the one and the one, the idea of the relativity of the edges between them, and therefore the truth is sought here in the middle. Cognition of the truth means in the context of the «eastern» worldview, knowledge of the universality of the universe. The science of the Buddhist East is not so much a theory, deduction, as «practical knowledge», inseparable from the personal experience of man. And this is the reason for the huge interest in traditional Buddhist teachings, which is characteristic of the scientific elite of the West today.

Thinking over the problems of the optimal combination of rational and other knowledge as the guiding impulses of our activity, we come to the following conclusion. The irrational component must certainly be taken into account when determining the goal to which one should move. Rational is to offer the most reasonable ways to solve the problem. In other words, the goal must be moral, and the paths to its achievement are reliable. Obviously, not only the ultimate goal, but also every step towards it must meet the criteria of morality. A new thinking is needed, and one of its characteristic features should be a harmonious combination of the work of thought and the «heart», rational and emotional, rational and intuitive knowledge and understanding of the world [3, p. 56].

In the foreseeable future, the pace of humanization of society will be directly and directly determined by the quality of specialists delivered by higher education. A lot will depend on with what reserve of knowledge, with what spiritual and moral orientation – universal humanitarian or narrow departmental-technocratic – they will come to life and will have an impact on society in the coming years.

The real humanism of students and teachers lies not only in their knowledge of the basic humanitarian strategies of the 21st century, but also in the practical experience of their development in relation to the profile of their professional activities, national environment, type of religion, social opportunities and prospects. Thus, the topic of interest to us is inextricably linked with the general humanistic renewal of social life and education.

Historical experience shows that society is interested in developing a holistic, harmonious model of education. It is usually based on a universal, integrating idea. In the Middle Ages, for example, it was a Christian idea, during the Renaissance – the idea of humanism. In modern conditions, such an idea may be the idea of culture, understood in the spirit of M. Bakhtin as the focus of the fundamental meanings of human life.

In this sense, the idea of culture has not yet become the property of teaching practice. In the system of modern domestic education, it is scattered across individual branches of knowledge, individual academic disciplines, mainly the humanitarian cycle. It is understood that the student will independently collect all these grains in his head and form a holistic image of culture, a universal picture of the world – scientific and artistic. However, this does not actually happen. A holistic, consistently implemented program is needed, the basis of which should be a university.

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民族音乐教育对培养学生民族文化素养的作用  
**THE ROLE OF NATIONAL MUSIC EDUCATION IN CULTIVATING  
STUDENTS' NATIONAL CULTURAL QUALITY**

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**摘要：**民族音乐是具有中华民族特色的音乐，是具有非常强烈和鲜明地域气息的音乐。民族音乐可以滋养人的灵魂。民族音乐无论是哪种风格或形式，哪种主题或内容，都包含着对祖国的热爱之情，学生能够通过民族音乐来增加自己对民族、民间传统文化的了解。民族音乐也可以开阔学生的视野，增加学生的知识储备量，提升学生的整体音乐水平，进而提高学生的民族文化素养。

**关键词：**民族音乐；培养学生素养；作用

**Abstract.** *National music is music with Chinese national characteristics, and it has a very strong and distinct regional atmosphere. National music can nourish human souls. No matter what style or form, or theme or content, ethnic music contains a love for the motherland, students can use ethnic music to increase their understanding of ethnic and folk traditional culture. National music can also broaden the horizons of students, increase students' knowledge reserves, improve students' overall music level, and thus improve students' national cultural qualities.*

**Keywords:** *folk music; cultivating student literacy; function*

China is a multi-ethnic country with thousands of years of cultural heritage. Chinese folk music is the historical mirror of the Chinese nation, embodies the essence of the Chinese nation's art, and reflects the development of the Chinese nation's spirit. National music contains deep cultural heritage and it also incorporates people's rich emotions. In the course of national music education, not only to strengthen the cultivation of students' music literacy, but also to the cultivation process of students' cultural literacy. It can also enhance students' understanding of national history and culture, cultivate national spirit, and promote the national spirit of the Chinese nation.

### I. Overview of folk music

National music is a song or piece of music that is produced in the folk and circulated in the folk, expressing folk life and produced. Chinese folk music art is a very distinctive art form in the world. The Chinese nation has created a large number of excellent national music cultures in thousands of years of civilization, and formed a national music system with profound connotations and rich contents. This system occupies an important position in world music. We must understand Chinese music, not only sing some Chinese songs, listen to a few traditional music, but also must investigate Chinese music from a national, historical, and regional perspective, understand Chinese music, and thus truly understand the meaning of Chinese music Its position and historical value in the world music system.

Published in 1964 by the Music Research Institute of the Chinese Academy of Art and published by the People's Music Publishing House, "An Introduction to National Music". At that time, it was written to compile teaching materials for the "ethnic music" class. The scope of the music forms in the book was limited to traditional ethnic music forms, not including the new music forms since the May Fourth Movement. The book divides Chinese folk music into folk songs and ancient songs, singing and dancing music, rap music, opera music, and folk musical instruments. [1]

Folk songs are songs that people create and sing in their own lives and labor. Originated from folk, popular in folk. The creators and dates of traditional folk songs are uncertain. They are mainly stored in the folk by oral creation and oral distribution.

Singing and dancing music, "singing and dancing" is a comprehensive art form that is popular among the people in our country. It is characterized by the combination of music and dance. In the long-term art practice, it has formed a unique style that is different from other art forms. This folk singing and dancing activity has the characteristics of being handed down from generation to generation and natural reproduction. The creator of art is a laborer. Singing and dancing activities generally have their own traditional time, place and method of activity.

Rap music, also known as Quyi, is a unique art form formed by the long-term development and evolution of ancient Chinese folk oral literature and singing art.

Opera music is a musical drama formed on the basis of Chinese folk music and other traditional cultures. It is a comprehensive stage art that integrates various artistic means such as literature, music, dance, martial arts, acrobatics, performance, and stage art.

National instrumental music refers to folk traditional music played with traditional musical instruments. Divided into solo and ensemble. The solo music is played by drums, and the ensemble is divided into silk and bamboo music, string music, wind music, and gongs.

It can be seen that national music is not just as simple as music, it contains the development and cultural connotation of the entire nation. Only when students learn from the shallower to the deeper will they learn about national music and national culture. Only through such a system can students' musical literacy be improved. At the same time, students' national cultural qualities are greatly improved.

## II. The role of national music in cultivating students' national cultural literacy

National music with regional characteristics of the Chinese nation contains a strong sense of patriotism. Through the study of national music, students deepen their understanding of the culture of various nationalities in China, and at the same time feel the unique cultural characteristics and cultural connotations of each nationality

### 1. Cultivate students' patriotism

Through careful study of folk music, it is not difficult to find that in folk music, no matter what kind of theme and content, or style and form, these are full of the love of the people of all ethnic groups for the motherland. For example: Zhuang, Yao, Dong, Dai and other ethnic minorities, we can learn from these ethnic minorities' costumes, music, dance, and ethnic musical instruments. From these aspects, I feel the joy and warm emotions from them, which are based on the fact that ethnic minorities now have a good life. Based on their love for their parents, they welcome friends from all over the country, welcome these distant friends to be guests, and show their national music and national culture to guests and friends from far away. Their enthusiasm and hospitality are just a picture of a beautiful and harmonious life. When students learn local folk music, in addition to being attracted by the local ethnic customs, they also feel the power of the motherland and the harmonious life of the people. The emotion of being proud of the motherland emerged spontaneously.

### 2. Cultivate students' understanding of national and folk culture

In terms of music literacy, students should have the ability to analyze music tracks objectively and impartially when they appreciate music tracks, and be able to perceive the cultural connotation and style contained in music in music. On the basis of good music recognition. For example, when students appreciate Shaanxi folk songs, they cannot use the standards and methods of enjoying Northeast folk songs, but should be based on the folk culture of Shaanxi Loess Plateau. The study of national music can enhance students' nationality. The understanding of traditional folk culture will help students develop their own musical literacy in this process. Take the Chinese quintessence, Peking Opera as an example. Peking Opera is one of the five major Chinese opera dramas, and is China's intangible cultural heritage. Peking opera is divided into business: birth, dan, net, end, ugly. Peking opera also involves many fields such as music, singing, literature,

performance, makeup, Facebook and gongs and drums. However, in real life, students rarely have access to Peking Opera, and their knowledge of Peking Opera is blank. Students have no knowledge of Peking Opera in this respect, so students do not understand Peking Opera, let alone appreciate or appreciate the Peking Opera repertoire. On the contrary, if students have an understanding of the musical form of Peking Opera, they will be more professional when enjoying Peking Opera, and also show that the students have a higher musical quality.

### 3.Help students develop a diverse music culture

China is a multi-ethnic country with 56 ethnic minorities. Each ethnic group has its own unique customs and derived music culture. National music is one of the most beautiful, full of life and most infectious culture in the culture of various nationalities, and is one of the greatest achievements in the development of musical art. In a narrow sense, if the Han students do not further expand and reserve knowledge of other music, the Han students are basically exposed to the music of their own country, then the knowledge of other music will be lacking and narrow, and the students' music literacy will be comprehensive. It is difficult to raise the level to a higher level. On the contrary, if the teacher expands the diversified music culture with the help of folk music in the usual music education, helps the students to contact more forms of music, so that the students' reserve of music knowledge is richer, the music level is improved, and the music literacy Also correspondingly improved. There is no easy way to understand these musical cultural knowledge. Through a long learning process, students not only let students know the national music of their own country, but also promote and inherit the national music and culture of our country.

### III.How to use ethnic music education to cultivate students' national cultural literacy

National music contains the cultural connotation of the nation, and national culture is the national heritage inherited by the nation for thousands of years. When students want to get a deeper understanding of the music of the ethnic group, they must understand the local culture and folk customs of the ethnic group, so as to enhance the national cultural qualities of the students. While learning national music, it is also an important process to help spread and inherit national music and national culture.

#### 1.Look at folk music with an objective public view

How to embody a person's comprehensive literacy depends on his knowledge and judgment of things. A person with good qualities, he can be objective and fair to everything, and he can be impartial and impatient when looking at problems, and he can examine the issues in a fair manner. Music literacy is manifested in the following: when faced with various forms of music, it can be viewed from an objective, fair and just perspective, even if the individual has a preferred form of music, he will not refuse or abandon other music form.

"Music has no national boundaries". Broadly speaking, the music of the Chinese nation is very different from the music of other countries. With the development of music without borders, when it comes to musical instruments, most students know about Western musical instruments, such as piano, guitar, saxophone, etc. However, they are not familiar with Chinese local musical instruments, such as Guzheng, Erhu, Xiao, etc. Not to mention the ethnic musical instruments that exist in ethnic minorities, such as the Miao, Dong, Yao, Lusheng, and Mongolian Matouqin. In a narrow sense, the music form of the Han nationality is also different from that of ethnic minorities. Therefore, in daily music education, teachers should instruct students to cultivate an objective and fair look at folk music in music that seeks common ground while reserving differences, thereby improving Personal music cultural literacy, as well as national cultural literacy. Take, for example, China's first Chinese music "Jasmine" that went abroad. This is a piece of Chinese local music that has been praised by many Western countries. Many Western countries have also created "Jasmine" a second time. Teachers should guide students to listen to different versions of "Jasmine" in music teaching. In the process of listening, try to analyze and compare music style, timbre, tone and so on. In the tasting, look at the different aesthetics of different versions interpreted by different methods, and further cultivate students to appreciate and evaluate the music of different music forms in a fair and objective manner, as well as folk music.

### 2. Open-minded and diverse ethnic music

Rich folk music and musical forms can broaden students' understanding of music. At the same time, the national culture contained in folk music can also broaden students' horizons and cultivate students' musical literacy and national cultural literacy. In teaching, teachers should also guide students to cultivate their open minds and tolerate the rich national music of the Chinese nation in the process of understanding multiple music and multiple cultures.

Take prairie songs as an example, such as the Tibetan music "Qinghai-Tibet Plateau" with broad music, long and high rhythm, free rhythm, and large melody. A variety of ethnic music but different characteristics and styles. At the same time, these two pieces of music are different from Jiangnan Music and Southwest Music. Different national cultures and national music are formed under the influence of regional culture. Students can only understand China's multi-ethnic culture and multi-ethnic music with a broad-minded understanding, learn excellent national culture, and continuously improve their personal music and cultural qualities.

### 3. Accept ethnic music rich in ethnic culture

Music is an art form that originates from the auditory cells and is supported by imagination and associativity [2]. Therefore, while using folk music to cultivate students' literacy, teachers can also guide students to enrich their connotations in tasting and understanding music. In the process of enjoying songs, students

should not only pay attention to the tone and rhythm, but also try to figure out the meaning of the lyrics, learn to combine the background of the song creation, understand the folk customs reflected by the song, and truly understand the infectivity and influence of the song. Such as a well-known Xinjiang dance song "Take your hijab", after in-depth understanding, I found that this popular song was first produced in the Uzbek Republic of the former Soviet Union, and was modified by Wang Luobin to have today's "Take your hijab" . And the "hijab" that appears frequently in the song shows the "marriage custom" in ancient history. It can be seen that a song, when deep into it to dig out its connotation, only to realize that the understanding of national music only exists on its surface. This shows that teachers should also encourage students to combine their life experiences and learning cognition to taste and appreciate different national music, and carefully analyze, explore, and understand the connotations of songs. It enables students to dig songs from shallow to deep, from the surface to the inside, so that students learn to learn songs more deeply and acquire more rich knowledge, and also cultivate students' good learning attitude and curiosity.

#### IV.Conclusion

National music broadly refers to musical works with Chinese national characteristics created by Chinese musicians, and in the narrow sense refers to musical works that originated from folk and passed on to folk. National music can directly reflect the art form that reflects the national culture and national spirit. National music has been inherited from ancient times to the present and has accumulated the traditional culture of the Chinese nation in its inheritance and development. And occupy a place on the stage of world music. Nowadays, more and more attention is paid to national traditional cultural education. Whether it is elementary school, middle school, high school, or university music textbooks, national music with rich national cultural characteristics and national cultural connotation is incorporated. Teachers can use these selected folk music to teach students in the teaching, feel the patriotic emotions in folk music, enhance students' understanding and cognition of traditional folk culture, and cultivate students through different forms of music Music literacy, as well as personal comprehensive literacy, to promote better growth of students.

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远程教育观点

**DISTANCE EDUCATION PERSPECTIVES**

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抽象。高等教育的能力方法要求教育过程要灵活, 健壮, 以适应当代学生的需求和用人单位的要求, 这是由远程学习技术提供的。 本文展示了作为非监督学习活动不可或缺的组成部分的远程教育对于中等高等教育机构形态学部门的优势。 基于原理和专门的远程学习技术, 设计了“临床解剖学(现代3D技术)”学科的远程学习技术的功能模型。

关键字-远程学习, 无监督学习活动, MOODLE平台, 远程教育功能模型

**Abstract.** *The competence approach to higher education requires the education process to be flexible and robust, adapted to the needs of the contemporary students and requests of the employers, which is provided by distance learning technologies. This article demonstrates the advantages of distance learning of the basic disciplines for the morphology department of a medial higher educational institution as an integral component of unsupervised learning activities. A functional model for the distance learning technology of the "Clinical Anatomy (Modern 3D Technologies)" discipline has been designed based on the principles and specialized distance learning techniques.*

**Keywords:** *distance learning, unsupervised learning activities, MOODLE platform, functional model of distance education*

Recognition and introduction of the Federal State Education Standards (hereinafter referred to as FSES) into the higher education system of Russia have dramatically changed the previously existing requirements to the acquisition of the basic competences and implementation of the education programs, which is impossible without establishment of an information education environment and employment of information technologies together with the electronic education resources available at the higher educational institution. The priority trend in the traditional education system of Russia is individual approach to the student. However, the student cannot manifest his or her individuality when the teacher sticks to the traditional teaching methods (drawing on the blackboard, "talk and chalk"

method), lectures and practical classes that require a personal contact between the teacher and the student). Today, a promising component of the teaching methods employed in higher education is innovative distance learning environment [1]. The distance learning process reveals the individualities of both the students and the teacher. The student acquires the general cultural and professional competences at any convenient time, with a possibility to revise the information as many times as required; the teacher controls the educational activities of the students with due regard to their capacities, interests and abilities, therefore combating the stereotype of teachers' authoritarianism.

The most important task of every higher educational institution is to provide the students with the maximum possible volume of theoretical and practical knowledge conforming to the requirements set before the specialists of different profiles, within the minimum period of time [2]. According to specialists, students are supposed to spend around 40% of their time on distance learning, 40% on supervised learning and 20% on self-education [3].

According to the provision of the Federal Law dated December 29, 2012, No. 273-FZ "On Education in the Russian Federation" concerning e-learning and distance education technologies, all educational institutions "shall be entitled to employ distance learning and distance education technologies in their education programs pursuant to the procedure established by the federal executive authority body in charge of the development of the education-regulating policies. Distance learning means "organization of the education process based on unsupervised learning principle, when the students are remote from the teacher in terms of space and time, but have an opportunity to maintain a dialogue with him/her in the virtual space" [4]. According to some authors [1, 2], thanks to the mobile and virtual teaching forms, distance learning makes up various learning models that meet the needs of the students and the requests of the employers.

Distance learning technologies allow the students to acquire the general cultural and professional competence simultaneously. Thus, the general cultural competences include the following:

- knowledge of the essence and general features of the objects and phenomena of the reality in the context of a certain academic discipline;
- understanding cause-and-effect, functional and other relations and interdependencies of the objects and their actual relevance;
- command of the main terminology required for further learning;
- skill and ability to navigate the world of the social, intellectual, moral, aesthetic values based on the acquired knowledge and skills;
- ability to apply the acquired knowledge, skills and abilities to solve various standard life situations, as well as problems connected to the performance of some standard social roles.

The acquired professional competences include:

- readiness to solve professional tasks;
- ability to develop necessary documentation;
- ability to maintain professional contacts;
- development of the ability to analyse, assess and forecast professional situations;
- ability to adequately evaluate any professional activity.

The tendency to shifting to distance learning is typical for all countries of the world, therefore expanding the circle of higher educational institutions that employ some distance learning technologies. For instance, in the years 1900-1960 there were 60 of such higher educational institutions, in 1960-1970 there were 79, in 1970-1980 - 187, and in 1980-1995 - 7002. At the present moment, foreign institutions provide distance education of higher level than Russian ones. Officially, distance education in Russia began to spread in 2012, when the term of electronic learning was established at the legislative level. In Russia, distance learning technologies are most frequently applied in higher education in the spheres of economics, law and humanities.

For the Accessible Environment project, distance learning plays an important role for physically disabled people, as it makes all levels of education, such as bachelor's, master's, and post graduate programs available with due respect to the adaptation of the curriculum to the needs of the learner.

According to some authors [2, 4], today distance learning technologies cannot completely replace traditional full-time education, but they can be used to improve it by making up the teaching models meeting the requirements of both the students and the employers. Distance learning technologies need to be integrated into the traditional education process through the development of new types of interaction between the participants of the education process. They provide remote support for traditional learning, i. e. an aggregation of activities to maintain the education process when no direct contact between the learner and the teacher is possible.

The main concept of innovative learning includes relevance and applicability in the target environment, together with commercial practicability. Medical educational institutions are not an exception. The FSES for the medical specialist programs requires the development of general cultural, general and specific professional competences within the main education program. The general professional competence GPC-1 ensures the readiness of the specialist with higher medical education possessing the information navigation skills to solve standard professional tasks using information and bibliographic resources, medical and biological terminology, information and communication technologies with regard to the main information security requirements.

At the present moment, the learning technologies employed by medical universities are intended to improve the quality of the education process. One of the strategic tendencies of the medical education is gradual implementation of electronic and distance education technologies into the learning process. Medical university alumni are actively involved in the continuous medical education process, with distance learning being one of its integral parts. Then, the most relevant process is the teacher's control and management of the quality of the unsupervised work of the students at the medical university. The unsupervised work of the student encompasses the academic, methodological, research and development activity carried out by the student without direct involvement of the teaching staff and as planned by the educational institution curriculum. The objective of unsupervised work of the students is the development of fundamental knowledge and professional abilities, acquisition of the research and development skills. Unsupervised work is intended to develop responsibility, discipline, independent decision-making in different professional situations and to motivate the students to dynamic learning. In accordance with par. 7.3.1 of the Order of the Ministry of Education and Science of Russia dated 09.02.2016 No. 95 "On Establishment of the Federal State Education Standard of Higher Education for the Education Profile 31.05.01/Medical Care (Specialist Program)", the rooms for unsupervised work of the students shall be equipped with computers connected to the Internet with an access to the electronic information and education environment of the organization.

There are various electronic learning platforms used for distance learning today. Among the education resources of the Internet, the most popular ones are LMS - Learning Management System, CMS - Course Management System, LMS MOODLE - Modular Object-Oriented Dynamic Learning Environment. The latter is a successful and continuously developing project developed and inspired by an Australian researcher of IT in education Martin Dougiamas.

The advantages of MOODLE platform are the possibility of active learning, exchanging information files, creation of forums and chats between all persons involved in the education process. 398 open source codes allow to adjust to the specificity of the course, and 399 filters help to create links to the existing resources and glossaries [5].

With MOODLE electronic platform, where the learning materials available in various formats, the students can study the compulsory and additional literature on the topic under study, listen to interactive lectures, watch video materials in Flash Video format and see Microsoft PowerPoint presentations. Lightbox Gallery format is used for browsing images and photographs. The learner can solve some case problems, study clinical cases or do control tests with self-examination option. The teacher can grade the quality of the tasks performed by the student and

the time spent on the task, provide some explanations and comments to the learners. However, any electronic platform has some disadvantages due to the excess of links, information, and absence of voice contact between the student and the teacher.

Under the project for development of electronic education resources in September 2018, at Human Anatomy Department, distance learning for the discipline "Clinical Anatomy (Modern 3D Technologies)" was implemented. Human Anatomy discipline is a fundamental one, for it makes up the basic knowledge of the structure of human organs and systems, anatomic principles of their development, which is essential for acquisition for further interdisciplinary knowledge and skills including clinical ones. Clinical anatomy focuses on clinically relevant topics, interpretation of X-ray pictures, computed tomography and magnetic resonance imaging results, ultrasound investigation from the perspective of the projection of the anatomically regular organs and their skeletal and syntopy.

The lecturers of the Human Anatomy Department have developed a documentation package, including methodological recommendations for students and lecturers, innovative educational technologies for the discipline and information support represented by video films, presentations and a lecture course.

The regulatory documents for distance learning comply with the requirements of the Ministry of Education and Science of the Russian Federation; electronic learning content meets the education standard of the presented discipline. Methodological recommendations for learners include the objective and tasks to be fulfilled to study the topic, criteria for assessment of knowledge, skills and abilities, and topic studied within the previous disciplines to master the selected topic. The main elements of the electronic educational resource are listed, and the approximate flowchart for the studies of the selected topic is provided, together with the training aids and supplies for the educational resource.

Methodological recommendations for the lecturers include the components mentioned above, compiled in order to develop general cultural and professional competences. Moreover, the innovative educational technologies for the "Clinical Anatomy (Modern 3D Educational Technologies)" sorted by topics have been developed.

The academic materials in the electronic format are divided into certain topics, presented in case-studies. The cases encompass the entire content of the topic, consisting of the following elements:

- introduction, where the topic and its connection to the other sections of the electronic course are presented;
- theoretical part, which is the main content of the topic;
- practical part, offering some tasks for the students to assess the level of their knowledge on their own;

- control part with tests with three distractors the students are supposed to take after the topic has been studied. After the tests are successfully passed, the student may proceed to the next topic.

Clinical anatomy case studies are presented in 8 electronic workbooks. Solving the tasks on the suggested topics, the learner relies upon the knowledge acquired in the process of studying of the supplied materials. The student may revise the challenging materials at any moment. The distance learning technology implementation processes consisted of four main stages.

The preparation stage included submission of a claim for "Development of Electronic Educational Resources and Management Infrastructure" participated by the entire teaching staff of the department.

The objective of the second stage was to develop eight themed cases consisting of illustrated training aids, methodological recommendations for distance learning students to solve the practical tasks, and case studies of 10 tasks with four descriptors for self-control, answers to the tasks and assessment criteria. This way, electronic workbooks for each topic were created.

During Stage III, the themed cases were published in the multimedia system of the department auditoriums; after that, the teaching program elements were transferred to the students' computers. The students used the provided presentations, videos and lecture courses to solve the cases unsupervised. The results were checked by the lecturer based upon the data presented by the students on information carriers.

At Stage IV, the software department specialists place the themed case-study tasks on Moodle electronic platform. The students submitted the fulfilled tasks, for the lecturer to give a feedback on the tasks and to assess the acquired knowledge. Performing the tasks and publishing the learning results, the students may communicate with the lecturer in the electronic environment using the Moodle forums, chats and databases.

The research of the regulatory and legal base for developing distance education at a higher educational institution including a medical one has revealed that the objective of online learning technologies is independent, unsupervised learning and professional self-improvement of students and specialists, achieved through visualization, which plays a critical role in the studies of different disciplines, including fundamental ones, through structured electronic training resources.

In order to improve the efficiency and quality of distance learning of the fundamental disciplines, the opinion of both the students and expert lecturers shall be surveyed.

Taking everything mentioned above into account, it may be concluded that distance learning technologies enhance the cognitive activities of the students, ensuring successful unsupervised learning of the students, thereby confirming the practicability of implementing some elements of online technologies into the courses on fundamental disciplines.

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在研究委婉语语义机制的背景下，概念隐喻表示模型  
**MODELS OF CONCEPTUAL-METONYMIC REPRESENTATION  
IN THE CONTEXT OF STUDYING SEMANTIC MECHANISMS OF  
EUPHEMIZATION.<sup>1</sup>**

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抽象。 本文提出了一种算法，用于重建属于现代“政治正确”领域的委婉语义的概念基础。 结果表明，最活跃的是转喻概念（概念性转喻）的块。 同时，隐喻概念（概念隐喻）的相对较高的生产率使我们能够通过突出常见的概念焦点来描述转喻和隐喻概念的相关模型。

关键词：委婉语，转喻概念，转喻概念块，隐喻概念，概念重点。

**Abstract.** *The article proposes an algorithm for reconstructing the conceptual foundations of the semantics of euphemisms belonging to modern “politically correct” areas. It is shown that the most active are the clusters of metonymic concepts (conceptual metonyms). At the same time, the relatively high productivity of metaphorical concepts (conceptual metaphors) allows us to describe the correlation models of metonymic and metaphorical concepts by highlighting common conceptual foci.*

**Keywords:** *euphemism, metonymic concept, metonymic concept cluster, metaphorical concept, conceptual focus.*

In recent decades, there has been a real research boom in the field of euphemism and euphemization in both foreign and Russian linguistics. The relentless interest of scientists in various aspects of the indirect name can be explained by the high culturological capacity of euphemistic units, their significant pragmatic potential, and a wide scope of their application. Each work that appears in this area once again proves that euphemism is a language universal that in each concrete linguistic and cultural community reveals its identity, its vivid features, due to the specifics of the conceptual worldview of a particular society.

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One of the least studied areas of euphemistic nomination to date remains the sphere of commercial activity of enterprises and banks, which directly intersects with advertising discourse. The difficulties in studying and describing this layer of euphemistic and politically correct vocabulary are caused by the heterogeneity of commercial practices and standards of enterprises representing different types of commercial, banking and production activities, the specific advertising tactics that they apply, and various public relations strategies. Despite the presence of a number of works in which attempts were made to describe the euphemistic units used in the commercial practice of the English-speaking language community (eg, [Potapova 2009], [Pestova, Kagileva 2013]), the principles of distinguishing and describing the conceptual aspect of their semantics remain undeveloped.

In the present study, our focus was on about 300 lexical and phraseological units, possessing emollient and/or camouflage potential, allowing them to be used as a more acceptable alternative instead of direct names of various aspects of commercial practice.

According to the results of the study, it can be argued that the meaning of most euphemistic units belonging to the study area is based on metonymic and metaphorical concepts (conceptual metonyms and metaphors), the action of which is fairly regular, which allows us to talk about constant metaphorical and metonymic models.

The analysis confirmed our hypothesis about the crucial role of metonymic concepts in constructing the semantics of euphemisms that appear in modern areas related to the operation of the laws of political correctness [Porokhnitskaya, Teplyakova, 2019]. Conceptual metonymy, which is a representation of some part of a concept by appealing to the whole concept (or its other part) or, on the contrary, representation of the whole concept through one of its elements, is the leading conceptual mechanism for the formation of semantics of euphemistic and politically correct units in modern taboo areas. We believe that in such areas, which in many cases belong to institutional discourse, the semantics of most euphemistic units are modeled on the basis of a concept (configuration of concepts), which are part of one of the leading metonymic clusters (cluster of generalized concepts, cluster of anthropomorphic concepts, cluster “deviation from the norm”, the “change” cluster (“normalization”), the cluster of location metonyms, the cluster of structural metonyms, the cluster of “time” metonyms).

According to the results of the analysis, we can speak of a particularly high activity of the concepts of the “**deviation from the norm**” cluster (e.g. *challenging* disadvantageous, unfavorable, *controversial* unreliable, dubious (reputation)), “**normalization**” cluster (*adjustment* price hike, *correction* significant reduction in value (securities)), **cluster of anthropomorphic concepts** (*consultant* seller of goods (often at home), *assistant* secretary) and **cluster of generalized concepts**

(*arrangement* unlawful agreement, *product* service (in the financial and banking sectors)).

It should be noted that the implementation of metonymic concepts in the structure of these clusters when modeling the semantics of euphemisms of the described sphere reveals some specificity in comparison with other “politically correct” areas, in particular with the field of “Crime and Punishment” [Porokhnitskaya, Teplyakova, 2019]. First of all, we are talking about the content of the “deviation from the norm” cluster, in which the concepts that form a separate “**deviation in the positive direction**” subcluster are called upon to actualize the idea of extremely favorable conditions for the client that are not provided in the usual situation. Compare, for example, *easy* (eg., in word combination *easy terms*), *exclusive*, *free*, *complimentary*, *direct*.

Another important feature of the implementation of conceptual metonymy within the analyzed area is the high productivity of concepts designed to represent completely or partially opposing subconcepts that are part of the analyzed concept (e.g., *service* (*service station* in expression self-service center), *improvement* deterioration in customer service or product quality, *long-term* (*buy*) unsuccessful investment, etc.). Generalized metonymic concepts in many cases make it possible to highlight ideas that mislead company clients. So, in the first example, it is not immediately obvious to the driver that he will have to service his car himself (in the case of special personnel, there should be a sign *attended service*). The consumer of a certain product or service will certainly be attracted by a message about a certain improvement in service, conditions, etc., although in most cases it is exclusively about improving the company's profitability. This type of metonymic polarization is likely to manifest itself to many modern spheres of euphemization.

Clusters of **time**, **location**, and **structural** metonyms should be recognized as less productive in the analyzed area, and yet they participate in the representation of ideas that are important for commercial and banking practice. They are employed to name the use by banks of clients' funds after the official termination of transactions on Friday (*to weekend*), concealing inferior goods below those of higher quality (*to top up*), establishing net profit (*bottom line*).

In the structure of the **time** cluster, the PRECEDENCE concept should be separately noted, which, as a central composition element, enables us to represent the idea of a used car as a vehicle that was previously owned by other people (*pre-owned*, *previously owned*), which shifts the emphasis from the negative aspect of the inevitable deterioration of the vehicle (cf. *used*).

Within the **framework** of the structural metonymy cluster, the CONTAINER concept is notable for its significant productivity, which is involved, in particular, in constructing the idea of product packaging (*slack fill* packaging, which visually increases the volume of goods). It is especially important to note the conceptual

component SIZE, which models the euphemistic vision of small packages that are positioned as larger packages (e.g. *medium*).

Another active concept in this cluster is the ELEMENT REPOSITIONING, which is involved, for example, in constructing the concept of misleading financial reporting (*restructured*).

The role of **location** metonyms is noticeable mainly in the context of representing the perception ordinary employees of any enterprise have of their management (*top floor, upstairs*).

One of the most important features of the analyzed area according to the results of the study is the high productivity of metaphorical concepts, the effect of which is more characteristic of traditional euphemia (death, intoxication, etc.). This fact, in our opinion, is due to the historical connection of the analyzed area with the classic tabooed sphere of “lies, deceit”.

Conceptual metaphors (metaphorical concepts) involved in the construction of a euphemistic vision of commercial and banking tactics in English-speaking society are very diverse and represent the main metaphorical clusters, which are also active in traditional euphemistic areas.

Most metaphorical concepts are components of two global metaphorical domains – LIFE AND ACTIVITY.

The LIFE domain is less productive than ACTIVITY and yet it is responsible for the conceptualization of the euphemistic vision of commercial practices in terms of DISEASE (eg, *blind copy* document, a copy of which is transmitted to a third party, without notifying the main participants, *to catch a cold* incur losses) and violent DEATH (e.g. *category killer* a shop selling goods at a lower price).

In the structure of the ACTIVITY domain, the majority of metaphorical concepts are characterized by a high degree of productivity and enable us to represent various aspects of commercial practice through the prism of everyday pastime: ART (e.g. *concert party* joint acquisition of shares under different names), SOCIAL (PERSONAL) RELATIONS (e.g. *sweetheart* illegal agreement between two parties to the detriment of a third party), HUNTING (e.g. *turkey shoot* Am. Eng. bargain), CRAFTS (*to churn* to make unnecessary efforts in relation to the client's securities in order to receive extra commission, lit. "beat milk to get butter or cream"; *haircut* big financial losses), TRAVEL (*to go south* go into decline, lose in price). According to the results of the study within the conceptual domain ACTIVITY, SPORTS and MILITARY ACTIONS should be recognized as most productive metaphorical concepts (e.g. *front-running* illegal actions of insiders when concluding transactions, *ping-ponging* transfer of a rich client from one specialist to another, *cross-firing* credit fraud associated with the creation of fictitious companies; *dawn raid* unexpected purchase of a large stake).

One more feature of the implementation of metaphorical representations with-

in the analyzed area is the euphemistic representation of one type of commercial practice through another (e.g., *to kick the tires* study the subject superficially, lit. "to kick tires when buying a new car"; *bucket shop* a company speculating on the market).

Speaking about the role of anthropomorphic metaphorical concepts in the euphemization of commercial and banking practices, it is important to note PERSONIFICATION as one of the leading conceptual mechanisms for the formation of semantics of euphemistic units of the analyzed thematic group. Representation of a particular practice or product through a metaphorical prism of a person with inherent qualities enables us in many cases to highlight the most attractive aspects of the services provided, shifting the emphasis from their shortcomings. Compare the following examples: *confident pricing* (over pricing), *experienced* (used (about a car)).

Another important metaphorical cluster that plays a critical part in constructing a euphemistic vision of various aspects of commercial activity is NATURAL PHENOMENA (WATER (*under water* sustaining losses), AIR (*to pull out of the air* make up) figures, statistics)), FIRE (HIGH TEMPERATURE) (*hot* obtained illegally)). In some cases, metaphorical concepts associated with natural elements are part of complex metaphorical concepts as one of the key elements (e.g., *boiler room* company engaged in the illegal sale of securities; concept HIGH TEMPERATURE; *to freeze out* crowding out minority shareholders by illegal means; concept LOW TEMPERATURE; *to tap* get a profitable loan (financing); WATER + MECHANISM, *crumbling edge* inevitable fall; EARTH). Upon closer examination, it turns out that in many cases the concepts of the subcluster NATURAL ELEMENTS play the role of the leading composition element in the structure of a complex metaphorical image, that helps to determine its focus (cf.: *high* degree of activity, *getting rid of smth.*, *large* cash flow, *downward* movement).

A subcluster of **zoomorphic** metaphors adjoins the cluster of NATURAL PHENOMENA, which, within the framework of the analyzed area, exhibits a rather high activity. Within the framework of this cluster, one can note the concept of a CAT (*dead-cat bounce* temporary increase in the value of a security, *fat cat* a wealthy businessman; a person who lives on his investment interest) and BIRDS (*feather your nest* to provide for oneself at the expense of other people, *lame duck* unsuccessful enterprise).

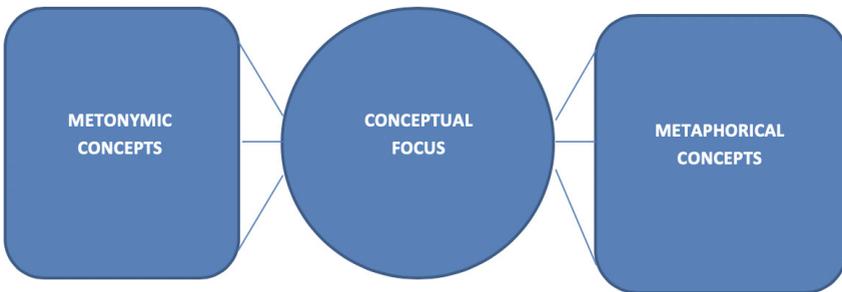
As shown above, the conceptual foundations of the semantics of euphemistic units in many cases are complex metaphorical images, which include, in addition to the concepts noted earlier, elementary (basic) concepts (CONTAINER, MOVEMENT, etc.), the correlation of which creates a multi-faceted metaphorical image. When conducting a conceptual analysis of euphemistic units, special attention should be paid to such composition elements, which, as a rule, indicate the conceptual focus of the whole image. Our study found that CONNECTION and

BLEND should be recognized as the core elementary concepts of the analyzed sphere.

The mentioned concepts are implemented through several pairs of opposition subconcepts: CONNECTION (*to link prices* to form an illegal cartel) vs ABSENCE OF CONNECTION (*parallel pricing* price agreement); HOMOGENEITY (*to smooth* conceal (for example, fluctuations on the market)) VS HETEROGENEITY (*uneven* bad (for example, a situation on the market)).

A careful study of the small structural elements of metaphorical and metonymic concepts that underlie the semantics of euphemism, in many cases enables us to reconstruct the vertex idea of the image or, in other words, its conceptual focus, which gives the key to understanding the implication of the whole image, semantics and pragmatics of the euphemistic unit, degree of its euphemistic potential.

The analysis of a large array of lexical and phraseological units used to mask and mitigate the undesirable aspects of business practices in the English-speaking community has demonstrated that a number of metaphorical and metonymic concepts that underlie the semantics of euphemisms in this area have common conceptual foci (see Fig. 1)



*Figure 1.*

Among the most systemic focus models implemented within the analyzed area, we should single out: **connection** (e.g. *concert party*, *association cartel*), **concealment** (e.g. *to snow*, *to top up*), **decrease** (*haircut*, *product shrinkage* delivery of a smaller volume of goods at the previous price (due to the confusion caused by metrication)), **relief** (*(banking) facility lending*, *turkey shoot*).

In conclusion, it should be emphasized once again that the analyzed area, occupying an intermediate position between traditional and modern “politically correct” euphemia, provides fertile material for analyzing the correlation of conceptual mechanisms of different types and models of conceptual focusing.

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谓语实用标记在Ch的句子中起作用。狄更斯角色反驳

## PREDICATIVE PRAGMATIC MARKERS FUNCTIONING IN THE SENTENCES OF CH. DICKENS CHARACTERS RETORTS

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抽象。这篇文章涉及务实的标记，例如我求求，我想知道，我希望，我相信。查尔斯·狄更斯 (Charles Dickens) 著名著作“巴纳比·拉奇 (Barnaby Rudge)”、“困难时期” (Hard Times)，“圣诞节颂歌” (Christmas Carol) 的对话中的句子正在分析中。显示了作者选择标记的方法，以及标记在不同交际类型的句子中的排列方式。讨论了将标记放入对话的反驳中的一些样式方法。

关键词：语用标记，话语标记，谓语标记，作风

**Abstract.** *The article deals with pragmatic markers like I beg, I wonder, I say, I hope, I believe. The sentences from the dialogues of Charles Dickens's well-known texts "Barnaby Rudge", "Hard Times", "Christmas Carol" are under analysis. The author's approach to the choosing of markers, their arrangement in the sentences of different communicative types is shown. Some stylistic devices of placing the markers into the retorts of the dialogues are discussed.*

**Keywords:** *pragmatic markers, discourse markers, predicative markers, authorial style*

Modern speech can hardly be imagined without the use of pragmatic markers. Many works have been devoted to the study of their synchrony and diachrony in different languages, including the works of K. D. Zaydes, E. A. Gorlo, Yu. V. Matyukhina, L. Ts. Sangeeva, G. R. Vlasyan, B. Fraser, AH Jucker, U. Lenk, S. Muller, L. Schourup, EC Traugott et al. This article discusses predicative pragmatic markers from XIX century literary texts.

As is known, the study of the historical functioning of linguistic phenomena has its own specifics, in particular, related to the nature of linguistic material, primarily the lack of sources of "live" speech. In order to get an idea of the predicative pragmatic markers used in the 1840-1850s, we studied their diversity in lines of character dialogues of the works of Charles Dickens published in 1841-1854, based on the assumption that the texts of the famous classic writer of the Victo-

rian period, thanks to the wealth and the variety of language forms, the accuracy of the details of the description of everyday scenes, the colorfulness of the transmission of speech features of contemporaries, can serve as a source of language material for the study of structures that were used during the writing of the work. The material for the analysis was the suggestions from the lines of the characters of the novels “Hard Times” and “Barnaby Rudge” and the novel “A Christmas Carol in Prose”. Sentences of different communicative type and complexity were selected as objects of study, containing modal-predicative combinations *I think, I hope, I believe, I am sure*, etc. as clauses. The lexical and grammatical characteristics of markers, their position and role in the sentence were studied, their combination with unpredictable pragmatic markers, ways of representing lines with studied sentences. The results of the study are as follows.

Predictive pragmatic markers are embedded by the author in sentences of different communicative types. So, to the imperative sentences built by the verb in the imperative mood, structures are added based on the verbs *beseech* and *beg*: *Ask your own, I beseech you.* (“Barnaby Rudge”, p. 220); *Keep it at ease, I beg of you.* (ibid, p. 226); *Don't apologise, sir, I beg.* (ibid, p. 195). The meanings that these verbs have - are “ask,” “plead, pray,” for *beg* [1, p. 170] and “plead, pray, ask, beg,” for *beseech* [1, p. 177], add an emotive component to the expression of an order, request or urgent advice. On the one hand, it demonstrates the emotional state of the speaker, on the other hand, it serves as an additional means of inducing the listener to perform the proposed action.

Markers are also included in various types of interrogative sentences. So, the following sentence, which is a general question with inversion, *Is it possible, I wonder, that there was any analogy between the case of the Coketown population and the case of the little Gradgrinds?* (“Hard Times” p. 30), contains a combination *I wonder*. This combination with the verb. *wonder*, meaning “to be interested, want to know, question” [2, p. 853], is located after the main sentence, and, most likely, its main purpose is to attract the attention of the reader or listener to the word *possible*.

The special question includes markers formed by the verbs *say* and *ask*: *When was Simmuns here, I say?* (“Barnaby Rudge”, p. 551); *What do you mean, I ask again?* (ibid., p. 19); *I ask you, what do you mean by this, Mrs Sparsit, ma'am?* (“Hard Times”, p. 251). Like the combination *I wonder*, markers *I say, I ask again, I ask you* are performativities. Embedding them in a sentence gives the question a shade of perseverance, demonstrates the speaker's firm intention to obtain the necessary information.

A general question without inversion, or declarative, is known to be characterized by the fact that when it is used, the speaker expresses a slightly greater confidence in receiving a positive answer than when using a general question with

inversion. In a declarative question containing a marker, this confidence becomes somewhat "veiled": *You are thirsty, I suppose?* ("Barnaby Rudge", p. 187); *If I was to stop half a crown for it, you'd think yourself ill used, I'll be bound?* ("A Christmas Carol", p. 62).

The greatest variety of predictive pragmatic markers is observed in constructions of the narrative type.

Forming the main sentence, the considered predicative combinations can contain as a clause one clause, as in the examples *I believe I shall enlist in your regiment tonight.* ("Barnaby Rudge", 247); *I should hope you want no other invitation.* ("Hard Times", p. 200).

In a sentence containing a marker as the main clause, there may be several subordinate clause in parallel or sequential subordination. Sequential subordination can be observed in the example. *I think it must have been to you that he made that promise.* ("Hard Times", p. 156), parallel subordination - in the example *I know he had wanted money very much, and had spent a great deal.* (ibid., p. 267).

Functioning as an introductory sentence, the marker can refer to the whole clause or to its part, delimiting the syntagma.

The proposal accepting the marker is characterized by varying degrees of complexity and the location of the marker depends on the author's intention to direct the reader's attention to a particular clause, which may be the only one, as in the example *He's dead long ago, I hope.* ("Barnaby Rudge", p. 308).

If a marker is embedded in a complex sentence, then it can relate to the main sentence, placed between it and the subordinate clause, in which case it is called upon to highlight the entire prediction, as in the example *You will think, I know, I labour under some delusion* ("Barnaby Rudge", p. 332), or a specific word, such as the word *new* in a sentence *That's something new, I am sure, when anybody wants to hear of me.* ("Hard Times", p. 193), and also, undoubtedly, performs a number of other functions, in particular, demonstrating, respectively, confidence or surprise.

The marker forms the final structure if the main sentence is after the subordinate clause: *And when you have made it, you can keep it too, I should think.* ("Hard Times", p. 35). In this example, the combination *I should think* is designed to focus the listener on the fact that permission has been given to him.

Being placed after the relative clause in the formation *We knew pretty well that we were helping ourselves before we met here, I believe.* ("A Christmas Carol", p. 108), marker draws attention primarily to the combination *we met here*, that is, to the fact that several people met in one place without prior agreement, and helps to demonstrate the speaker's amazement and certain embarrassment.

Integrating into a complex sentence, the marker can be located after any of the clauses and performs the same functions as in the complex one. So, in the sentence

*She appointed to see you here tonight, I know, but found it inconvenient, and couldn't wait.* (“Barnaby Rudge”, p. 212) the most significant is the word *tonight*, and in the sentence *The night is waning fast, and it is precious time to me, I know.* (“A Christmas Carol”, p. 104) – combination *precious time to me*.

Placed inside a sentence, near a certain part of it, a marker also helps highlight certain words or combinations. If it is impossible to hear the speaker “live”, such structuredness helps to imagine how the line was pronounced. So, for example, in sentences *There will be no need, I hope, for us to meet again.* (“Barnaby Rudge”, p. 104); *But Louisa saw her, I have no doubt, in Mrs Gradgrind's presence.* (Hard Times p. 25); *Mrs Bounderby, though a graceless person, of the world worldly, I feel the utmost interest, I assure you, in what you tell me.* (“Hard Times”, p. 168) markers delimit syntagmas, further highlighting combinations *no need, saw her, the utmost interest*, respectively. Particular emphasis in actualization of the sentence *That, I believe, is agreed on all hands.* (“Hard Times”, p. 42) of the subject pronoun *that*, allows us to understand the thematic and rheumatic parts of this sentence.

Some sentences include several pragmatic markers, both predicative and non-predicative.

Predicative markers, being in the same sentence, can be located close to each other. This is observed if the marker draws the end of one clause and the beginning of the second, for example, *There an't such a rusty bit of metal in the place as its own hinges, I believe; and I'm sure there's no such old bones here as mine.* (“A Christmas Carol”, p. 107). We also met a sentence with two predicative markers centered at the beginning of the sentence and located one after the other – *It appears to me, ma'am, I say, that a different sort of establishment altogether, would bring out a lady of your powers.* (“Hard Times”, p. 285), the purpose of this marker placement may be to further attract the attention of the reader or listener to what the sentence will discuss.

Markers can also be spread, forming the final of each of the components of the proposal by the clause: *You'll make your fortune, I hope, and none of our poor folkth will ever trouble you, I'll pound it.* (“Hard Times”, p. 45); *You have your opinion, I dare say; and I have mine, I know.* (“Hard Times”, p. 232), or forming more complex structures like *'I was only going to say,' said Scrooge's nephew, 'that the consequence of his taking a dislike to us, and not making merry with us, is, as I think, that he loses some pleasant moments, which could do him no harm.'* (“A Christmas Carol”, p. 99). You can see that different markers are usually used in the same sentence.

The combinations of predicative and non-predicative markers in one sentence are diverse. So in the example *Well, and now you are surprised to be sure, and with reason, I must say.* (“Hard Times”, p. 209) non-predicative markers are grouped at the beginning of a sentence, and its ending is formed by a predicative combination.

Formation ***I confess, however, that the misgiving has crossed me on my way home.*** (“Hard Times”, p. 25) begins with two markers, followed by a non-predicative marker. In a sentence ***Nevertheless, I may be allowed, I hope, to congratulate you – which I do with all my soul, I assure you – on your not having sustained a greater loss.*** (“Hard Times”, p. 176) we can see at least three marker sentences spaced in the “space”, one of which, non-predictive *nevertheless*, is at the beginning of the construction, and two predicative, *I hope* and *I assure you* are separated by syntagms.

A marker formed by the same verb can draw up an interrogative without inversion and a narrative sentence: ***You don't mean to say their old wearers are all dead, I hope?*** (“Barnaby Rudge”, p. 313); ***That's plain speaking, I hope.*** (“Hard Times”, p. 235). Moreover, the pragmatic type of marker, in accordance with the typology of B. Fraser [3], can be different, for example, performative, as in the sentence ***'Don't tell me we won't, man', said Mr Bounderby, by this time blowing a hurricane, 'because we will, I tell you!'*** (“Hard Times”, p. 148), and an information source marker, as in ***The lady is quite a philosopher, I am told?*** (ibid., p. 122).

If a marker is used as an introductory sentence, it is usually separated by a comma, as can be seen in the above examples. The separation of the marker by the author's comment is a specific technique for attracting the reader's attention to the part of the sentence containing the marker. In the case of such design, the marker is usually located at the beginning of the line and is separated from the receiving proposal along with the appeal or interjection. Moreover, a comment can contain only the subject (the name of the speaker or interjection) and the predicate (usually the verb of speaking), as in the examples ***'I believe, sir,' quoth Mrs Sparsit, 'you wished to see me.'*** (“Hard Times”, p. 120), ***'He has given us plenty of merriment, I am sure,' said Fred, "and it would be ungrateful not to drink his health."*** (“A Christmas Carol”, p. 101). It is also possible to expand this part of the line by using additional measures - circumstances of the course of action or related circumstances: ***'I hope, Bounderby', said Mr. Gradgrind, in a conciliatory voice, 'that this was merely an oversight.'*** (“Hard Times”, p. 51); ***'Ay! I mean', said Mr Childers, with a nod, 'that he has cut.'*** (ibid., p. 36). A character's line may contain a marker, but it not be separated by the author's words: ***'Just wait a bit,' retorted Bounderby, 'you have said your say, I believe.'*** (ibid., p. 235). Such structuring of lines is undoubtedly connected with the thematic division of the sentence, and is also directly related to the speed of the speaker speaking a certain section of the text.

In the studied texts, we came across combinations that have a stable composition "pronoun + verb" – *I believe, I trust, I suppose, I know, I mean, I know, I consider, I confess, I apprehend, I wonder*. Markers based on the verbs *be* and *have* are also stable – *I am sure, I'll pound it, I'll be bound, I have no doubt*, as well as verb-based combinations, for example, *beseech*, valency properties of which require formulation – *I beseech you*. Combinations with verbs *hope, assure, think, say, tell, beg, ask*

have a variable composition and form varieties in different ways. So, a combination with *hope* may or may not include a modal verb *I hope, I should hope*; the verb *assure* needs to be supplemented and, in addition, can be “strengthened” by an auxiliary *do: I assure you, I do assure you*; variety combined with a verb *think* is introduced by modal verb *should* and conjunction *as: I think, I should think, as I think*; the verb *say* performs various functions in clauses — the predicate, its parts, additions: *I say, I dare say, I must say, I was only going to say*; the verb *tell* changes the mood category: *I tell you, I am told*; the verb *ask* accepts addition and circumstance – *I ask you, I ask again*, and the verb *beg* – addition: *I beg, I beg of you*.

Sometimes the author manages to show the speech characteristics of the characters, giving specificity precisely to markers, as *I do assure you* and *I conthider* in examples *I were not up to ‘t myseln, sir; I do assure yo*. (“Hard Times”, p. 208) and (...) *but I conthider that I lay down the philothophy of the thubject when I thay to you, Thquire, make the betht of uth: not the wurtht!* (ibid., p. 45)

Some markers, due to the lexical composition, are tied to the receiving sentence of a certain communicative type. So, *I beg, I beseech you* are most characteristic of the imperative, and *I ask, I wonder* – for an interrogative sentence. A number of markers draws up both a narrative sentence and a general question without inversion (declarative). Such, for example, are *I suppose, I think, I trust, I know, I believe, I mean*.

Pragmatic marker is placed in the receiving sentence in two ways - the marker is the main or introductory clause, while the latter can relate to the main or subordinate clause or delimit the syntagma in their composition. Moreover, the same combination is often used as both the main and introductory sentences, as *I trust* in examples *The hopes I have been encouraged to form that you come from that lady, do not deceive me, I trust*. (“Hard Times”, p. 224) and *I trust it is my good fortune to produce a person you have much desired to find*. (ibid., p. 251).

One of the techniques for designing a hero’s line in a text is breaking it up with commenting words of the author, while the marker is in the detachable part and then the reader focuses on it, or is at the end of the structure, is distant from the author’s comment.

The author also uses the technique of combining several predicative pragmatic structures in one sentence; cases of combining predicative and non-predicative markers are not uncommon. All this allows us to give the sentence as part of the hero’s remarks “liveliness”, similarity with real colloquial speech. Having markers in sentences of different communicative types and varying complexity, the author uses the structures that exist in the speech of his contemporaries, “surround” him in everyday life. Therefore, based on the varieties used by C. Dickens, one can get an idea of the variety of predicative pragmatic markers found in speech in the middle of the XIX century.

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SOCS蛋白在失衡代谢过程中的作用  
**THE ROLE OF SOCS PROTEINS IN IMBALANCE METABOLIC  
PROCESS**

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抽象。该研究讨论了人体多余脂肪组织与免疫应答系统变化之间的关系，包括蛋白质的参与-细胞因子信号转导抑制剂（SOCS）在人体免疫应答中的参与。该研究的目的是表征SOCS蛋白在代谢过程失衡中的作用。患者中的酶免疫法测定了SOCS蛋白1、3、6的浓度。比较了肥胖（24位患有I，II，III级肥胖的进行性肥胖者）和健康个体（15位）的受试者的SOCS-蛋白质指数。研究发现，在大多数超重患者中，SOCS 3蛋白值显著低于健康个体，在某种程度上，SOCS 1和SOCS6蛋白含量增加，这表明有肥胖倾向。确定了体内过多的脂肪组织与可能是特定患者体内免疫变化的病因的疾病之间的相互关系；在病史中，发现SOCS 1蛋白含量降低与肝病形式的肝病的存在之间存在相关性，以及SOCS 3蛋白水平升高与过敏反应的存在之间存在相关性。SOCS蛋白参与人体免疫反应的进一步研究可能对诊断和治疗肥胖，糖尿病，肝脂肪变性，过敏和其他疾病的新治疗方法很有希望。

关键词：细胞因子信号抑制因子SOCS蛋白，免疫代谢，脂肪生成，酶免疫测定。

**Abstract.** *The study discusses the relationship of excess adipose tissue in the body with changes in the immune response system, including the participation of proteins - suppressors of cytokine signaling (SOCS) in the body's immune response. The aim of the study was to characterize the role of SOCS proteins in the imbalance of metabolic processes. The enzyme immunoassay in patients determined the concentration of SOCS proteins 1,3,6. The SOCS - protein indices were compared in subjects who were obese (24 people with progressive forms of obesity I, II, III degree) and healthy individuals (15 people). The study found*

*that in most overweight patients, the SOCS 3 protein value is significantly lower than in healthy individuals, in some part there was an increased content of SOCS 1 and SOCS6 proteins, which indicates a tendency to obesity. The interrelation between the excess amount of adipose tissue in the body and diseases that can be a causal factor of immune changes in the body in a particular patient is determined; a correlation was found between a lowered content of SOCS 1 protein and the presence of liver lesions in the form of hepatosis, as well as a correlation between an elevated level of SOCS 3 protein and the presence of allergic reactions in medical history. Further studies of the participation of SOCS proteins in the body's immune response may be promising for the diagnosis and new therapeutic approaches to the treatment of obesity, diabetes mellitus, liver steatosis, allergies and other diseases.*

**Keywords:** *suppressors of cytokine signaling SOCS proteins, immunometabolism, adipogenesis, enzyme immunoassay.*

### **Introduction**

In recent years, ideas about the role of adipocytes in metabolism have changed. Adipocytes are key cells that control nutrient availability, lipid accumulation, energy homeostasis, and insulin sensitivity. Adipose tissue is populated by immune cells, and in obese people it is in a state of chronic inflammation [4,6,7,11]. In overweight people, the total number of adipose tissue T cells increases with the predominance of Th1 over Treg. The ratio correlates with body mass index (BMI) and varies from 6:1 in thin to 12:1 in obese individuals [2,3,5].

Currently, Russian and foreign scientists are studying the relationship of excess body fat in the body with changes in the immune response system, including the participation of SOCS proteins in the body's immune response. According to some scientists, suppressors of the signaling protein family, cytokines (SOCS), are probably modulators of various diseases associated with, among other things, autoimmune pathology, inflammation, allergies, bacterial infections, carcinogenesis, etc. [2,8]. The aim of the study was to characterize the role of SOCS proteins in the imbalance of metabolic processes.

### **Materials and methods**

The SOCS - protein indices were compared in subjects who were obese (24 people with progressive forms of obesity I, II, III degree) and healthy individuals (15 people). The average age of patients was  $40 \pm 10$  years. Body mass index was determined according to the Kettle formula:

$$I = m / h^2, \quad (1)$$

where I - body mass index; m-weight in kg; h - growth in meters

The exclusion criteria from the study were: patients aged less than 18 and over 65 years old, concomitant somatic diseases in the stage of exacerbation or decom-

pensation, the presence of acute respiratory infections at the time of the study, pregnancy, diabetes mellitus, severe sepsis, immunosuppression due to neoplasms or HIV infection, active viral hepatitis, patient refusal from the study. A complex of immunological and general clinical research methods was used in the work. The concentration of SOCS 1,3,6 proteins was determined by enzyme-linked immunosorbent assay using Elisa Kit test systems manufactured by Cusabio Biotech. Statistical processing of the results was carried out using the Microsoft Excel XP software package. The volume of studies performed and the use of appropriate statistical methods allowed us to evaluate the results with reliability and critical significance level  $p < 0.05$ . Data are presented as the absolute number (%) of patients or medians, 0 and 4 quartiles [M; Q0, Q4]. The study was conducted after obtaining informed consent from each patient; performed in accordance with the standards of clinical practice (Gold Clinical Practice) and the principles of the Helsinki Declaration. The study design was approved by the ethics committee of the FSBEI HE "Orel State University named after I.S. Turgenev".

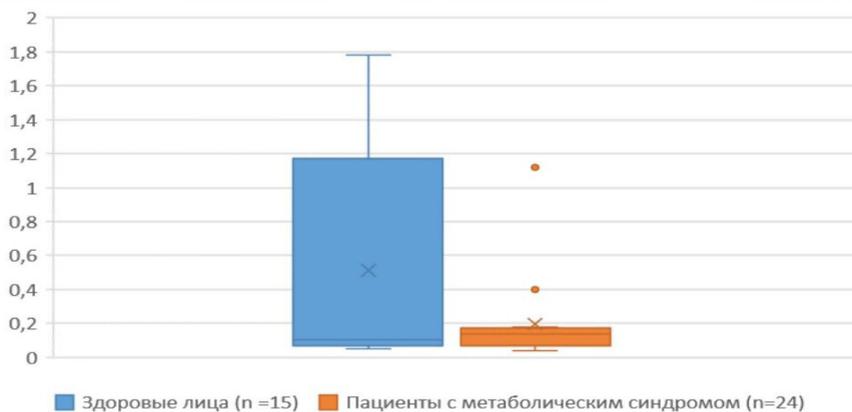
### Results and discussion

According to the current distribution, the presence of obesity of the first degree (BMI 30-35) was recorded in the majority of the studied (62, 5%), in one third of the patients 2nd degree of obesity (BMI -35-40) (29.17%) was found, 3rd - degree (BMI over 40) was present in 8.4% of the subjects. When analyzing anthropometric data, average growth indices of  $170 \pm 15$  cm and weights of  $95 \pm 15$  kg were recorded, respectively.

All examined obese patients underwent general clinical laboratory tests (general blood count, general urinalysis, biochemical blood test, including determination of transaminases, total protein, bilirubin, total cholesterol). According to laboratory results, 8.33% of patients showed accelerated ESR and eosinophilia; 8.33% leukocyturia, an increase in total cholesterol was detected in 12.5%, increased bilirubin in 16.67%. Patients underwent instrumental studies: EGD with determination of the level of *Helicobacter pylori*, ultrasound of the abdominal organs. Instrumental examinations in 45.83% of patients revealed hepatosis and diffuse changes in the pancreas; 41.67% have chronic gastritis, 25% have chronic gastritis associated with *Helicobacter pylori* infection. In all subjects allergic history was examined. The presence of allergic reactions was confirmed by 45.83% of the studied obese.

The concentration of SOCS1,3,6 proteins in patients was determined by the method of enzyme immunoassay in blood serum. As the results of studies showed, in patients with metabolic syndrome a wide variability of the concentration of SOCS proteins of 1,3,6 was established. Studies of scientists [15] using SOCS1-deficient mice have shown that endogenous SOCS1 is crucial for the prevention of liver diseases. It was found that in mice with SOCS1 deficiency, the main cause of

death is hepatic inflammation, accompanied by fatty degeneration and hepatocyte necrosis. The concentration of SOCS 1 protein in blood serum in obese patients and in a group of healthy individuals is shown in Figure 1.



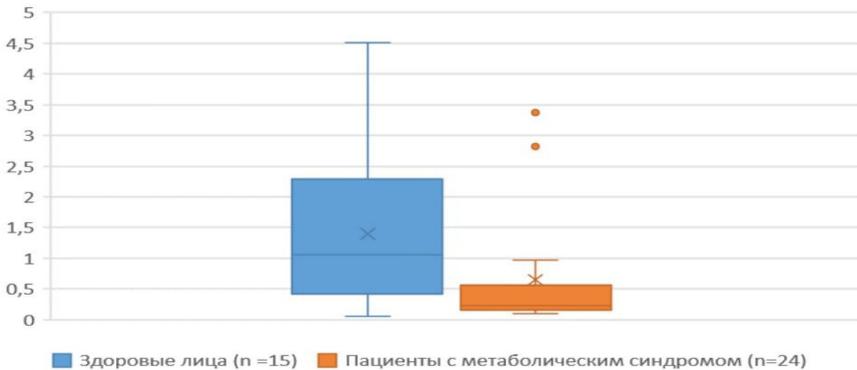
**Figure 1** – Concentration of SOCS 1 protein in blood serum

As can be seen from the figure, the concentration level of SOCS 1 protein was 0.16 [0.04; 1.12], which is significantly lower than in healthy individuals 0.58 [0.05; 1.78],  $p < 0.05$ . According to the works of several authors [13,15], a decrease in SOCS 1 correlates with an increased risk of liver diseases (hepatitis, cirrhosis, fatty degeneration); intestines (colitis), which is combined with the presence of hepatosis and diffuse changes in the pancreas in the examined patients (45.83%).

Domestic scientists [1] revealed a decrease in the level of expression of the SOCS1 gene transcription regulator in allergic bronchial asthma compared with a group of practically healthy individuals, regardless of the phase and severity of the disease. According to our studies, a history of allergic reactions was present in almost half of patients (45.83%). On the contrary, it was shown [15] that excessive induction of SOCS1 by TLR ligands and cytokines contributes to a change in insulin sensitivity in the metabolic syndrome. In 8.3% of patients with overweight, the SOCS 1 indicator is higher than average, which, according to the literature [13,15], may indicate a tendency to alimentary obesity; increased risk of type 2 diabetes.

SOCS3 proteins regulate cytokine or hormonal signaling, as a rule, preventing, but in some cases exacerbating the course of various diseases. The main role of SOCS3 is due to its binding to both JAK kinase and the cytokine receptor, which leads to inhibition of STAT3 activation. Available data [4] show that SOCS3 regulates signal transduction via other STATs (in addition to STAT3), as well as moni-

tors cell pathways unrelated to STAT activation. The works of several authors [2,4,9,14] found that the loss of SOCS3 in vivo has a strong effect on weight gain due to obesity and insulin sensitivity. In this regard, our studies are of interest, as a result of which it was established (Figure 2) that the average value of SOCS 3 was 0.61 [0.09; 3.37], which is significantly lower than 1.39 for healthy individuals [0.05; 4.51],  $p < 0.05$ .

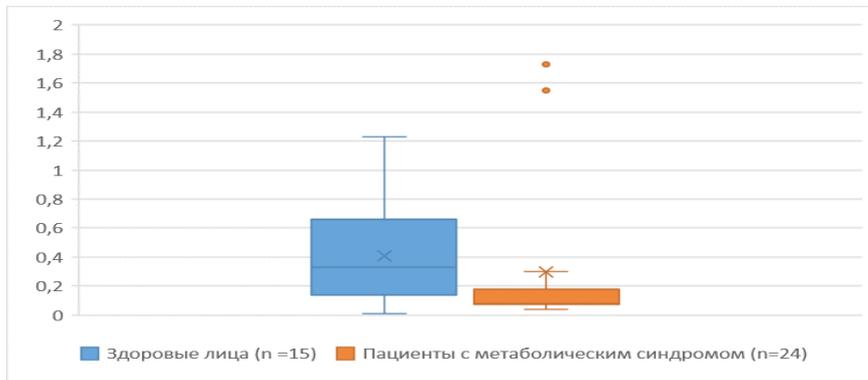


**Figure 2 – Serum SOCS 3 protein concentration**

In addition, it should be noted that SOCS3 protein was increased in blood serum in 12.5% of individuals, which was combined with the presence of allergic diseases in the examined patients and is consistent with the literature. According to studies by a number of scientists [12,15], an increase in SOCS 3 may indicate a predisposition to inflammatory bowel diseases (Crohn’s disease, ulcerative colitis); increased risk of asthma, atopic dermatitis, psoriasis, allergies. According to some authors, a decrease in SOCS 3 expression in CD4 + cells can be effective in preventing the development of allergic asthma [4,12].

The concentration of SOCS 6 protein in blood serum in obese patients and in a group of healthy individuals is shown in Figure 3.

As can be seen from the figure, the concentration level of SOCS 6 protein was 0.3 [0.04; 1.73], which is slightly lower than in healthy individuals 0.41 [0.01; 1.23], the obtained differences in this case are not statistically significant,  $p > 0.05$ . According to the work of a number of authors [4,10], a decrease in this indicator increases the risk of developing cancer. The value of SOCS6 protein was increased in 8.33% of individuals in the blood serum, which, according to the literature [10,12], may indicate insulin resistance, as a result, an increased risk of type 2 diabetes mellitus, obesity, which is consistent with our studies.



**Figure 3** – Serum SOCS 6 protein concentration

### Conclusions

In the course of the study, it was found, that:

- SOCS proteins may play a role in transcriptional control of adipogenesis; in most overweight patients, the SOCS 3 protein value is significantly lower than in healthy individuals, in some patients there was an increased content of SOCS 1 and SOCS6 proteins, which indicates a tendency to obesity.

- the relationship between the excess amount of adipose tissue in the body and diseases that can be a causal factor of immune changes in the body in a particular patient is determined; a low SOCS 1 protein content was combined with the presence of hepatosis in the examined patients, and an elevated SOCS 3 protein level with allergic reactions.

Thus, further studies of the participation of SOCS proteins in the body's immune response may be promising for the diagnosis and new therapeutic approaches to the treatment of obesity, diabetes mellitus, liver steatosis, allergies and other diseases.

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翻修髋关节置换术的结构特点

**FEATURES OF THE STRUCTURE OF REVISION HIP  
REPLACEMENT OPERATIONS**

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抽象。全世界和俄罗斯联邦都指出，全髋关节置换术的手术数量逐年增加，不可避免地导致翻修置换术的手术数量增加。他们的会计制度还不完善，其原因，期限，审计干预的范围，预防措施也没有得到研究。这项工作的目的是研究全髋关节置换术后进行的翻修手术干预的结构。该研究基于对2015年至2019年期间对129例髋关节破坏性营养不良疾病患者进行的161次翻修假体手术的临床数据进行的单中心回顾性研究。不同地，根据执行的是哪个帐户（第一次或第二次）修订手术，研究了性别，年龄，年代，病因特征以及外科手术干预的数量。给出了所揭示差异的解释。结论是需要研究翻修手术的风险因素，以及针对个体内假体手术的个性化方法作为减少翻修手术数量的主要原则的重要性。

关键词：髋关节翻修假体，翻修假体的结构，感染并发症，无菌性不稳定。

**Abstract.** *The annual increase in the number of operations on total hip arthroplasty, noted both in the world and in the Russian Federation, inevitably leads to an increase in the number of revision arthroplasty operations. Their accounting is not well established, and the reasons, deadlines, scope of audit intervention, preventive measures have not been studied. The aim of the work was to study the structure of revision surgical interventions performed after total hip arthroplasty. The study is based on a monocenter retrospective study of clinical data on 161 revision endoprosthetics operations performed in 129 patients with destructive-dystrophic diseases of the hip joint in the period of 2015-2019. Differentially, depend-*

*ing on which account (first or second) revision operation was performed, gender, age, chronological, etiological characteristics, as well as the volume of surgical intervention were studied. The interpretation of the revealed differences is given. Conclusions are drawn about the need to study the risk factors for revision surgeries and the importance of a personalized approach to primary endoprosthetics surgeries as the primary principles for reducing the number of revision surgeries.*

**Keywords:** *revision endoprosthetics of the hip joint, structure of revision endoprosthetics, infectious complications, aseptic instability.*

### **Relevance**

Currently, operations of primary total hip arthroplasty are an effective tool in the treatment of patients with severe destructive-dystrophic diseases. The ten-year survival rate of implantable endoprostheses reaches 95-97%. However, in young people, when installing endoprostheses with metal-metal friction pairs, with complex deformations of the hip joint and severe comorbidity, the survival rate decreases to 70-80% [1]. Against the background of an annual increase in the number of primary operations, the number of patients requiring revision surgeries inevitably increases - for various reasons and at different times [2, 3, 4, 5]. In this case, the main attention is paid to the study of “early” audit operations performed in the first five years after the initial operations [1, 6].

**Purpose of the study:** to study the structure of revision surgical interventions performed after total hip arthroplasty.

### **Materials and methods**

The basis of this study was clinical observations of 129 patients who, on the basis of the orthopedics department №1 of the Samara Regional Clinical Hospital named after V.D.Seredavin, received 161 operations of revision hip arthroplasty in the period 2015-2019. One revision operation was considered one clinical observation. Prior to retrospectively studied revision surgeries, all patients underwent primary total hip arthroplasty operations in the same department.

### **Results and discussion**

During this period, the number of revision endoprosthetics was significantly less than the number of primary endoprosthetics. This amounted to 7.5% (161 operations) and 92.5% (2146 operations), respectively. It should be noted that the number of revisions was determined by quotas - money allocated by the state for these operations, which in different years was uneven. Identification of the true needs of patients in revision operations was not included in the objectives of this study.

The structure of the revised surgical interventions we analyzed was dominated by the first revisions. They amounted to 80.1% (129 operations). We conditionally called them revisions № 1. The remaining 19.9% (32 operations) were re-revisions or, conditionally, revisions №2.

**Analysis of revisions № 1. Sex.** Revisions №1 was more often performed in women - in 58.1% of clinical cases.

*Age.* A feature of revisions № 1 was that their number increased with age, but only up to 70 years, and then decreased. So, under the age of 50 years, revisions № 1 were performed in 15.5%, in the age of 50-59 years - in 20.1%, in the age of 60-69 years - in 30.2%. Then, at the age of 70-79 years, the frequency of such operations decreased to 27.9%. And at the age of more than 80 years, it amounted to only 6.3% of clinical observations. The average age of patients subjected to revisions № 1 was  $57.6 \pm 1.1$  years.

*Terms.* The number of revisions № 1 made in the first five years after the initial operations was 35.0%. Over the next five years, it decreased to 20.1%, and over a period of 10 years it increased to 44.9% of clinical observations. Thus, more than a third of all audits were performed in the "early" time - from 1 year to 5 years. Along with this, about half of all revisions were made in the "late" period - over a period of more than 10 years.

*Causes.* The leading causes of revisions № 1 in each of the three indicated time periods were infection and aseptic loosening of the implant. But, as the terms increased, their total number gradually decreased, yielding to the total number of other reasons - periprosthetic fractures, dislocations, endoprosthesis fractures, impediment, stress-shielding, osteolysis. So, in the first five years, infection and aseptic loosening in the aggregate amounted to 71.1%, and other causes - 28.9%. Over the next five years, this ratio increased slightly in the direction of other reasons, amounting to 65.4% and 34.6%, respectively. After 10 years, it shifted even more toward other causes, corresponding to 58.6% and 41.4% of clinical observations.

Of particular interest is the relationship between the frequency of the leading causes of revisions № 1 - infection and aseptic loosening. In the first five years, they were detected with a frequency of 48.9% and 22.2%, respectively, over the next five years - 30.8% and 34.6%, and after 10 years - 20.7% and 37.9% of clinical observations. Thus, as the periods after the initial endoprosthesis replacement increased, the leading positions of infection and aseptic loosening took place. Loosening, as the reason for revisions № 1, gradually began to dominate.

*Volume.* Among all revisions № 1, the volume of surgical intervention in the form of replacing only the acetabular component was predominant, amounting to 30.2%. The second place was occupied by the installation of a spacer - 24.8%. The third place belonged to the simultaneous replacement of both the acetabular and femoral components - 17.8%. Less often, only the femoral component was replaced and the modular components were replaced, respectively in 10.8% and 10.1% of clinical observations. Surgical interventions from the "other" category (debridement, removal of osteophytes) accounted for 6.3%.

**Analysis of revisions № 2.** *Sex.* These operations, unlike revisions № 1, were more often performed in men - in 53.2% of clinical observations.

*Age.* The number of revisions № 2, as well as the number of revisions № 1, increased with age, but up to 70 years. So, at the age of less than 50 years, the number of such operations was 12.5%, at the age of 50-59 years old it grew to 25.0%, and at the age of 60-69 years old it increased to 50.0%. Then, at the age of 70-79 years, it sharply decreased - up to 12.5%. And at the age of 80 years or more, revision № 2 was not performed at all. The average age of patients undergoing revision № 2 was  $63.2 \pm 1.2$  years, which was significantly higher than the average age of patients undergoing revision №1 ( $p < 0.05$ ).

Thus, the peak of revisions № 2 occurred at the age of 60-69 years. At the same time, it was significantly higher than the similar peak of revisions № 1, which amounted to 50.0% and 30.2%, respectively ( $p < 0.05$ ). Obviously, this “age shift” is due to the fact that, in a chronological plan, revisions № 2 were always performed later than revisions № 1. And for those patients who turned 80 or more years old, all revisions № 2 were performed earlier. Patients of this age group, potentially constituting a risk group for revisions № 2, simply did not live up to these operations

*Terms.* The number of revisions № 2, performed during the first five years after the operations of the primary total hip arthroplasty, amounted to 31.3%. In the next five years, it decreased to 25.0%. And in the period after 10 years it increased to 43.7%. There is a dynamics similar to revisions № 1. Noteworthy is the large number of revisions № 2 performed during the first five years after the initial operation (about one third) and in the period after 10 years (about half).

*Causes.* The leading causes of revisions № 2, as well as revisions № 1, were infection and aseptic loosening of the implant. The dynamics of their combination, as opposed to other reasons, was as follows. In the first five years after primary operations, infection and aseptic loosening together accounted for 80.0%, and other causes - 20%. Over the next five years, this ratio has changed slightly, equal to 87.5% and 12.5%, respectively. After 10 years, it has changed even more - increased towards aseptic loosening and infection, which amounted to 92.8% and 7.2% of clinical observations, respectively. Thus, in revisions № 2, in comparison with revisions № 1, the dynamics of the opposite direction was noted: over time, the proportion of infections and aseptic loosening significantly increased, and the proportion of other causes decreased.

Against this background, the dynamics of the first two most common causes individually - infection and aseptic loosening - also had a certain peculiarity. So, in the first five years, the infection was the cause of revisions № 2 in 50.5%, and aseptic loosening - in 30.0%. In the next five years - in 25.0% and 62.5%,

respectively, and after 10 years - in 21.4% and 71.4% of clinical observations, respectively. That is, over time, aseptic loosening began to prevail among the causes of revisions № 2, both over infection and other causes. This pattern can be explained as follows. Together with a one-time audit (revision № 1), the structure of bone and muscle tissue was significantly weakened, a peculiar “locus minoris resistentiae” was formed, which led to instability of the components of the endoprosthesis - the development of aseptic instability and, inevitably, after some time – to second revision (revision) № 2).

*Volume.* Among all revisions № 2, the volume of surgical intervention in the form of replacing only the acetabular component was predominant, amounting to 28.1%. Less often, simultaneous replacement of both the acetabular and femoral components was performed, which amounted to 21.8%. Modular components were replaced even more rarely - 21.8%, and replacement of only the femoral component - 15.6%. Surgical interventions included in the “others” category (debridement, removal of osteophytes) accounted for 12.7% of clinical observations.

Thus, the structure of revisions № 2 in terms of the volume of surgical intervention was somewhat different from revisions № 1. More often, simultaneous replacement of both the acetabular and femoral components, as well as the replacement of modular components, was performed.

### **Conclusion**

As a result, it can be stated that revision endoprosthetics operations constitute a significant problem for both surgeons and patients, which is associated with a number of circumstances. Firstly, revision operations are the lot of patients mainly of older age groups, associated with comorbidity and reduced adaptive capabilities of the body, which predisposes to the development of complications that can cause revision. Secondly, the number of “early” revision interventions performed in the first five years after the primary operation (revision № 1) can be reduced by studying, recording and preventing the risk factors for the most common complications, aseptic loosening and infection, at the stage of the primary operation. Thirdly, the additional burden on the body of an elderly person in the form of a revision operation can be reduced by observing to the maximum extent the conditions for performing the primary endoprosthetics operation - taking into account indications and contraindications, scrupulous preoperative planning, careful observance of the technique for installing the endoprosthesis components, competent postoperative period and individually constructed rehabilitation program.

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根据现代文献，医源性对大隐静脉的损伤在小腿下半部手术中静脉功能不全的初始体征发展中的作用

**THE ROLE OF IATROGENIC DAMAGE TO THE LARGE  
SAPHENOUS VEIN IN THE DEVELOPMENT OF INITIAL SIGNS  
OF VENOUS INSUFFICIENCY DURING OPERATIONS ON THE  
LOWER THIRD OF THE LOWER LEG ACCORDING TO MODERN  
LITERATURE**

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抽象。根据现代文献，该文章致力于确定在创伤手术中医源性对大隐静脉的损伤在下肢静脉功能不全的初始征兆发展中的作用。审查的目的是找出医学界如何研究此问题。

分析了100多种国内外作者的资料。研究了可用的资料后，我们得出的结论是，文献中关于此类研究的数据很少。首次研究了在最初没有血管病理学症状的患者中，对创伤手术过程中大隐静脉的损伤对下肢静脉功能不全的初始症状发展的影响问题。根据我们的研究，在92%的病例中，在创伤手术期间对大隐静脉的损伤导致下肢静脉功能不全的初步迹象的发展。

关键词：下肢静脉功能不全，下肢浅表血管，创伤手术，医源性损害。

**Abstract.** *The article is devoted to determining the role of iatrogenic damage to the great saphenous vein during traumatological operations in the development of the initial signs of venous insufficiency of the lower extremities according to modern literature. The aim of the review is to find out how this problem has been studied in the medical community.*

*More than 100 different sources of domestic and foreign authors were analyzed. Having studied the available sources, we concluded that there is very little data on such studies in the literature. For the first time, the problem of the effect of damage to the saphenous vein during traumatological operations on the development of the initial signs of venous insufficiency of the lower extremities in patients with initially absent signs of vascular pathology was studied. According to our studies, damage to the great saphenous vein during trauma surgery in 92% of cases leads to the development of initial signs of venous insufficiency of the lower extremities.*

**Keywords:** *venous insufficiency of the lower extremities, superficial vessels of the lower extremities, trauma surgery, iatrogenic damage.*

At present, the injury rate of the population has significantly increased and now stands at 12.8 million people annually in the Russian Federation, among which, according to various authors, fractures of the leg bones account for 25.1% - 31.2% of all skeleton bone fractures, while fractures ankles account for 20-22% of all skeletal bone damage [1].

Quite often, during traumatological operations, such as open osteosynthesis of the inner ankle, distal blocking of the tibial pin, osteosynthesis of the distal part of the lower leg bones, spokes at the distal level when the apparatus of G.A. Ilizarov is mounted on the lower leg, damage to the large saphenous vein (v. Saphena magna) at the place where it passes near the inner ankle occur. Subsequently, this leads to a violation of the outflow of blood through the vein, and, consequently, to the development of vascular complications, such as venous insufficiency. [2,3].

When performing traumatological operations, much attention is paid to the musculoskeletal system, often without paying due attention to the vascular component, if this is not a life-threatening condition [4,5]. This article should draw the attention of surgeons to the need to maintain a large saphenous vein. So that subsequently, with a perfectly performed operation, having received complete consolidation of the fractures, not to receive complaints from patients that after an n-period of time, after the fractures have healed, the patient feels heaviness in the legs, long-lasting swelling, night cramps, leg fatigue, appearance of visible dilated veins, which indicates the initial signs of venous insufficiency. [6-8].

Quite often fractures of bones of the lower extremities damage blood vessels. But there is another reason for vascular damage - iatrogenic. Iatrogenic vascular damage is an important problem of peacetime vessel trauma due to its frequency

and severity [9]. Despite the progress of emergency angioplasty, many aspects of the diagnosis and treatment of vascular damage remain unresolved to date. Its most complex and controversial sections are various aspects of surgical tactics for iatrogenic vascular injury [10-11].

One of the main reasons for the development of iatrogenic vascular injury, according to various authors, is the increase in the number of surgical interventions in emergency traumatology and orthopedics [12].

Decreasing in the frequency of development of iatrogenic injury and its complications, largely depends on its proper prevention. For this purpose, according to most researchers, it is advisable to preoperatively study the relationship of large blood vessels to the operated object, identify groups of surgical interventions in which vessel injury is most likely to occur and inclusion of a vascular surgeon in the operating team [13].

There are several works on the structure of iatrogenic vascular injury, which indicate a high percentage of vascular damage during trauma surgery, in particular, during osteosynthesis [14].

But in no article is there data on iatrogenic damage to the saphenous veins of the lower leg during traumatological operations that led to the development of venous insufficiency.

Many journals on vascular surgery consider the possibility of crossing or obliterating a large saphenous vein in order to treat varicose veins [15].

The most difficult section of iatrogenic vascular injury is its occurrence during traumatological operations, as many authors point out [16].

According to a number of works concerning iatrogenic trauma in trauma patients, the main reason for the development of intraoperative vascular damage during osteosynthesis is a deviation from the classical patterns of their use, the complexity of fractures and the difficulty of reposition of bone fragments [17-18].

From the point of view of some surgeons who have extensive experience in the surgical treatment of patients who have suffered iatrogenic vascular injury, one cannot limit oneself to only stating the occurrence of a vascular complication and stopping bleeding, in modern conditions, it is necessary to strive to restore the integrity of the damaged vessel [19].

According to some authors, most of the damage to arteries and veins during osteosynthesis occurs when the apparatus of G.A. Ilizarov is used, which greatly complicates the diagnosis of vascular injury, and restoration of the vessel is possible only if it is dismantled.

The most promising methods for diagnosing iatrogenic vascular injury, apparently, is the use of a portable dopplerograph having a thin sensor, which allows, in almost any circumstances, to establish damage to peripheral vessels by the presence or absence of blood flow through the vessel [20].

The literature still debates the question of what to do first - to repair a damaged vessel or to repair and fix bone fragments? At the end of the XX century, many authors L. Evstifeev (1995), Katsamouris A.N. et al. (1995), Porcellini N. et al. (1997), Schlickewei W. et al., (1992) believed that osteosynthesis should be performed in the first place - this creates favorable conditions for the restoration of the vessel and reduces the likelihood of injury to it by bone fragments and thrombosis of the latter.

However, at the beginning of the XXI century, an opinion appeared that vascular restoration should take precedence over the restoration of all other injuries [21]. Of course, this minimizes the possibility of developing postoperative vascular complications, but care must be taken to avoid breaking the line of the vascular suture when bone fragments are fixed.

Thus, today there is no consensus on what to restore first: bone integrity or vessel integrity? Is it advisable to use a vascular suture under tension or is it still possible to use an autovein as a transplant? Autoplasty with a vein section plays an important role in reconstructive surgery, which makes it possible to manipulate bone fragments more. Allotransplantation on peripheral vessels is unpromising, as it is always accompanied by secondary thrombosis. For prosthetics, a large saphenous vein on the lower limb and v. cephalica or v. basilica on the upper are most often used.

But in the modern scientific literature there is practically no data on how the blood flow occurs and changes on the selected section of the vein, what consequences this leads to. Most practitioners report that in emergency cases it is necessary to save the limb or even the life of the patient, and this is fully justified. But with planned or delayed surgical interventions, surgeons should think about what the autologous fence will lead to as a graft or how will iatrogenic vein damage manifest itself and what the long-term consequences will be?

Most often, duplex angioscanning is currently used to clarify the diagnosis of vessel damage. According to most authors, duplex scanning should be used in the diagnosis of any vascular injury [22].

In addition, a number of methods related to the treatment and diagnosis of damaged vessels, based on the use of duplex scanning as the main imaging method. Most authors are inclined to the widespread use of duplex scanning in the diagnosis and treatment due to the high visualization ability of this method, as well as its non-invasiveness [23]. However, it should be noted that the possibility of using these studies for emergency indications is not available in all clinics, especially in non-specialized ones, which requires the introduction and widespread use of portable dopplerographs [24].

The prevention of the development of iatrogenic vascular injury is extremely poorly covered in the literature. Most of the work on vascular injuries that occur

during operations is casuistic in nature, with consideration of one or more cases that do not allow rational selection of the main measures for the prevention of iatrogenic injury.

According to many authors, the practical training of general surgeons, oncologists, gynecologists, traumatologists, endoscopic surgeons on the basics of emergency vascular surgery should be improved.

Great difficulties arise in the development of preventive measures aimed at preventing the development of iatrogenic injury to blood vessels during traumatological operations. One of the possible solutions to avoid iatrogenic damage to the vessel is preoperative planning, the study of vascular anatomy in each individual patient. We have developed a method for preventing damage to the large saphenous vein during trauma surgery on the lower third of the leg. (Patent for the invention of the Russian Federation № 2717602, registration date 03.24.2020), which allows to exclude damage to the vessel during surgery [25].

In the literature regarding vascular trauma, trauma surgery provides only examples of injuries and vascular repair methods. Apparently, this section is practically unstudied and requires further study, since the frequency of vascular injuries during osteosynthesis reaches the frequency of vascular damage after intravascular studies. The complexity of restoring vascular patency when damaged by a nail or a needle after osteosynthesis is more difficult technically than after other types of iatrogenic trauma [26].

Iatrogenic vascular damage can be avoided with a good knowledge of the anatomical and topographic features in the area of the operation, careful preoperative planning, careful operation, and non-invasive research methods should be preferred during diagnosis [27-28].

The data presented in the literature review served as a prerequisite for our in-depth analysis of the immediate and long-term results of treatment of patients with iatrogenic damage to the large saphenous vein in the region of the internal ankle and the further development of the initial signs of venous insufficiency.

Operating traumatologists focus on the musculoskeletal system, often forgetting about the vascular component, unless of course there is damage to the main vessels, which is not entirely correct. The time has come to pay due attention to injuries that subsequently worsen the quality of life, despite the achieved consolidation of fractures.

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3岁以下儿童热灼伤毒血症期间中枢和外周血流动力学的变化  
**CHANGE IN CENTRAL AND PERIPHERAL HEMODYNAMICS  
DURING TOXEMIA DURING THERMAL BURNS IN CHILDREN  
UNDER 3 YEARS OLD**

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**Relevance.** With imperfection of the subcortical parts of the brain of young children (up to 3 years old), a higher metabolism, a high content of water in the brain tissues are noted, which leads to the appearance of a more severe symptom complex of shock, a period of toxemia, septic toxemia and burn exhaustion. The cardiovascular system has great compensatory capabilities, which leads to persistent circulatory disorders, a state of decompensation of the contractile function of the heart develops due to its increased contractility. Due to the high risk of complications and mortality, the problem of developing effective timely corrective measures remains relevant [1,2,5].

**Purpose.** To study changes in central and peripheral hemodynamics during toxemia during thermal burns in infants.

**Material and research methods.** In total, research data from 25 children aged 5 months to 3 years was studied. Patients were examined depending on the severity and area of damage, age, duration of treatment in the ICU. So in infancy, the number of children in ICU up to 10 days was 15 (1 subgroup), 11-20 days - 5 children (2 subgroups), more than 21 days (21-40 days – 5 babies). Assessment of the severity of the burn was carried out by calculating the surface area of the damaged skin and using the Frank index. When calculating the Frank index, the following were taken into account: a) the burn surface area (degree 1, 2 and 3a burn), expressed as a percentage; b) the area of the burn surface (burn 3b and 4 degrees), expressed as a percentage and multiplied by a coefficient of 3; c) a burn

of the respiratory tract, comprising 30% of the index and type A + B + C. The prognosis is favorable if the IF is less than 30 units. The prognosis is relatively favorable if IF = 31-60 units. The forecast is doubtful if IF 61 - 90 units. The prognosis is unfavorable if the IF is more than 90 units [1,2]. Hemodynamics were assessed by indicators of systolic (SBP), diastolic (DBP) pressure, heart rate (HR), shock (UO), minute blood circulation (MBC) and total peripheral vascular resistance (TPVR). Hemodynamic parameters were calculated using the following formulas [3,4]:

$$MBC = BP \text{ reducer} * HR / 1000,$$

Where is the reducer.  $BP = PBP * 50 / \text{cf BP}$  (in children under 3 years old),

$$TPVR = SBP * 5 / MBC * 10, \text{ l / min, d.s.cm}^5\text{m.}$$

A detailed analysis of reliably significant deviations, intergroup differences of the studied indicators was carried out. The results were obtained by monitoring with hourly recording of the studied parameters. The research data were processed by the method of variation statistics using the Excel program by calculating arithmetic mean values (M) and mean errors (m). To assess the significance of differences between the two values, Student's parametric criterion (t) was used. The relationship between the dynamics of the studied parameters was determined by the method of pair correlations. The critical level of significance was taken equal to 0.05. Intensive therapy from the moment of admission was aimed at eliminating from burn shock, simultaneous analgesia and intravenous administration of crystalloids, volemic solutions under the control of hemodynamics, volume of diuresis. Regular, every 8-12 hours, the introduction of painkillers, cardiotonic, desensitizing, stress-limiting agents, vitamins. According to indications, hormones and blood substitutes were used. Inhaled oxygen was inhaled. For all children, vitamins C and group B were used, antipyretic and hypersensitizing agents, as well as drugs against stressful damage to the gastrointestinal tract, convalescence, septicotoxemia and toxemia. According to indications, early surgical necrectomy, prophylaxis of coagulopathy, energy-deficient state, volemic disorders, and correction of "tachycardial syndrome" were successfully carried out.

### Results and its discussion

**Table 1**

*Characteristics of infants who received thermal burns*

Groups	Age, month	Height, cm	Weight, kg	S, %	2-3 A	3 B	IF, units	number of hospital days	hospital days ICU
1	19,3±6,2	81,6±8,8	10,9±2,2	32,7±9,8	32,7±9,8	0,1±0,03	33,4±10,1	15,4±3,5	6,8±1,8
2	14,2±4,6	79,7±5,7	10,1±1,9	33,6±7,6	24,8±7,4	9±2,8	48,4±11,28	41,6±10,2	12,8±1,3
3	10,1±2,1*	71±2,5	9,9±0,8	32,7±4,9	26,7±2,2	6±2,7*	71,3±8,4*	49,3±3,8*	26,3±2,4*

\* reliably relative to data in 1 group

As shown in Table 1, there were no significant differences in anthropometric data (height, body weight), burn surface area, or lesion area of grade 2-3A. However, a significantly significant difference in age was found. Children of group 3 were younger than patients of group 1 by 9 months ( $p < 0.05$ ). The area of 3B degree lesion reliably prevailed by 5.9% ( $p < 0.05$ ), IF was more than twice as large ( $p < 0.05$ ), which accordingly led to an increase in the duration of intensive care in ICU conditions by 20 days ( $p < 0.05$ ) and treatment in a hospital for 34 days ( $p < 0.05$ ) due to the severity of the condition. Thus, the main factors affecting the severity of the condition of children with thermal burns with an area of more than 20% were age (the younger the child, the more severe the condition), the area of damage to the skin surface, grade 3B, and IF. Thus, age, IF indicator, and area of thermal damage of degree 3B can serve as objective indicators of the severity of a thermal burn and can predict the duration of intensive care at the ICU and inpatient care.

**Table 2**  
*Change in hemodynamics during toxemia depending on the severity of a burn injury*

days	UO ml			MBC, l per minute			TPVR l / min.dins.scm <sup>-1</sup> □ m		
	1 group	2 group	3 group	1 group	2 group	3 group	1 group	2 group	3 group
1	27,6±2,2	26,2±2,1	28,1±0,6	3,7±0,5	3,9±0,9	4,0±0,4	691,0±67,5	628,6±86,0	590,1±47,9
2	25,9±2,9	26,5±2,3	27,7±3,3	3,4±0,5	3,6±0,2	4,2±0,3	759,0±121,2	665,3±41,1	550,4±88,1
3	27,1±2,9	26,9±2,1	26,9±1,8	3,7±0,4	3,7±0,2	3,5±0,3	687,7±72,3	670,5±58,1	667,7±90,2
4	26,2±2,1	26,2±1,8	27,6±0,8	3,7±0,4	3,6±0,1	3,9±0,4	687,2±54,5	679,7±65,0	635,5±40,9
5	26,7±2,2	27,6±3,3	27,6±0,7	3,7±0,2	3,8±0,5	3,8±0,4	693,6±50,4	666,2±78,8	651,1±52,5
6	27,9±2,1	27,5±1,4	28,1±3,0	3,9±0,3	3,8±0,1	3,9±0,6	668,4±49,1	660,6±40,1	618,3±89,4
7	26,7±2,3	23,9±2,9	27,1±1,5	3,8±0,4	3,3±0,5	3,7±0,4	702,2±62,5	768,3±107,7	642,6±65,3
8	27,1±1,8	25,6±0,7	25,3±0,6	3,8±0,3	3,5±0,2	3,6±0,2	702,0±45,6	708,6±36,1	694,4±61,7
9	29,7±0,6	26,3±1,5	28,7±2,7	4,1±0,1	3,5±0,1	3,9±0,4	646,4±25,2	696,6±42,5	643,4±58,9
10		27,1±3,0	26,8±1,6		3,7±0,3	3,7±0,3		672,6±47,2	681,2±24,3

As shown in Table 2, on day 1, the UO, MBC, TPVR indices did not significantly differ from the normative values, indicating the effectiveness of the anti-shock, intensive therapy. In the following days, UO, MBC, and TPVR were stable over the entire period of toxemia. Only the heart rate indicator exceeded generally accepted normative values by 15-20%. On the second day, a significant increase in tachycardia was detected in children of the 3rd group, which exceeded the indicator of the 1st group by 17% ( $p < 0.05$ ). In the process of corresponding correction in the following days, the indicator did not differ from the data of other groups.

In children in the 1st group of patients, a direct correlation between SBP and UO and MBC was found; in the 2nd and 3rd groups, this relationship was broken. PBP in group 1 was directly dependent on UO, and in group 2 on UO

and MBC. However, in group 3, this relationship became unreliable. In group 1, a physiological direct dependence of MBC on UO (0.9138), on the state of vegetative tone (0.9646) and the inverse on TPVR (-0.8416) was revealed. Already in group 1, a negative relationship between changes in TPVR and UO (-0.7847). The negative correlation between TPVR and the degree of sympathotonic reaction (-0.7826) and TPVR and UO (-0.7845) can be understood as a mechanism for the formation of the hyperdynamic type of hemodynamics for burn stress in children of group 1. In group 2, a direct correlation was found between PBP with UO (0.9078), PBP with MBC (0.8141), UO and MBC (0.9050). The inverse correlation of DBP and UO (-0.8047), DBP and MBC (-0.7772), TPVR / UO (-0.8692), TPVR and MBC (-0.8944) showed a tendency to increase cardiac output with a decrease the tone of the peripheral vessels that determine the total peripheral resistance. A direct relationship between DBP and TPVR (0.9546) shows the leading value of vascular tone in the formation of TPVR growth. In the 2nd group, as in the first, a physiological direct dependence of MBC on UO (0.9050), on the state of vegetative tone (0.9159) and the inverse on TPVR (-0.8944) were revealed. In group 3, against the background of a more severe general condition, a direct correlation was found between DBP and TPVR (0.7864), sRAD and TPVR (0.7367), MBC and OBT (0.7984), and an inverse strong correlation of MBC and TPVR (-0.9218 ) At the same time, new compensatory connections appeared, such as MBC and heart rate (0.7804), MBC and the daily volume of injected fluid parenterally and enteral (-0.7001), which explained the reason for the decrease in MBC under conditions of limiting water load. The inverse dependence of heart rate on TPVR (-0.7120) indicates the possibility of reducing tachycardia with an increase in peripheral vascular tone in the most severe patients.

**Table 3**  
*Water balance during toxemia*

days	Total daily volume			Administered intravenously			The volume of daily diuresis		
	1 group	2 group	3 group	1 group	2 group	3 group	1 group	2 group	3 group
1	128±28	111±32	113±23	82±23	67±14	91±24	3±1	3±1	1,5±0,5
2	185±30	176±28*	111±13	86±15	82±20	78±17	4±1	4±1	3,4±1,1*
3	198±43	195±35*	154±14*	88±27	91±22	84±11	5±1	4±1	4,1±0,7*
4	199±49	181±38	155±22	85±22	86±16	89±15	5±1	5±1	5,0±1,5*
5	192±46	171±24	118±15	84±23	79±17	86±13	5±1	4±1	5,1±0,7*
6	201±31*	184±35*	118±8	82±20	87±13	80±17	5±1	4±1	4,5±0,7*
7	199±33	195±32*	139±20	83±15	81±19	78±11	5±1	5±2	4,2±0,6*
8	191±21	170±17*	149±44	81±14	82±11	82±16	5±1	4±1	4,1±1,9*
9	231±64*	169±20*	148±22	87±22	67±18	75±18	5±0,2	4±0,1	4,0±0,7*
10		161±10	154±16		61±13	81±12		6±1*	3,6±1,1*

\*- reliably relative to data in 1 group

As can be seen from the data presented in table 3, in 1 day after a burn injury, the total volume of injected water corresponded to the physiological needs in young children. In the following days, in patients of group 1, the water load tended to increase to maximum values by 6 (57%,  $p < 0.05$ ) and 9 (84%,  $p < 0.05$ ) days, which was caused by the expediency of compensating for the deficit not only due to increased losses, but also the need for detoxification therapy. In the 2nd group of children, a significantly significant increase in water load was observed already on the 2nd day (by 58%), 3 (by 76%), 6 (by 65%), 7 (by 76%), 8 (55%), 9 days (by 52 %). An interesting fact is that in the most severe patients, a significantly significant increase in the volume of infusion therapy was detected only on the 3rd day (36%). The latter, most likely, was due to the limitation of water load on the remaining days due to the relatively more significant risk of developing cardiac decompensation. Intravenous infusion therapy was carried out in an average volume in the 1st group of 82-87 ml / kg, in the second - 67-91 ml / kg, in the third - did not significantly differ from 1 and 2 groups (91-75 ml / kg per day). Thus, the volume of the intravenous water load was determined not only by the need to adequately fill the BCC deficit, but also by taking into account the limited resources of the cardiovascular system and the hydrophilicity of tissues of age-related origin. Confirmation of the risk of developing acute heart failure is a possible mechanism for increasing TPVR in connection with an increase in intravenous infusion therapy (0.7758), the total amount of water introduced per day (0.7992) in patients of group 3. The latter necessitated careful control of the volume of infusion therapy in the study group (the possibility of including diuretics, cardiotonics in the correction). Confirmation is moderate polyuria throughout the entire period of intensive care. So, only in children of the 3rd group, the hourly volume of urine output turned out to be significantly more than the indicator in 1 day more than doubled by 2,3,4,5,6,7,8,9 days.

### **Conclusions**

Burn injury at the age of  $10.1 \pm 2.1$  months with a burn area of  $3B 6 \pm 2.7\%$  of the skin surface increases IF to  $71.3 \pm 8.4$  units. At 1 day, effective anti-shock therapy included maintaining the total amount of fluid administered at the physiological need level. In patients of group 1, the water load tended to increase to maximum values by 6 (57%) and 9 (84%) days. In the 2nd group of children, a significantly significant increase in water load was observed already on the 2nd day (by 58%), 3 (by 76%), 6 (by 65%), 7 (by 76%), 8 (55%), 9 days (by 52 %). In the most severe patients, an increase in the volume of infusion therapy was detected only by 3 days (by 36%), which was due to a relatively higher risk of developing cardiac decompensation. The parameters of cardiac output and total peripheral vascular resistance in all groups were maintained at the age level during the period of toxemia of burn disease in infancy.

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从葡萄粉中分离出的水溶性多糖（栽培）（*Vitis Vinefero L.*）的表面现象的研究

**STUDY OF THE SURFACE PHENOMENA OF A WATER-SOLUBLE POLYSACCHARIDE ISOLATED FROM GRAPE MEAL (CULTIVATED) (VITIS VINEFERO L.)**

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抽象。葡萄-是食品工业中果汁和葡萄酒的主要来源。由于其加工，许多废物以餐食的形式残留。

该工作的目的是研究多糖水溶液的表面性质，以建立相对于亲油染料的临界胶束浓度和增溶能力。

作为研究的对象，我们使用了从栽培葡萄（*Vitis Vinefero L.*）粕中获得的水溶性多糖（WSPS）的一部分。使用Rebinder仪器研究表面活性；WSPS胶束溶液相对于亲油性染料的溶解能力是通过使用比色计（FEK-56M）的比色法确定的。

研究结果表明，从栽培的葡萄粉中分离出的WSPS属于表面活性剂。它们具有自发形成胶束的能力。这些WSPS分子的增溶能力是第一次发现。

关键词：水溶性多糖，葡萄粉，表面活性，临界胶束浓度，溶解。

**Abstract.** *Grape – is the main source of juice and wine in the food industry. As a result of its processing, a lot of waste remains in the form of meal.*

*The aim of the work was to study the surface properties of aqueous solutions of polysaccharides, to establish the critical micelle concentration and solubilizing ability relative to the oleophilic dye.*

*As the object of study, we used the fraction of water-soluble polysaccharides (WSPS) obtained from meal of cultivated grapes (Vitis Vinefero L.). Surface activity was studied using a Rebinder instrument; the solubilizing ability of WSPS micellar solutions relative to the oleophilic dye was established by the colorimetric method using a photocolormeter (FEK-56M).*

*The results of the studies showed that WSPS isolated from a meal of grape cultivated belongs to surfactants. They have the ability to spontaneous micelle formation. The solubilizing ability of these WSPS molecules was discovered for the first time.*

**Keywords:** *water-soluble polysaccharides, grape meal, surface activity, critical micelle concentration, solubilization.*

Waste generated after pressing grapes is a promising secondary raw material for the production of pectin, water-soluble polysaccharides and other biologically active substances.

So, the content of pectins in the meal of grapes is from 3 to 7% by dry matter. Grape seeds contain up to 60% of phenolic compounds represented by flavonols, catechins, leucoanthocyanins.

The conditions of extraction of grape oil from seeds, the production of substitutes for coffee and coffee drinks from grape meal, the production of solid fruit mushrooms Veshenka mushroom [1, 2] are studied.

An extract of grape seeds at a dose of 200 mg/kg in a model of toxic liver damage in rabbits showed pronounced detoxification and hepatoprotective activity, and an emulsifier with a content of 20% of this oil showed a high regenerating activity in a model of thermal damage to the skin of white rats [1]. The antitumor, antiangiogenic, antimetastatic, neuroprotective effect was also proved for the grape seed extract, which is due to the high content of proanthocyanides and epigallocatechins in it. Hypotensive, hypoglycemic, antidiabetic and other properties have been identified [3].

The effectiveness of grape meal as erythropoietin for the prevention and treatment of blood diseases has been proven [4].

Therefore, at present, there is an increasing interest in creating waste-free technologies for the integrated processing of waste grape raw materials.

**Purpose of work** is a study of the surface activity and solubilizing ability of WSPS obtained from a meal of cultivated grapes (*Vitis Vinefero L.*).

These polysaccharides were obtained according to the method of N.K. Kochetkov [5].

We studied: the surface tension of WSPS aqueous solutions, the size of the molecular layer upon adsorption on the liquid-gas interface, the possibility of micelle formation, and solubilizing ability.

To assess the ability of WSPS to lower the surface tension of a solvent, its aqueous solutions with a concentration of 0.1-0.8% were prepared.

Using the Rebinder device, the pressure drops of the gauge liquid were established and the magnitude of the surface tension, the excess of adsorbed substance in the surface layer, surface activity, and critical concentration of micelle formation were calculated [6, 7, 8].

To study the solubilizing ability of WSPS solutions, the colorimetric method was used [9]. The work was carried out on a photocolorimeter - 56 M. Since oleophilic dyes (Sudan III) are dissolved in the hydrophobic part of the micelles, with the formation of a colored solution, this method allowed us to control the solubilization process. The color intensity is related to the amount of solubilized dye, which allowed us to calculate the molar solubilizing ability. The results are shown in table 1.

**Table 1.** Parameters of surface properties of WSPS obtained from meal of grape cultivated (*Vitis Vinefero L.*).

C, %	h, cm	$\sigma \cdot 10^3$ , N/m	$-\Delta\sigma \cdot 10^3$ , N/m	$C \cdot 10^4$ , kmol/m <sup>3</sup>	$\Delta C \cdot 10^4$ , kmol/m <sup>3</sup>	$G \cdot 10^9$ kmol/m <sup>2</sup>	S, A <sup>2</sup>	L, A	V, A <sup>3</sup>
0	2,8	72,44	-	-	-	-	7,8	537,9	4195,6
0,1	2,3	59,5	-12,94	3,6	1,8	10,61			
0,2	2	51,74	-20,7	7,2	3,6	16,97			
0,4	1,9	49,15	-23,29	14,4	7,2	19,09			
0,8	1,8	46,56	-25,88	28,7	15,0	21,22			

The value of surface tension was calculated by the formula [5, 10], presented below:

$$\sigma = \sigma_0 \cdot h_x / h_0,$$

where:  $\sigma$  and  $\sigma_0$  - surface tension of water and WSPS solutions, N/m;

$h_x$  and  $h_0$  – pressure drops of the monometric fluid for the test solution and water, cm

The dependence of the table is visible: with an increase in the concentration of WSPS, the surface tension decreases, which is clearly seen in Fig. 1.

Using the tangent of the slope of the tangent drawn to the surface tension isotherm, the surface activity value was found using the function:  $g = -\Delta\sigma / \Delta C$ .

The calculation showed that the surface activity was 0.517 N\*m<sup>2</sup>/kmol.

The spontaneous distribution of the dissolved substance at the phase boundary is characterized by surface energy, the value of which was calculated by the Gibbs equation:

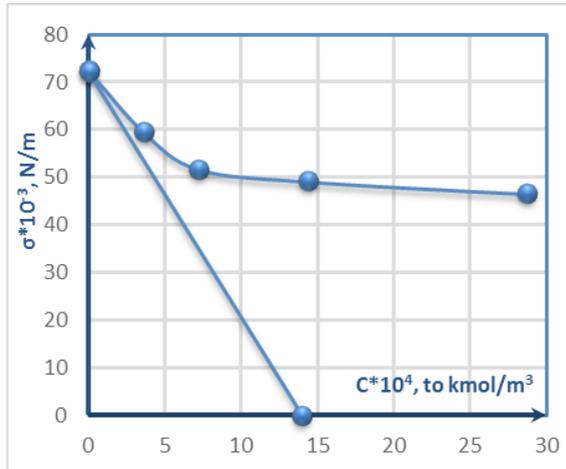
$$G = - \frac{\Delta\sigma}{\Delta C} \cdot \frac{C}{RT},$$

where: C – equilibrium concentration kmol/m<sup>3</sup>;

R – universal gas constant;

T – temperature (295 K);

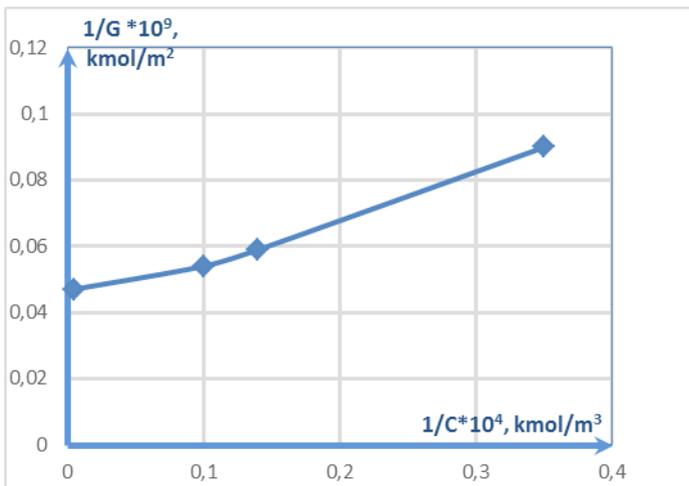
$\Delta\sigma$  – increment of surface tension coefficient corresponding to the increment of concentration ( $\Delta C$ ) [7, 9, 10].



**Figure 1.** Isotherm of surface tension of WSPS solutions obtained from meal of grape cultivated (*Vitis Vinefero L.*).

The existence of a monomolecular saturated layer at the "solution-air" interface is explained by the constancy of the limiting adsorption  $G_{\infty}$  - the limiting excess of adsorbed WSPS molecules in the surface layer [11].

To find this value, a graphical dependence of  $1/G$  on  $1/C$  was built. The segment cut off by a straight line on the ordinate axis characterizes the value  $1/G_{\infty}$  (Figure 2).



**Figure 2.** Graphical dependency of  $1/G$  on  $1/C$  of the WSPS aqueous solution.

The found value of  $G_{\infty}$  was  $21.27 \cdot 10^{-10}$  kmol/m<sup>2</sup>.

This allowed us to calculate the area occupied by one molecule at the interface:

$$S = \frac{1}{G_{\infty} \cdot N_A},$$

where:  $S$  – area, m<sup>2</sup>;

$G_{\infty}$  - marginal surface excess, kmol/m<sup>2</sup>;

$N_A$  – Avogadro number;

The length of the molecule, numerically equal to the thickness of the saturated adsorption layer was calculated by the equation:

$$l = M \square G_{\infty} / \rho,$$

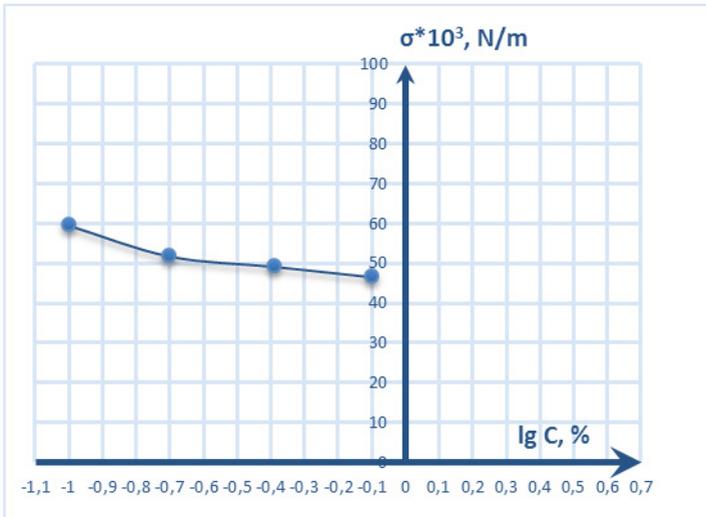
where:  $l$  – molecule length, m;

$M$  – molecular weight of WSPS;

$\rho$ - substance density, kg/m<sup>3</sup>

The volume of the surface layer was found by the ratio:  $V = S \cdot l$ . The results are presented in table 1.

The relatively large length of the molecule contributes to the formation of a bulk layer of the polymolecule at the interface.



**Figure 3.** Dependence of the surface tension of WSPS on the logarithm of concentration.

In order to search for practical applications of WSPS, the ability of molecules to micelle formation and solubilization was established. The micelle core exhibits the properties of a non-polar liquid. Therefore, the solubilize is evenly distributed between the micelles and the aqueous phase. The process of solubilization in

solutions of surfactants occurs due to the diffusion of the solubilize to the surface of the micelles and their penetration. An oleophilic dye (Sudan III) was used as a solubilize. Using the optical density of its benzene solutions, we constructed a calibration graph of the dependence of optical density on concentration.

To establish the ability of WSPS to micelle formation and to find the critical concentration of micelle formation, we plotted the dependence of  $\sigma = f * \lg C$ .

The presence of an inflection on the isotherm indicated the formation of spherical micelles. For WSPS solutions, the critical micelle concentration (CMC1) was  $7,19 * 10^{-4}$  kmol/l (0,2 g per 100 g of solution).

The ability of WSPS molecules to micelle formation made it possible to evaluate their solubilizing ability, saturating their aqueous solutions with an oleophilic dye. The dye (Sudan III) is dissolved in the hydrophobic part of the micelle, staining an aqueous solution of WSPS. The solubilized dye content was determined by measuring the optical density using a photocolorimeter. 0.01 g of Sudan III was added to WSPS aqueous solutions, vigorously stirred. Settled for 40 minutes. The settled solution was pipetted and the absorbance was determined at  $\lambda=540$  nm in a 5 mm thick cuvette. Using a calibration graph, the amount of solubilized Sudan III per unit volume of solution (S) was determined. An increase in the color intensity of the solution indicated the amount of colloidal dissolved dye. The molar solubilizing ability of the WSPS solution was determined by the ratio:

$$S_m = S / C_{WSPS}$$

where: C – concentration of WSPS, mol/l;

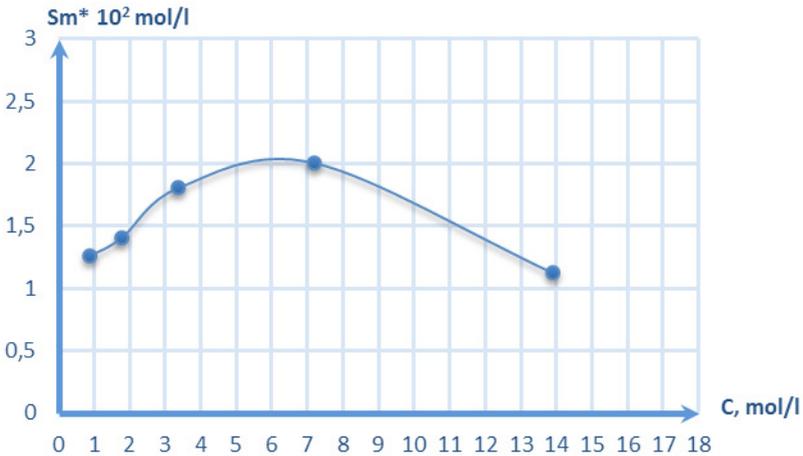
S – the amount of solubilized Sudan III, (g per 100 ml of solution).

The results are presented in table 2.

**Table 2.** The result of a study of the solubilizing ability of WSPS obtained from meal of grape cultivated (*Vitis Vinefero L.*).

C $\square 10^4$ , mol/l	The optical density of the solution, D	Optical density after solubilization, D *	S $\square 10^3$ mol/l	Sm $\square 10^2$ mol/l
0,9	0,02	0,05	0,32	1,25
1,8	0,08	0,09	0,68	1,40
3,4	0,14	0,50	1,76	1,80
7,2	0,23	0,62	4,02	2,00
13,9	0,91	0,69	4,49	1,12

The amount of solubilized dye increased in proportion to the concentration of WSPS. Solubilization began when the concentration of WSPS reached critical micelial concentration (Fig. 4).



**Figure 4.** The dependence of the solubilizing ability of WSPS on the concentration relative to the oleophilic dye.

At a WSPS concentration of  $7,19 \cdot 10^{-4}$  kmol/l, a straight bend is observed. Comparing with the value of the critical micelle formation concentration determined earlier, it can be noted that the maximum solubilizing ability of WSPS is observed during the formation of spherical micelles.

The change in the nature of the curve at higher concentrations of WSPS is explained by the rearrangement of micelles and their transition to other forms with a smaller micellar volume.

**Conclusion.** The results of the studies showed that:

- 1) grape cultivated meal can be used to obtain WSPS;
- 2) WSPS are surfactants;
- 3) in water, WSPS is colloid-soluble and capable of micelle formation; its critical micelle concentration was  $7,19 \cdot 10^{-4}$  mol/l;
- 4) the obtained WSPS have a solubilizing ability with respect to the oleophilic dye (Sudan III);
- 5) solubilizers of natural origin can be used to increase the solubility of hydrophobic substances, including drugs, and to study the possibility of their use as stabilizers of disperse systems.

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重组L-苯丙氨酸-铵裂解酶的分子量和氨基酸组成的测定  
**DETERMINATION OF THE MOLECULAR WEIGHT AND AMINO  
ACID COMPOSITION OF RECOMBINANT L-PHENYLALANINE-  
AMMONIUM-LYASE<sup>1</sup>**

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抽象。研究了重组L-苯丙氨酸-铵裂解酶(PAL)的理化性质。在变性Laemmli条件下,通过在10%聚丙烯酰胺凝胶中的圆盘电泳测定重组PAL的分子量。使用离子交换色谱对茚三酮进行柱后衍生,研究了重组PAL的氨基酸组成。

关键词: 重组L-苯丙氨酸-铵裂解酶, 电泳, 氨基酸组成, 抗肿瘤药物。

**Abstract.** *The physicochemical properties of the recombinant L-phenylalanine-ammonium lyase (PAL) were studied. The molecular weight of the recombinant PAL was determined by disk electrophoresis in 10% polyacrylamide gel under denaturing Laemmli conditions. The amino acid composition of recombinant PAL was studied using ion exchange chromatography with post-column derivatization with ninhydrin.*

**Keywords:** *recombinant L-phenylalanine-ammonium lyase, electrophoresis, amino acid composition, antitumor drugs.*

Cancer is one of the leading causes of death on the planet. Of primary importance in solving the problem of oncological diseases are studies aimed at revealing the molecular genetic mechanisms of the functioning of drugs used to treat cancer patients [1].

Currently, the fundamental problem of practical oncology is the low selectivity and high toxicity of known antitumor drugs. An alternative approach to solving this problem is enzyme therapy of cancer.

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<sup>1</sup>This work was carried out as part of a research project funded by the Scholarship of the President of the Russian Federation (SP-1361.2018.4) on the topic: "Development and practical implementation of genetic engineering technologies for obtaining new drug candidates for targeted therapy of cancer"

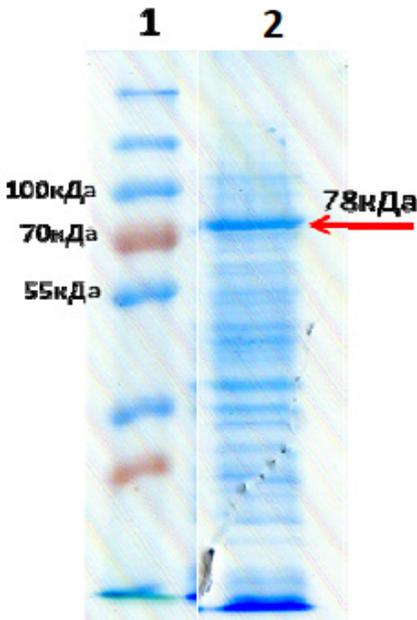
In the modern market of antitumor agents, there are drugs for the enzymatic treatment of cancer, most of which are L-asparaginases from various bacterial sources that exhibit significant antileukemic activity. For example, antitumor drugs based on L-asparaginase enzymes derived from *Escherichia coli* (Elspar) bacteria are known. The antitumor effect of the drug is based on the ability of asparaginase (L-asparaginaminohydrolase) to disrupt the metabolism of L-asparagine, its penetration into asparagine-dependent blastomatous cells. L-asparaginase has little effect on hematopoiesis, significantly reduces the number of blast cells in peripheral blood and bone marrow [2].

A promising enzyme preparation for the treatment of cancer is L-phenylalanine-ammonium lyase (PAL). This enzyme catalyzes the reversible deamination of the amino acid L-phenylalanine to trans-cinnamic acid and ammonia. The antitumor effect of the drug is due to a decrease in the level of L-phenylalanine in leukemic tumor cells, which, unlike normal cells, are not able to synthesize their own L-phenylalanine. As a result, protein synthesis is disrupted, as well as DNA and RNA synthesis. In this case, healthy cells are not affected. It has been proven that

the lifetime of L-asparaginase is shorter than that of L-phenylalanine-ammonium lyase [3].

Based on the foregoing, a project aimed at the development and practical implementation of genetic engineering technologies for obtaining new drug candidates for targeted therapy of cancer based on the recombinant enzyme preparation of L-phenylalanine-ammonium lyase is very relevant.

At the previous stages of the work, we identified the PAL gene of pigment yeast, analyzed the nucleotide composition of the PAL gene, isolated the PAL gene from pigment yeast, developed a system for cloning and expression of the target PAL gene in *E. coli* cells, optimized the cultivation parameters of



**Figure 1** – Electrophoresis of recombinant PAL:  
 1 – molecular weight marker PageRuler™  
 Prestained Protein Ladder (Fermentas),  
 2 – recombinant PAL

the recombinant *E. coli* strain producing PAL, development of methods for the isolation and purification of recombinant PAL.

The purpose of this work is to study the physicochemical properties of recombinant PAL, namely, the determination of the molecular weight and amino acid composition of the recombinant L-phenylalanine-ammonium lyase.

The molecular weight of the recombinant L-phenylalanine-ammonium lyase was determined by disk electrophoresis in 10% polyacrylamide gel (PAAG) under denaturing Laemmli conditions. Electrophoresis results are shown in Figure 1.

Based on the analysis of Figure 1, the molecular weight of the recombinant protein is 78 kDa. The results are consistent with the literature, according to which the molecular weight of L-phenylalanine-ammonium lyase is 76880 Da. Mass fraction of protein according to electrophoresis was 65%.

The amino acid composition of the recombinant PAL was determined by ion exchange chromatography with post-column derivatization with ninhydrin using the Aracus PMA GmbH amino acid analyzer. The results are presented in table 1.

**Table 1 – Amino acid composition of recombinant L-phenylalanine-ammonium lyase**

Name of amino acid	Content of amino acids, g/100 g	The amount of amino acid residues
Aspartic acid	8.38±0.42	63
Threonine	6.72±0.34	48
Serine	7.25±0.36	69
Glutamic acid	10.86±0.54	67
Proline	1.73±0.09	15
Glycine	3.90±0.20	52
Alanine	8.22±0.41	81
Cystine	1.44±0.07	6
Valine	7.33±0.37	54
Methionine	2.54±0.13	17
Isoleucine	4.33±0.22	33
Leucine	11.28±0.56	86
Tyrosine	2.54±0.13	14
Phenylalanine	2.48±0.12	15
Tryptophan	2.63±0.13	8
Lysine	4.53±0.23	31
Histidine	4.88±0.24	25
Arginine	5.57±0.28	32
<b>Total</b>	<b>96.61±4.83</b>	<b>716</b>

From table 1 it follows that in the amino acid composition of the recombinant L-phenylalanine-ammonium lyase, such amino acids as leucine (11.28 g/100 g), glutamic acid (10.86 g/100 g), aspartic acid (8.38 g/100 g), alanine (8.22 g/100 g) predominate. The PAL molecule contains 716 amino acid residues, which is consistent with published data [4].

Further studies are aimed at determining the activity, pH and temperature optimum, thermal stability and analysis of the antitumor properties of the recombinant PAL, to establish the possibility of its use as a promising agent for targeted therapy of cancer.

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评估椰子油酶解产物的致突变性  
**ASSESSMENT OF THE MUTAGENICITY OF ENZYMATIC  
HYDROLYSATES OF COCONUT OIL<sup>1</sup>**

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抽象。使用DNA彗星方法在体外实验中研究了椰子油酶解产物的致突变性,该方法基于琼脂糖凝胶中单个裂解细胞受损DNA的恒定电场在恒定电场中的不同迁移率。

关键词: 椰子油水解物, 诱变性, DNA彗星, 琼脂糖凝胶。

**Abstract.** *The mutagenicity of enzymatic hydrolysates of coconut oil was studied in experiments in vitro using the DNA comet method, which is based on the registration of different mobility in the constant electric field of damaged DNA of individual lysed cells enclosed in an agarose gel.*

**Keywords:** *coconut oil hydrolyzate, mutagenicity, DNA comet, agarose gel.*

Coconut oil plays a crucial role in the food and cosmetic industries. It is shown that in addition to nutritional value, coconut oil exhibits anticancerogenic and antimicrobial effects. In the literature there is information about the possibility of preventing the development of dental caries using coconut oil. Although the exact mechanism of the antimicrobial action of coconut oil is still unknown, it has been hypothesized that monolauric acid and other medium-chain monoglycerides have

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<sup>1</sup>This work was carried out as part of a research project funded by the Scholarship of the President of the Russian Federation (SP-1366.2018.4) on the topic: "Development of bactericides for oral care based on enzymatic hydrolysates of vegetable oils and the study of their toxicological safety indicators"

the ability to disrupt bacterial cell walls, penetrate and destroy cell membranes, and inhibit metabolic enzymes, causing the death of bacteria. Thus, enzymatic hydrolysates of coconut oil seem to be a promising object for creating new effective agents for the prevention and treatment of infectious diseases of the oral cavity, in particular caries. One of the requirements for dental drugs is their effectiveness and the relationship between efficacy and toxicity [1].

The aim of this work is to study the mutagenicity of enzymatic hydrolysates of coconut oil in *in vitro* experiments.

Mutagenicity means the ability of certain drugs to cause damage to the hereditary apparatus of cells (genes, chromosomes) of various tissues, manifested in a change in the genotype of their offspring.

*In vitro* DNA comet assay (MP 4.2.0014-10) was used to assess the mutagenicity of enzymatic hydrolysates of coconut oil, based on the detection of different mobility in the constant electric field of damaged DNA of individual lysed cells enclosed in an agarose gel. In this case, the DNA migrates to the anode, forming an electrophoretic trace that visually resembles a “comet tail”, the parameters of which depend on the degree of DNA damage. Human peripheral blood lymphocytes were used as test objects, which were cultured in DMEM medium with 0.3 mg/ml L-glutamine supplemented with 10% fetal bovine serum, 100 units / ml penicillin and 0.1 mg/ml streptomycin controlled conditions at a temperature of 37 ° C and 5% CO<sub>2</sub> [2].

The test sample (enzymatic hydrolysates of coconut oil with a concentration of 0.5 to 5.0 mg/ml in the resulting solution) and 225 µl of cell suspension (1·10<sup>6</sup> cells/ml) were added to microtubes containing 5 µl of phosphate-saline buffer (pH 7.4). To control the solvent, 5 µl of phosphate-buffered saline, 20 µl of double-distilled water and 225 µl of cell suspension (1·10<sup>6</sup> cells/ml) were poured into microtubes. The cell suspension with the samples was incubated at 37°C for 3.5 hours. At the end of the incubation, the tubes were centrifuged at 400 g for 5 minutes. The supernatant was discarded and the precipitated cells were washed twice in phosphate-buffered saline and EDTA by centrifugation at 400 g for 5 min. After the second washing, the precipitated cells were diluted with phosphate-buffered saline and EDTA and the procedure for obtaining micropreparations was started immediately.

Then, 25 µl of hydrogen peroxide solution was added to the microtubes, 225 µl of cell suspension (1·10<sup>6</sup> cells/ml) was added and incubated for 5 min at 4°C. At the end of the incubation, the tubes were centrifuged at 400 g for 5 minutes. The supernatant was discarded and the precipitated cells were washed twice in phosphate-buffered saline and EDTA by centrifugation at 400 g for 5 min. After the second washing, the precipitated cells were diluted with phosphate-buffered saline and EDTA and immediately started the procedure for obtaining micropreparations.

Micropreparations were prepared as follows. A layer of universal 1% agarose was applied to glass with dried universal 1% agarose. Cooled for 5 min at 4°C to set the gel. In a microtube, 1% low-melting agarose was quickly mixed in equal parts with a suspension of cells after exposure to the studied samples of enzymatic coconut oil hydrolysates and applied in the following layer. Cooled for 5 min at 4°C to set the gel. After that, the third layer was applied — 0.5% low-melting agarose and cooled for 5 min at 4°C.

A working lysing solution was poured into the cuvette with micropreparations until it covered the micropreparations by 2–3 mm, covered with a lid and incubated at 4°C for 1 h. At the end of the lysis, micropreparations were removed from the lysing solution and transferred to a chilled cuvette (4°C) alkaline solution for electrophoresis (pH = 13). Incubated at 4°C for 20 min. Next, electrophoresis was carried out at an ambient temperature of 20–25°C for 20 min at an electric field strength of 1 V per 1 cm of the length of the platform for micropreparations.

The next stage is the staining of micropreparations. Micropreparations were placed in a cuvette and poured with double-distilled water. Neutralization was conducted for 5 min at room temperature. The neutralization procedure was repeated twice in a fresh portion of water. When staining the preparations with SYBR Green I dye, the preparations after electrophoresis were fixed in a 70% ethanol solution for 15 min and dried at room temperature [2, 3].

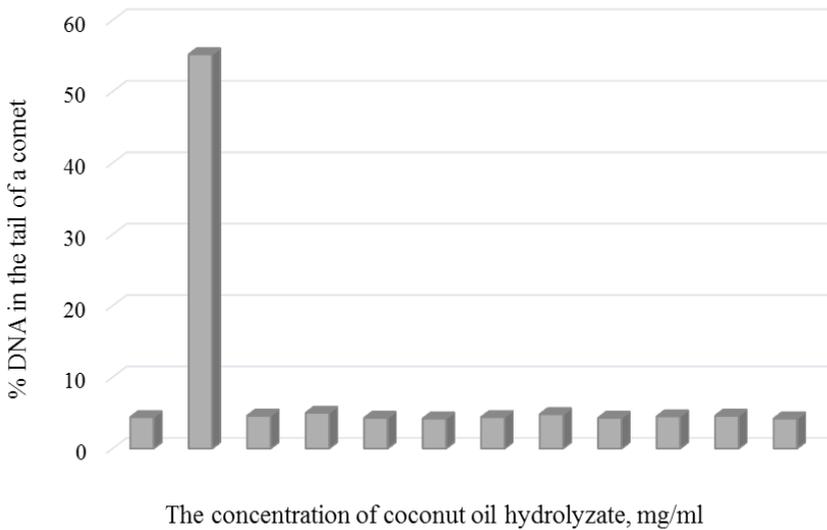
To stain "DNA comets" with ethidium bromide, micropreparations were immersed in a cuvette with a dye solution and incubated in a dark place at 4°C for at least 1 hour. Immediately before analysis, the micropreparation chosen for recording "DNA comets" was washed in distilled water 2–3 times.

To stain DNA comets, the SYBR Green I dye was applied to a micropreparation at the rate of 100 µl over an area of 25 mm<sup>2</sup> and stained for 20 min. At the end of the coloring, the dye remaining on the micropreparations was not removed.

The resulting micropreparations were analyzed under a fluorescence microscope at a magnification of x200. Image acquisition and data processing was carried out using a hardware-software complex including a highly sensitive camera combined with a microscope and specialized software. The percent of DNA in the comet tail was used as an indicator of DNA damage [4, 5].

The results of the assessment of the mutagenic properties of enzymatic hydrolysates of coconut oil are presented in Figure 1.

Obviously, enzymatic hydrolysates of coconut oil in the entire range of studied concentrations do not exhibit mutagenic properties, since the % of DNA in the tail of the comet is slightly different from that for the control experiment and below this value for hydrogen peroxide, which is highly mutagenic.



**Figure 1** – Test results of mutagenicity of coconut oil enzymatic hydrolysates

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贝加尔湖底部沉积物中嗜冷微生物代谢产物的氨基酸组成分析  
**ANALYSIS OF THE AMINO ACID COMPOSITION OF  
METABOLITES OF PSYCHROPHILIC MICROORGANISMS  
ISOLATED FROM BOTTOM SEDIMENTS OF LAKE BAIKAL<sup>1</sup>**

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抽象。 利用色谱-质谱法研究了嗜冷微生物产生的代谢产物的氨基酸组成。使用MasCot数据库对片段,由选定的嗜冷性微生物产生的代谢产物进行分析。

关键词: 嗜冷微生物代谢产物细菌素色谱-质谱法

**Abstract.** *The amino acid composition of metabolites produced by psychrophilic microorganisms was studied using the method of chromatography-mass-spectrometry. Analysis of fragments, metabolites produced by selected psychrophilic microorganisms, was performed using the MasCot database.*

**Keywords:** *psychrophilic microorganisms, metabolites, bacteriocins, chromatography-mass-spectrometry.*

Recently, more and more research is aimed at finding alternative antimicrobial agents. One of these substances is antimicrobial peptides - bacteriocins, produced mainly by gram-positive bacteria. The peculiarity of bacteriocins, as most researchers note, is that they are not toxic and, as a rule, bacteria do not develop resistance to them. The identification of new producers of bacteriocins

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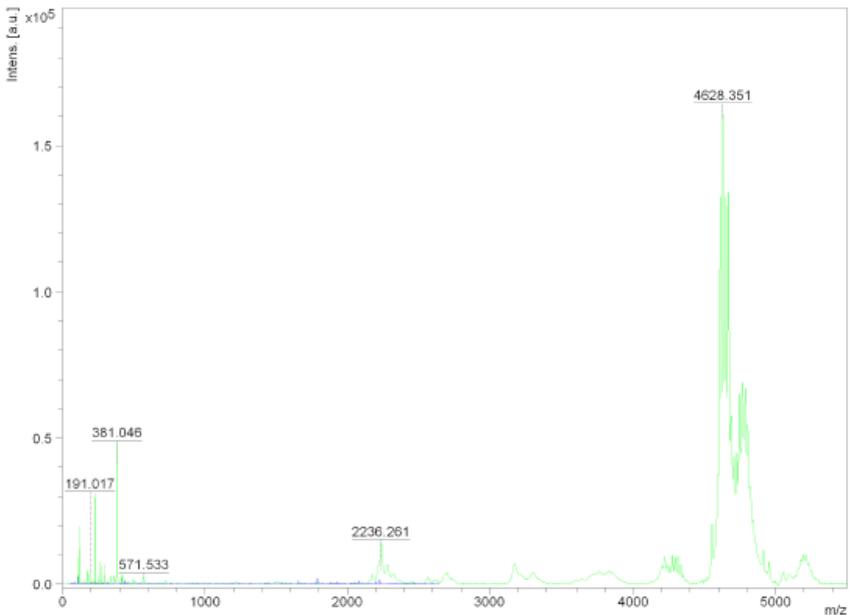
<sup>1</sup>This work was carried out as part of a research project funded by the Scholarship of the President of the Russian Federation (SP-1374.2018.4) on the topic: "Screening and characterization of the antagonistic properties of microorganisms - extremophiles isolated from the bottom sediments of Lake Baikal in connection with the creation of new antimicrobial preparations "

capable of more effectively inhibiting the growth and development of pathogenic microorganisms that cause various diseases is an urgent task at the present time.

A promising source of microorganisms capable of producing bacteriocins are bottom sediments of lakes. Lake Baikal is a unique ecological niche. It is characterized by great depths, low temperature and the constancy of the chemical composition of water. High oxygen saturation of the entire water column, low concentration of organic substances and low salinity of water determine the specific conditions of the activity of microorganisms - extremophiles. Bacteria are the most important component in the ecosystem of water bodies, it is it what takes an active part in shaping water quality and improving the sanitary-hygienic state [1, 2].

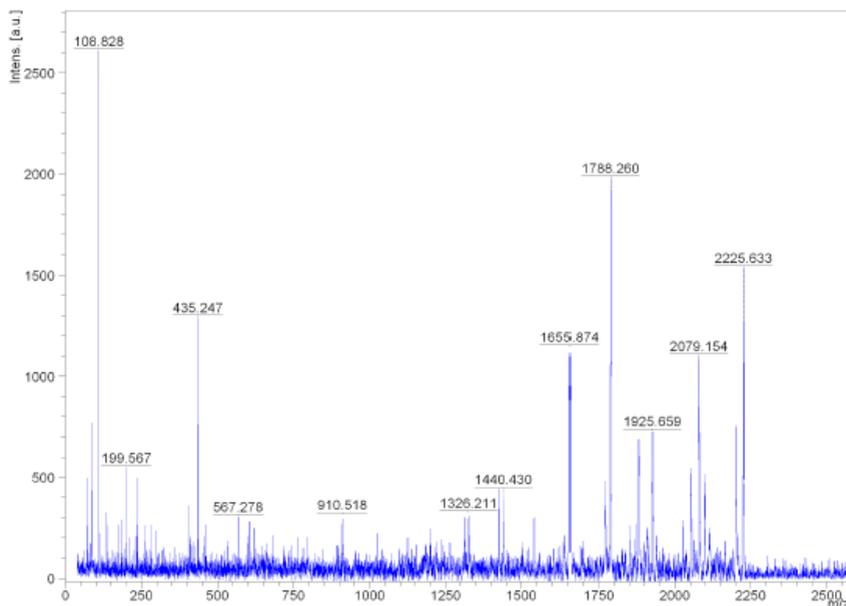
At the previous stages of the work, extremophilic (psychrophilic) microorganisms were isolated from the bottom sediments of Lake Baikal. Their genetic identification was carried out, cultural, morphological and antimicrobial properties were studied.

The aim of this work is to analyze the amino acid composition of the metabolites of psychrophilic microorganisms isolated from the bottom sediments of Lake Baikal.



**Figure 1** – Analysis of fraction A/1 by MALDI-TOF/TOF

To study the amino acid composition of metabolites produced by selected psychrophilic microorganisms, the obtained fractions (fraction A/1 and fraction A/7) were analyzed using a Bruker "Autoflex " MALDI-TOF/TOF spectrometer. A concentrated solution of picolinic acid in acetonitrile was used as a matrix. The mass spectrometer was pre-calibrated with peptide standards, the LIFT mode was calibrated using trypsinized bovine serum albumin. For a more detailed analysis of fraction A/1 in the secondary ionization mode, ions with a molecular mass of 4628 Da were selected. The results of fragmentation of peptides of fraction A/1 are presented in figures 1-2 and table 1.



**Figure 2** – Molecular fragments of peptides of fraction A/1 obtained by the MALDI-TOF/TOF method

**Table 1** – Molecular Fragments for A/1

m/z	time	Intens.	SN	Quality Fac.	Res.	Area	Rel. Intens.	FWHM	Chi <sup>2</sup>
69.019	24468.67	465.731	7.000	1826.217	444.116	79.430	0.189	0.155	1730.462
71.022	24572.14	245.273	3.682	682.479	351.691	54.413	0.100	0.202	427.414
84.953	25254.19	761.511	11.513	1517.793	454.192	157.582	0.309	0.187	8320.368

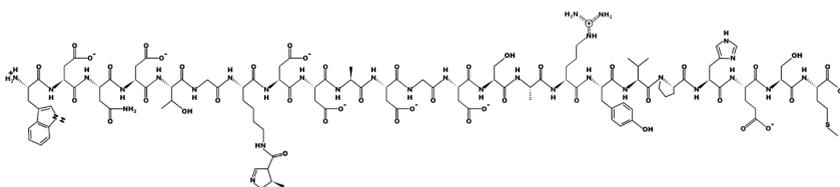
m/z	time	Intens.	SN	Quality Fac.	Res.	Area	Rel. Intens.	FWHM	Chi <sup>2</sup>
108.828	26301.93	2463.959	37.001	13552.312	589.487	509.347	1.000	0.185	11001.632
134.707	27312.15	332.817	5.001	668.389	570.366	89.157	0.135	0.236	1066.729
171.650	28595.11	268.009	4.137	266.104	727.973	73.758	0.109	0.236	1214.514
183.560	28977.87	273.016	4.211	187.838	915.240	64.351	0.111	0.201	1406.851
199.567	29472.72	542.044	8.342	1716.909	1106.896	115.915	0.220	0.180	2680.079
207.577	29712.66	194.181	3.003	94.742	774.240	62.036	0.079	0.268	464.651
228.463	30316.84	205.694	3.198	142.160	1121.405	50.536	0.083	0.204	297.072
233.473	30457.49	475.319	7.433	1072.176	974.688	137.699	0.193	0.240	2442.890
263.498	31269.57	255.562	3.989	101.075	906.624	91.380	0.104	0.291	1498.960
281.397	31731.05	248.046	3.830	34.834	1080.593	80.283	0.101	0.260	1850.638
298.412	32155.87	225.620	3.463	49.691	1142.543	73.950	0.092	0.261	1775.674
407.272	34618.13	355.887	4.967	164.586	1345.712	143.674	0.144	0.303	2392.871
435.247	35193.41	1292.209	17.588	9229.424	1549.584	491.737	0.524	0.281	3877.076
460.174	35689.99	263.112	3.495	381.263	1488.463	111.734	0.107	0.309	213.054
567.278	37678.18	309.524	3.813	252.636	1419.855	180.106	0.126	0.400	659.305
603.314	38302.05	283.257	3.417	37.810	1653.479	154.684	0.115	0.365	2379.388
619.213	38571.06	271.694	3.281	46.409	1348.241	188.460	0.110	0.459	2055.293
910.518	42971.33	314.186	3.436	156.704	1467.082	347.774	0.128	0.621	1409.240
1312.042	47942.92	294.208	3.005	112.973	1457.773	597.774	0.119	0.900	2328.768
1326.211	48102.36	323.108	3.295	104.557	1696.081	575.397	0.131	0.782	2868.150
1426.200	49202.61	384.253	3.929	170.129	1785.962	740.396	0.156	0.799	3441.558
1440.430	49355.83	384.671	3.921	485.470	2021.483	666.446	0.156	0.713	1280.449
1655.874	51584.64	1143.582	11.001	8709.596	2035.188	2574.701	0.464	0.814	6214.967
1770.195	52705.67	465.240	4.302	67.465	1966.197	1239.438	0.189	0.900	7368.635
1788.260	52879.34	1842.696	17.484	50448.537	2011.797	4897.495	0.748	0.889	5180.516
1880.715	53754.30	613.126	6.026	878.218	2089.737	1724.394	0.249	0.900	4789.498
1925.659	54171.65	603.451	5.875	2809.305	2433.490	1496.358	0.245	0.791	1716.192
2051.272	55312.52	485.794	5.407	144.162	2279.114	1384.258	0.197	0.900	10431.649
2079.154	55560.94	943.750	10.915	5333.081	2877.177	2165.159	0.383	0.723	9221.213
2097.216	55720.97	471.012	5.610	1911.345	2502.954	1255.354	0.191	0.838	1124.191

m/z	time	Intens.	SN	Quality Fac.	Res.	Area	Rel. Intens.	FWHM	Chi^2
2200.271	56621.29	649.827	9.436	527.831	2445.416	1882.642	0.264	0.900	25453.716
2225.633	56839.66	1272.705	18.910	104806.004	3459.511	2653.947	0.517	0.643	1441.705

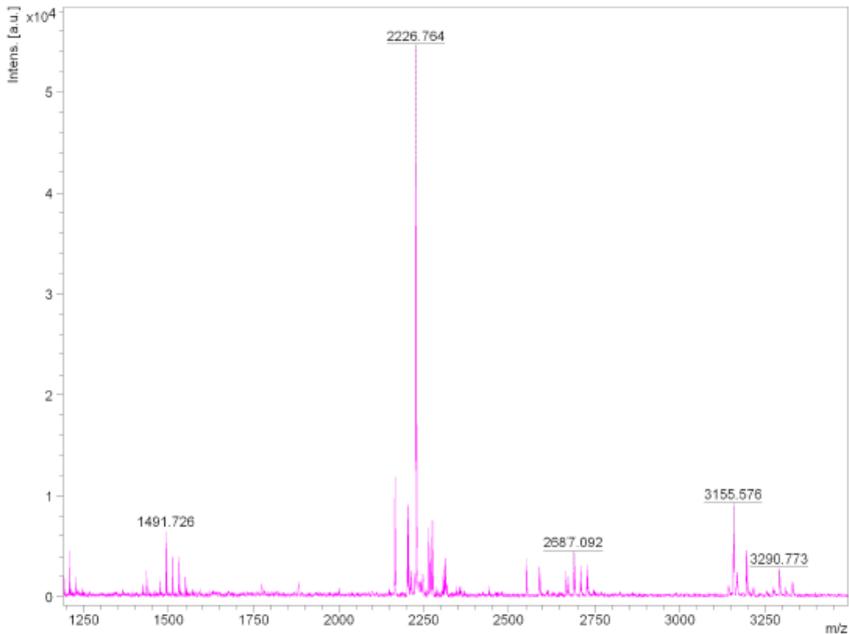
Analysis of fragments, metabolites produced by selected psychrophilic microorganisms, fraction A/1, using the Mascot database, allows to recognize the following amino acid sequences:

- 1) TrpAspAsnAspThrGI MetAspAspAlaAspGlyAspSerGlyGlyThrAlaGly
- 2) TrpAspAsnAspThrGI MetAspAsnAlaAspSerAspSerGlyGlyThrAlaGly
- 3) PhenAspAlaAspThrGI MetAspAspAlaTrpGlyAspSerGlyMetThrAlaGly

Peptides may have a cyclic structure due to the peptide bond between the amino group of the N-terminal amino acid and the carboxyl group of the C-terminal amino acid.



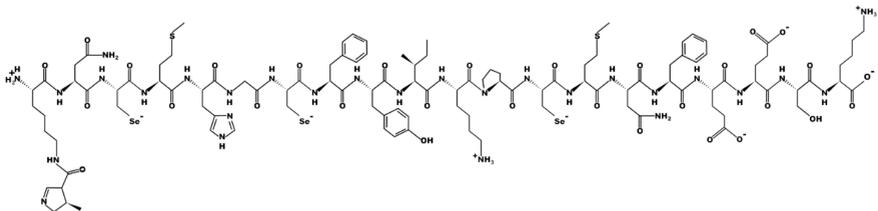
Also, using the above methodology, the amino acid composition of the peptide produced by selected psychrophilic microorganisms was obtained. The results of fragmentation of peptides of fraction A/7 are presented in Figure 3 and indicate that this peptide has a similar structure with the peptide of fraction A/1.



**Figure 3** – Molecular fragments of peptides of fraction A/7 obtained by the MALDI-TOF/TOF method

As a result of analysis using Mascot, the following amino acid sequence of the peptide fragment was obtained:

ONUMHGUFYIKPUMNFEESK



Chromatographic studies have shown that the peptide found in fraction A/7 is produced by all five studied microorganisms. The peptide of fraction A/1 was found only in culture fluid of *Ps. putida*.

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熔融氯化物中液态金属电极极化过程中电化学活性颗粒浓度对传质参数的影响  
**EFFECT OF THE CONCENTRATION OF ELECTROCHEMICALLY  
ACTIVE PARTICLES ON THE MASS TRANSFER PARAMETERS  
DURING POLARIZATION OF LIQUID METAL ELECTRODES IN  
MOLTEN CHLORIDES**

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抽象。当由于自然对流和界面对流而产生的各种类型的耗散结构以金属盐的形式出现时，给出了电化学活性颗粒浓度对熔融盐中液态金属电极极化的电流密度和传质系数的研究结果。循环池-在电极或电解质层表面沿相边界层流移动并相互涡旋，并确定传质条件和极化依存关系 (PD) 的类型。结果表明，随着浓度的增加，电流密度和传质系数也随之增加，它们的浓度变化率取决于结构的类型，并且当形成循环室时，其比自然对流或在自然对流中要大得多。电解质层沿相间边界层流移动的情况。

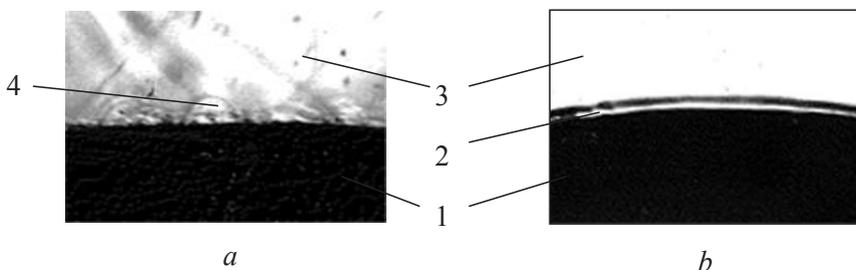
关键词：熔融盐，液态金属电极，耗散结构，循环池，层状电解质层，极化依赖性，电流密度，传质系数，浓度。

**Abstract.** *The results of studies of the concentration of electrochemically active particles on the current density and mass transfer coefficient for the polarization of liquid metal electrodes in molten salts are presented, when dissipative structures of various types arise due to natural convection and interfacial convection in the form of circulation cells - interlinked with each other vortices at the surface of an electrode or an electrolyte layer moving laminiarily along the phase boundary and determining mass transfer conditions and the type of polarization dependencies (PD). It was shown that with increasing concentration, the current density and mass transfer coefficient increase, and their rate of change with concentration depends on the type of structures and when the circulation cells are formed, it is much larger than with natural convection or in the case of an electrolyte layer moving laminiarily along the interphase boundary.*

**Keywords:** *molten salts, liquid metal electrodes, dissipative structures, circulation cells, laminiar electrolyte layer, polarization dependences, current density, mass transfer coefficient, concentration.*

### Introduction

During the polarization of liquid metal electrodes in molten salts diluted with metal-electrode ions, various types of structures arise at the electrode surface that determine the conditions of mass transfer and the type of polarization dependences (PD). Such structures may be the concentration gradient of electrochemically active particles in the electrolyte; flows caused by natural convection (NC) in the form of swirling jets or an electrolyte layer moving along the electrode surface; flows caused by interphase convection (IC) in the form of circulation cells (CC) ((the mode of circulation cells – development of CC and the attenuation of CC) or the electrolyte layer moving lamarily along the phase boundary (laminar flow (LF) mode) (Fig.1, *a, b*).



**Fig.1.** Melt flows near the electrode surface. Increased by 14 times.

*a* - CC mode; *b* - LF mode. 1 - liquid lead; 2 - laminar layer of electrolyte;  
3 - melt; 4 - circulation cell

The aim of the work is to study the effect of the initial concentration ( $c_0$ ) of electrochemically active particles on the current density and mass transfer coefficient during polarization of liquid lead electrodes in molten chlorides diluted with metal-electrode ions.

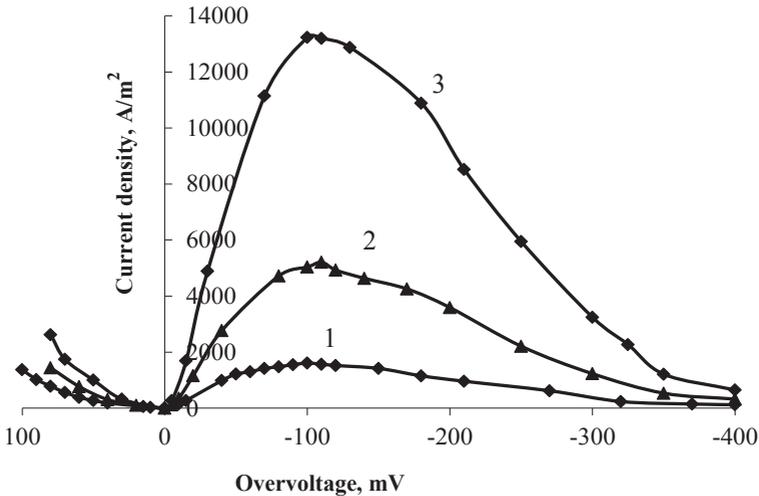
### Experimental methodology

Liquid lead electrodes were polarized cathodically and anodically under potentiostatic conditions using a PI – 50 – 1 potentiostat with a PR – 8 programmer at different initial concentrations of electrochemically active particles ( $c_0$ ). The potential was set and maintained relative to the lead reference electrode [1]. We also used visual observations and video recording. The experimental cell and experimental technique are described in detail in [2].

### Results and discussion

In fig. 1, using the example of the Pb – PbCl<sub>2</sub> – NaCl – KCl (1:1) system, typical PDs for a lead electrode obtained by varying the content of lead chloride at a constant temperature are presented (at cathodic polarization up to a maximum current density, CC develops, after the maximum, CC attenuation; at anodic polarization, the LF mode takes place). In the entire range of the studied

concentrations, the course of the polarization dependences is the same, which indicates the similarity of the hydrodynamic conditions at the interface. Common to all the systems studied with increasing concentration is a significant increase in current density at a given overvoltage ( $\eta$ ) and approximately the same overvoltage values within  $\pm 10$  mV corresponding to the maximum and decrease in current density on polarization dependences in the CC mode.



**Fig. 1.** Polarization dependences in the  $\text{PbCl}_2 - \text{NaCl} - \text{KCl}$  system (1:1), temperature 973 K, electrode diameter 6 mm.  
The concentration of  $\text{PbCl}_2$ ,  $\text{mol/m}^3$ : 1 – 34; 2 – 67; 3 – 97

In CC mode, the dependence of the current density ( $i$ ) on  $c_0$  depends on the composition of the electrolyte and the initial concentration itself. For the  $\text{PbCl}_2 - (\text{NaCl}; \text{NaCl} - \text{KCl} (1:1); \text{KCl})$  systems, the dependences  $i = f(c_0)$  exhibit a kink at some “critical” concentration of  $c_{\text{cr}}$  and two sections are clearly observed (Fig. 2).

The value of  $c_{\text{cr}}$  depends on the composition of the system and is equal for  $\text{PbCl}_2 - \text{NaCl}$ ,  $\text{PbCl}_2 - \text{NaCl} - \text{KCl} (1:1)$ ,  $\text{PbCl}_2 - \text{KCl}$ ,  $\text{mol/m}^3$ :  $\approx 35$ ,  $\approx 86$  and  $\approx 36$  respectively. On  $i - c_0$  with the  $c_0$  curve for the  $\text{PbCl}_2 - \text{NaCl} - \text{CsCl}$  (eut.) system, the inflection point is apparently not reached

In the LF mode with anodic polarization, the dependences  $i = f(c_0)$  are monotonous nonlinear in nature (Fig. 3) for all systems in the entire range of studied concentrations.

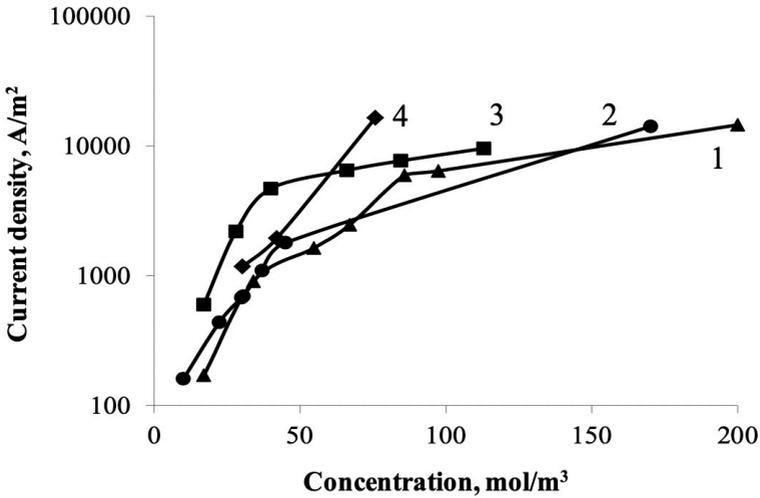


Fig. 2. The dependence of the current density in the CC mode on  $c_0$  at overvoltage  $-40\text{ mV}$  in systems: 1 –  $\text{PbCl}_2 - \text{NaCl} - \text{KCl}$  (1:1); 2 –  $\text{PbCl}_2 - \text{KCl}$ ; 3 –  $\text{PbCl}_2 - \text{NaCl}$ ; 4 –  $\text{PbCl}_2 - [\text{NaCl} - \text{CsCl} (\text{eut.})]$

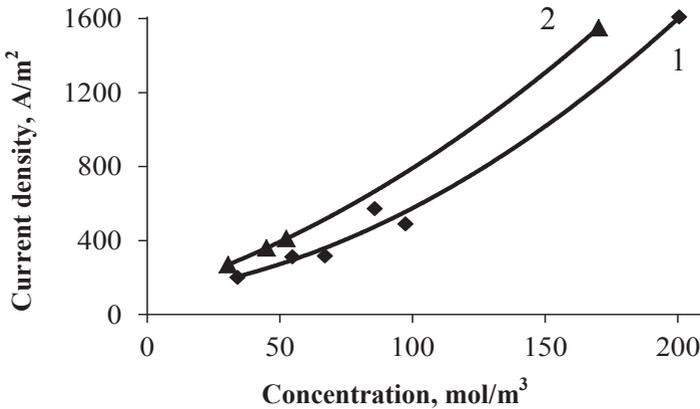


Fig. 3. Dependence of current density in the laminar flow regime on concentration at an overvoltage of  $40\text{ mV}$ ; systems: 1 –  $\text{PbCl}_2 - \text{NaCl} - \text{KCl}$  (1:1); 2 –  $\text{PbCl}_2 - \text{KCl}$

Using the measured values of  $i$  for given  $\eta$  and  $c_0$  the mass transfer coefficients  $K_s$  were calculated using the equation

$$K_s = \frac{i}{z \cdot F \cdot c_0 \left[ 1 - \exp\left(\frac{\eta_d \cdot z \cdot F}{R \cdot T}\right) \right]}$$

where  $z$  – number of electrons involved in the electrode reaction,  $F$  – Faraday number,  $R$  – universal gas constant,  $T$  – absolute temperature,  $\eta_d = \frac{R \cdot T}{z \cdot F} \ln \frac{c_s}{c_0}$  – diffusion overvoltage,  $c_s$  – concentration of electrochemically active particles at the surface of the electrode.  $c_s$  was calculated by the equation of the theory of delayed discharge for mixed kinetics [3] using data on the exchange current density and transfer coefficient for the corresponding systems [4].

According to dependencies  $i = f(c_0)$   $K_s$  in CC mode, at a given overvoltage, it changes with concentration in a rather complicated way (Table 1).

**Table 1.** The values of the mass transfer coefficients at various initial concentrations of electrochemically active particles

PbCl <sub>2</sub> – NaCl – KCl system (1:1), temperature 973K						
Concentration, mol/m <sup>3</sup>	34	55	67	86	97	200
The mass transfer coefficient · 10 <sup>3</sup> , m/s at an overvoltage of –50 mV. CC mode. Given the overvoltage stage of the ionization discharge [9].	28	29	41	78	79	120
The mass transfer coefficient · 10 <sup>3</sup> , m/s at an overvoltage of 50 mV. LF mode. Assuming electrode reversibility.	1.96	1.91	1.67	2.19	1.80	3.15
PbCl <sub>2</sub> – NaCl system, temperature 1081K						
Concentration, mol/m <sup>3</sup>	17	28	66	84	113	
The mass transfer coefficient · 10 <sup>3</sup> , m/s at an overvoltage of –50 mV. CC mode. Assuming electrode reversibility.	40	80	93	91	85	

With  $c_0$  less than  $c_{cr}$   $K_s$  monotonously increase with increasing concentration for all systems. With  $c_0$  is more than critical, the mass transfer coefficient can slightly decrease or increase for all  $\eta$  values.

Due to nonlinear relationships between the current density, mass transfer coefficient, and concentration, the changes in  $i$  and  $K_s$  with changes in  $c_0$  ( $di/dc_0$ ), ( $dK_s/dc_0$ ) are not constant, but depend on the concentration (Table 2).

Values given in the Table 2 ( $di/dc_0$ ), ( $dK_s/dc_0$ ) indicate that the current density and mass transfer coefficients during electrolysis under the conditions of the combined action of interphase and natural convection depend more strongly on the initial concentration than under the conditions of action of only natural convection, and in the mode of circulation cells much stronger than in the laminar flow mode.

Thus, the influence of the concentration of electrochemically active particles is determined by the type of structures arising at the surface of the electrode when the system deviates from equilibrium.

The mass transfer coefficient in the regimes of circulation cells and laminar flow can be represented as a first approximation as the sum of the mass transfer coefficients due to natural convection ( $K_s^{NC}$ ) and due to interfacial convection ( $K_s^{IC}$ ). Table 2 in column 6 shows the values of  $K_s^{IC}$  changes with a change in concentration, calculated as the difference between the values in columns 4 and 5.

In CC mode, a change in  $K_s^{NC}$  with a concentration has practically no effect on a change in  $K_s^{IC}$ . For the LF regime, such an estimate shows that, despite the constancy of the general mass transfer coefficient in the  $PbCl_2 - NaCl - KCl$  system, the mass exchange rate associated with interfacial convection increases with increasing  $c_o$ , moreover, according to a nonlinear law.

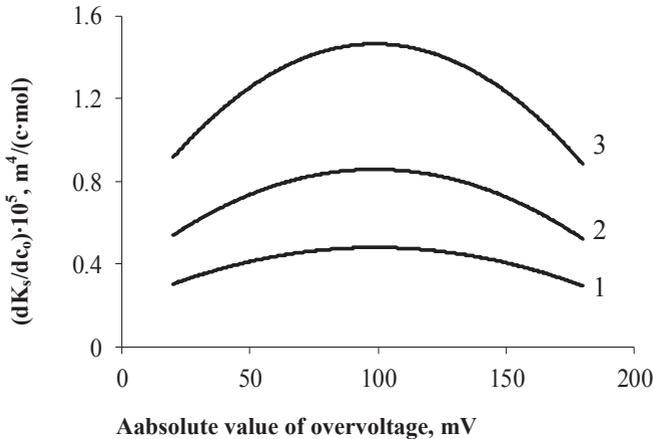
**Table 2.** Comparative characteristics of the parameters of the cathodic and anodic processes during electrolysis under the conditions of “pure” NC and the combined action of natural and interfacial convection ( $di/dc_o$ ,  $dK_s/dc_o$ )\* in the  $PbCl_2 - NaCl - KCl$  system (1:1). In the CC mode,  $K_s$  was calculated taking into account the overvoltage of the discharge-ionization stage.

$c_o$ mol/m <sup>3</sup>	$di/dc_o$ A/H	$d^{iNC}/dc_o^{**}$ A/H	$(dK_s/dc_o)\Psi$	$(dK_s^{NC}/dc_o)\Psi$	$(dK_s^{IC}/dc_o)\Psi$
Overvoltage – 50 mV					
34	34	2.2	0.5	0.012	0.488
67	165	2.8	1.3	0.008	1.292
86	402 / 101	3	2.2 / 0.4	0.006	2.194 / 0.394
97	103	3.1	0.4	0.006	0.394
Overvoltage – 100 mV					
34	52	3.1	0.6	0.013	0.587
67	275	3.9	1.5	0.008	1.492
86	705	4.3	2.5	0.007	2.493
Overvoltage – 50 mV					
34	6.03	5.22	0.0092	0.0058	0.0034
67	8.65	5.98	0.0092	0.0034	0.0058
86	10.14	5.84	0.0092	0.0026	0.0066
97	11.06	6.44	0.0092	0.0025	0.0067

\*numbers through a slash indicate the value of the derivative when approaching a given critical concentration from the side of lower and higher concentrations. At the critical concentration point, the derivative has a gap.

\*\*values  $d^{iNC}/dc_o$  and  $dK_s^{NC}/dc_o$  are calculated using the mass transfer model with a “clean” NC [5; 6].

The values of  $(di/dc_o)$ ,  $(dK_s/dc_o)$  are also affected by the degree of deviation of the system from equilibrium or the degree of development of dissipative structures at the interface. Figure 4 shows the dependences  $(dK_s/dc_o)$  on the overvoltage for the  $PbCl_2 - NaCl - KCl$  system (1:1), on which it is clearly seen that  $(dK_s/dc_o)$  increases with the development of structures, reaches maximum values under the conditions of the existence of developed circulation cells and decreases with their attenuation.



**Fig. 4.** Change in the mass transfer coefficient with a change in concentration in the CC mode depending on the overvoltage in the  $PbCl_2 - NaCl - KCl$  system (1:1). The concentration of lead chloride,  $mol/m^3$ : 1 – 34; 2 – 67; 3 – 97

Under the combined action of natural and interfacial convection, the current density and mass transfer coefficient are functions of the physicochemical properties of electrolyte, as with NC, and also depend on:

- properties of the metal phase, which, however, are independent of concentration;
- driving force of interfacial convection, which is determined by the change in interfacial tension with potential  $(d\sigma/dE)$  according to electrocapillary curves [7].

From Table 2 it follows that in the CC mode, the quantity  $d\sigma/dE$  has the greatest effect on the change in  $i$  and  $K_s$  with concentration, while in the LF mode up to  $c_o \sim 34 mol/m^3$  interfacial convection is weaker than natural but then its influence is somewhat enhanced.

If we assume that the dependence of the current density on  $d\sigma/dE$  does not change with increasing concentration, then it should be assumed that, starting from the critical concentration value (Fig. 2), the slope of the electrocapillary curve changes in such a way that the decrease in interfacial tension when the potential is

shifted to a positive the side follows a close-linear law when  $d\sigma/dE$  increases very weakly and, consequently, the IC intensity decreases.

The decrease in IC intensity with increasing concentration in CC mode can be explained from a general standpoint. Indeed, in a pure background electrolyte and in an individual salt melt of electrochemically active particles, IC, obviously, should not develop at all, since there is no stable concentration gradient perpendicular to the interphase boundary, causing a positive feedback between the forces acting at the interphase boundary and the quantity flows movements and masses caused by these forces. [8]. Therefore, in a fairly wide range of changes in concentration at a certain value, the intensity of interfacial convection should be the highest.

Thus, as the intensity of interfacial convection increases, and, consequently, the mass transfer rate, they must first increase and then decrease at a certain critical concentration value. This value is determined by the nature of the system. For one salt of electrochemically active particles,  $c_{cr}$  depends on their activity in the melt. For various salts of electrochemically active particles, the value of  $c_{cr}$  is apparently determined by the structure of complex anions, which determines their surface activity.

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