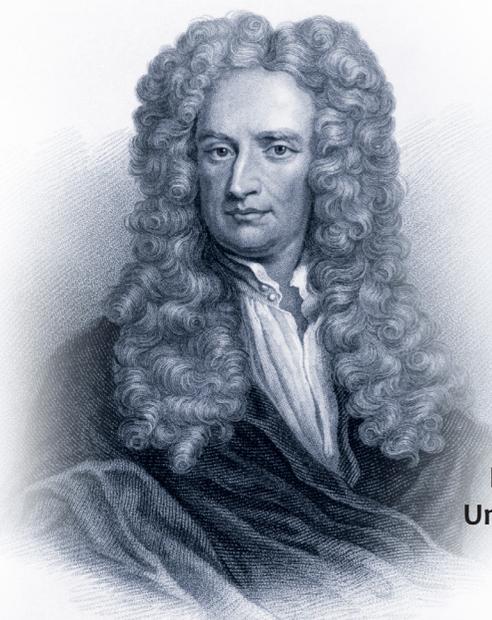**INTERNATIONAL CONFERENCE**

PROCESS MANAGEMENT AND SCIENTIFIC DEVELOPMENTS

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These Conference Proceedings combine materials of the conference – research papers and thesis reports of scientific workers. They examines tecnical and sociological issues of research issues. Some articles deal with theoretical and methodological approaches and principles of research questions of personality professionalization.

Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

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CHEMICAL SCIENCE

TECHNICAL SCIENCES

RECRUITMENT BASED ON ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Abstract. In connection with the digital transformation of the economy, organizations are faced with the task of choosing methods of transition from the classical methods of human resource management to the "HR 3.0" model, which allows increasing the efficiency and speed of solving the problems of hiring, retaining and developing personnel as a result of using cloud technologies, chat bots and artificial intelligence. One of the key areas for improving human resource management is the digitalization of the recruiting process. The article proposes a technology for the implementation of digital recruiting by companies; a methodology for evaluating candidates' resume, a methodology for conducting preliminary interviews using intelligent dialogue systems based on the principles of machine learning; an example of using the chat bot in the selection and evaluation of candidates is considered; The advantages of digital recruiting over the classical methods of personnel selection are indicated.

Keywords: human resources management, digital recruiting, automated recruiting system, intelligent dialogue system, chat bot.

Introduction

As a result of the gradual introduction of advanced methods and approaches into business processes, human resources management (HR) undergoes a digital transformation. At the stage of transition to the digital economy, artificial intelligence technologies, HR and predictive analytics, tools for working with large data sets, machine learning are introduced into the traditional management model; HR processes are robotized and automated, which in turn requires specialists to master new key skills [1].

Human resources management is moving to a new level - the "HR 3.0" model, which allows to increase the efficiency and speed of solving the problems of hiring, retaining and developing staff thanks to mobile technologies, technologies for searching candidates through social networks,

analysis of large data arrays, the use of cloud technologies and digital forms psychometric tools for staff assessment. The key areas of HR digitalization include: digital recruiting, HR marketing, staff training, HR analytics [2].

The process of recruiting and hiring staff most affects the company's business results. The classic form of the recruitment process is being replaced by digital recruiting. The main advantages of using automated personnel recruitment systems are: freeing up time for new tasks, ensuring transparency of the recruiting budget, and shortening the search for employees [3].

An analysis of the effectiveness of the introduction of digital technologies in the human resource management process has revealed areas in which automation fully met the expectations of specialists: sending notifications to candidates, recruiting analysts, ranking resumes and searching for candidates [4].

International research "The Future of HR", conducted in 2019 by "KPMG International", indicated the areas of digital human resource management [5]: the introduction of technologies and skills that provide benefits and competitive advantage from the use of big data analysis; the integration of human and digital labor through the use of artificial intelligence and machine learning; the use of HR analytics in order to improve the quality of management decisions and predict employee behavior, as well as their performance.

In this regard, organizations are faced with the task of choosing methods of transition from classical methods of human resource management to digital, giving competitive advantages.

Technology for the implementation of digital recruiting

The classical implementation of the recruiting process contains a large number of routine operations and repetitive tasks that are advisable to automate, that is, convert the classic recruitment into digital form. The technological concept proposed by the author for implementing digital recruiting is presented in Figure 1 [6]. According to this figure, digital recruiting is a combination of the functions of subjects (HR specialist, candidate for the position) and objects (HR portal, Internet resources, chat bot) of the personnel selection system that allow you to close a vacancy in the shortest time and with the least effort and expense (find workplace).

The combination of technology elements such as "HR Portal" and "Chat bot" is an automated recruiting system (ARS) that allows you to: reduce the cognitive distortions allowed by recruiters and reduce the influence of the human factor; automate resume screening and preliminary interviews; establish communications with candidates and maintain them throughout the

hiring process; expand the staffing funnel; improve the quality of selected candidates; collect and process analytical data for objective decisions in recruiting management; eliminate the risk of losing information about valuable candidates and selection status; reduce the subjectivity of the selection process; reduce hiring costs and recruitment time; ensure the growth of labor productivity of HR specialist [3, 7].
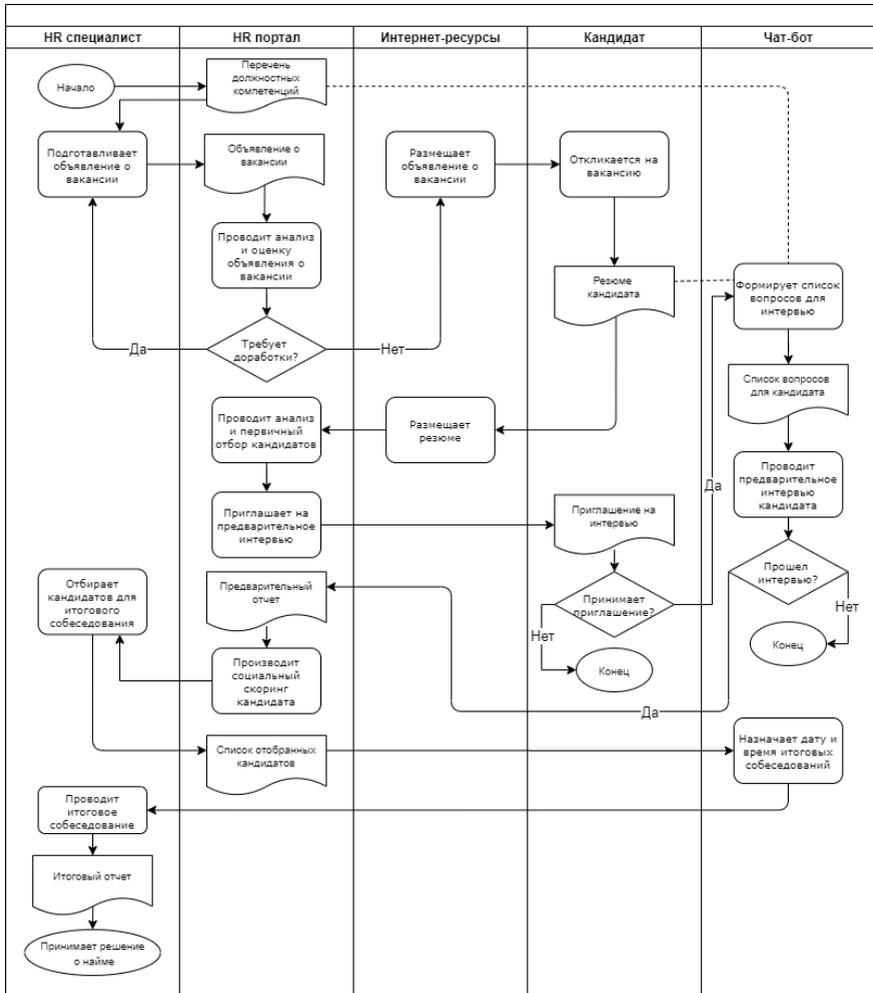

Figure 1 - Digital Recruiting Technology
Source: compiled by the author.

The ARS system provides a transparent principle of operation [3]:

- HR specialist sets vacancy parameters by which the system selects the right applicants in Internet resources (on job search sites, social networks, online exchanges), imports suitable resumes into the HR portal database;

- HR portal carries out initial selection of candidates according to their resume;

- HR specialist instructs the chat bot to invite and conduct a preliminary interview with the selected candidates;

- the chat bot develops a list of questions and conducts an interview, the results of which are provided to an HR specialist;

- having received written consent, the HR portal conducts social scoring of candidate accounts on social networks;

- HR portal system sends to the specialist reports on selected candidates during preliminary tests;

- HR specialist selects candidates for final interviews with company experts;

- the chat bot contacts the candidates and sets the date and time of the final interviews, coordinating the schedules of the interviewing experts and candidates;

- HR specialist analyzes the results of interviews, provides them to the company management, which makes the final decision on hiring.

Thanks to ARS, a recruiter does not need to manually search for a resume, compare competencies and qualities of a candidate with the requirements of a vacancy, and contact applicants. The system also allows you to compile a resume database, analyze the sources of candidates search and determine the most effective among them, collect data on the number of interviews and compare them with previous periods, study the funnel of candidates, calculate the cost of response of candidates, create an external personnel reserve.

As practice shows, the most costly and lengthy recruiting processes, including a large number of routine and similar operations, are the initial selection of a resume and conducting a preliminary interview with the candidate. Thus, it is advisable to carry out these processes with the help of an intelligent dialogue system built on the principles of machine learning, a chat bot.

To date, the most popular recruiter bots are: XOR (xor.ai) - a bot on Telegram, Facebook and HeadHunter (hh.ru)); TalkPush (talkpush.com) - bot in Facebook Messenger; Wendy (wadeandwendy.ai) - screening bot in Slack; Skillaz is a system for automating the selection, decision-making, processing and analysis of jobseeker data on job search sites and social networks [8].

Consider the principle of the initial selection of candidates for their resume HR portal. The resume rating is set according to the aggregate score from a number of criteria having different specific weights, depending on the requirements of the vacancy, and aggregated in the integral indicator - aggregate resume score [3]:

$$P = \sum_{i=1}^{n} (b_i \times K_i),$$

where P – resume rating, score; b_i – the amount of points received by the candidate on the i-section of the criteria for evaluating a resume, score; K_i – the importance of the i-section of the criteria for evaluating a resume (depends on the requirements of the vacancy, affixed by HR specialist).

When evaluating an HR resume, a specialist assigns passing points to the portal system for each section of the matrix, depending on the position. Based on the requirements of the vacancy, the specialist establishes the significance level of the evaluation criteria section. Passing points and significance level are determined by specialists of the relevant services and company divisions (experts). Each vacancy competency identified is assigned points and competencies are ranked in the order they are expressed in a particular position.

At the next stage, the HR specialist connects to the chat bot process. At the recruiter's command, the system sends an active link to the candidate's mobile device that has passed the selection stage by resume. This link allows you to launch a chat bot on a specific platform of a social network, messenger or on the company's website, which develops a list of questions and conducts a preliminary interview [7]. In this case, the list of questions is divided into an informational and specialized unit.

The information block includes questions for the candidate that do not require specialization: profession (specialty), level of education, place of residence and willingness to move (business trips), purpose of passing tests (internship, getting a position), type of employment (full, partial, remote), desired salary level, basic skills, abilities and qualities of the candidate. The specialized unit is represented by narrowly focused issues, drawn up depending on: a list of job competencies; skills demanded in the labor market; the level of preparation of the candidate identified in the analysis of his resume. Based on the results of the answers to the questions of the specialized unit, information is generated about the proposed level of wages, the need for an internship by a candidate with experience, skills, abilities and qualities identified by the candidate.

At the end of the interview, the information collected by the bot is sent to the analytical unit of the ARS system (HR portal) to analyze the candidate's answers, the results of which determine the level of his competence, his compliance with the requirements of the vacancy, and also form a preliminary report provided by the HR specialist.

The practical application of intelligent dialogue systems, built on the principles of machine learning, in the selection of personnel

Testing of the interview bot was carried out in the Vitebsk IT company with a staff of 120 people. Candidate level: graduate students of higher educational institutions of Vitebsk. The purpose of selection: practice and internships in the company. Number of candidates: 14 people. Baseline: interviews with candidates; Javascript developer job requirements posted on "Rabota. tut.by "(table 1).

Table 1 - Javascript developer job requirements

Rank	Mandatory requirements	Score	Rank	Desirable skills	Score
1	Knowledge of JavaScript standards (ES5, ES6+)	16	1	Experience writing unit tests (Jest + Enzyme)	9
2	Knowledge of HTML5, CSS preprocessors	12	2	Experience in configuring a project from scratch (Webpack)	9
3	Knowledge of HTTP	8	3	Knowledge of functional libraries (lodash, underscore)	6
4	Basic skills for working with GIT	4	4	Experience with frameworks and libraries (Angular, React, Vue)	6
5	Interest in new technologies	3	5	Knowledge and experience with Redux	6
6	Desire to grow and develop	3	6	English language (no lower than "A2")	3,5
7	Initiative	3	7	Experience with Docker	6
			8	Understanding of JS on the server side of Node. js (Express, PassportJS, authorization), SQL, NoSQL	3
Total		49	Total		39,5

Source: compiled according to [Rabota. tut.by].

Based on the requirements of the vacancy and the level of training of candidates, the "InterviewBot" chat bot developed by the author on the "Telegram" platform made up questions for interviews in an informational and specialized block.

The results of the interviews were entered into the HR database, where the data for each candidate were analyzed, an average portrait of the applicant was compiled, and a diagram of the candidates' preparedness for the vacancy requirements was built (Figure 2).
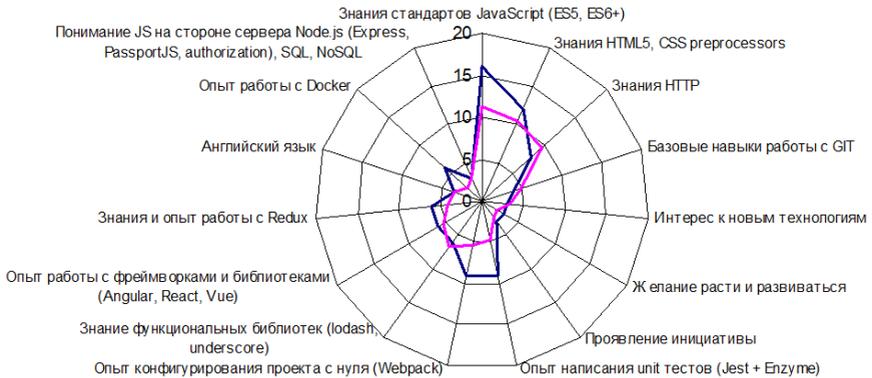
The data of the "average" candidate are displayed in red, and the vacancy requirements in blue.

Figure 2. – Diagram of the suitability of candidates for job requirements.

The constructed correspondence diagram allows you to determine not only the level of knowledge, skills, but also the direction of training during practice and during the internship of candidates (JavaScript, HTML5, CSS preprocessors; writing unit tests; configuring a project from scratch (Webpack); working with frameworks and libraries (Angular, React, Vue); work with Redux and Docker).

The obtained candidate selection values using the chat bot were compared with the selection values carried out by an HR specialist, and the data were entered in the HR portal summary table (table 2).

Table 2 – Comparative analysis of the selection of candidates conducted by chat bot and HR specialist

Indicator	Value, %	
	Chat bot	HR specialist
The number of candidates who participated in the selection	100	100
The number of candidates selected	57,2	50,0
The number of candidates who received a second attempt to qualify after studying the necessary material	14,2	7,1
The number of candidates rejected	28,6	42,9

Source: compiled by the author.

Thus, the interview conducted by the chatbot allowed us to accept 1.1 times more candidates for internships, reduced the dropout rate by 1.5 times and doubled the number of candidates who received a second attempt to qualify after studying the necessary material.

"Interview bot" has the following advantages over a recruiter: a continuous process of work 24 hours a day, 365 days a year; the ability to work on various platforms, customizable to the needs of the candidate; multi-channel responses (the ability to respond to requests from multiple candidates at the same time); minimum current maintenance costs; continuous training and replenishment of the interview base; digital storage of received information in the ARS system.

Conclusion

A common problem in assessing job seekers is the "human factor" (subjectivity of the assessment, technical errors, manifestation of emotions, loss of concentration, etc.) and short deadlines for processing large amounts of information. To solve this problem, employees of HR departments and specialized recruitment agencies are offered their digital counterparts - recruiting bots (recruitment chat bots), capable of: analyzing the data presented in the resume; to determine the level of competence and experience; schedule an interview; conduct an initial interview; to rank candidates.

When introducing a digital HR specialist, it is important to develop principles and metrics for staff recruitment; a list of questions relevant to the vacancy; methodology for analyzing the information received; choose a software product for the collection, processing and storage of HR information.

In order to reduce the time and labor costs of HR specialists, the convenience of collecting, processing and storing information, companies are encouraged to introduce an automated recruiting system that uses the capabilities of artificial intelligence and allows HR personnel to be freed from routine processes and repetitive monotonous tasks.

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THE MANAGEMENT OF ENERGY AND FINANCIAL SECURITY OF THE INDUSTRIAL REGION

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Abstract. The article systemized approaches to the methodology for calculating the level of financial security have been consolidated. It is concluded that it is appropriate to use an indicative method of energy security analysis as a variant of the study of the energy and financial security. As a result of the assessment of the energy security level of the Kemerovo (Kuzbass) region it is concluded that all indicators of energy security have acceptable pre-crisis values. According to the share of own sources in the balance of electricity, the disposable capacity of power plants and the capacity of the largest power plant in Kuzbass region is in the pre-crisis zone, which determines its energy and financial independence. This determines the necessity to adjust the methodology for determining the energy and financial security. It is proposed to supplement the methodology of assessing the level of energy security with indicators that take into account the diversification of sources of electricity generation both as a main resource and the possibility of commercial accounting of electricity consumption.

Keywords: industrial region, financial security, energy security, indicative analysis

1. Introduction

The focus of experts, international organizations and business falls on the problem of ensuring energy security and monitoring its indicators mak-

ing this issue sharp and urgent [1, 2, 3]. Researchers agree that today the development of civilization is taking place along with the predominance of the high technological paradigm which contributes to the efficient use of all kinds of resources. In academia and the economic community there is a continuing debate about the impact of all factors on the direction and pace of social and economic development and its sustainability. An additional range of questions arises when studying the impact of economic sanctions on the Russian economy, the assessments of which are ambiguous [4, 5, 6]. Under the conditions of economic turbulence the development of high-tech production in all sectors of the Russian economy, as well as in other countries, contributes to its continued competitiveness in the global economy improving the level of national security and its components (food, economic, financial etc.) and expanding the investment process [7, 8]. Theoretical and practical questions remain unanswered when analyzing the adaptation of regions to the new economic conditions and the stimulation of the investment process in regions with different economic structure. The study of this process in its relations to the regional financial security presents a scientific challenge that has practical implementation as a system of regional policy management and its innovative, investment and financial aspects [9, 10, 11]. The question of the level which should be considered financially safe still remains open. The object of this study is Kemerovo region as one of the regions of the mineral and raw materials cluster, as its economy to a great degree determines the level of Russia's energy security.

Results and Discussion

The region-level study of the energy and financial security was conducted using a dialectical approach to the study of these issues in their interdependence with other aspects of social and economic life. Materials of official statistics bodies and reports of energy and financial companies were used as a data base. At the empirical level of the research we used methods of economic monitoring, analysis and synthesis as well as statistical methods. A large number of criteria for assessing energy security are used as a basis for an indicative analysis system in Russia and abroad. In the works of many international and Russian authors their number varies from 5 to 20 criteria. The method of indicative analysis allows to assess the level of energy security with sufficient accuracy determining the situation by the degree of crisis which is understood as a threat for the economic system.

Studies to assess the level of energy and financial security of the country and regions are conducted in several stages, the first of which is the analysis of possible threats to the energy and economic systems. The next

crucial task is to classify external and internal threats, actual and possible threats, determining the shape and intensity of each particular type of threat and the pace at which they reach the maximum acceptable level.

The essence of this phase is a comprehensive assessment of the level of energy and financial security using integral quantitative and qualitative characteristics. Monitoring is carried out at all stages of assessment. This method can be described as a set of continuous monitoring and analysis of the processes that take place in the industry and affect the level of energy security. Monitoring as a method of analysis has a research purpose and objectives. In particular it is the detection of security threats, assessment of current and expected levels of energy security, gathering information to justify the vector of energy development, determining the directions of investment and innovation processes [11, 12]. The final stage of monitoring is an indicative analysis of the security on a country scale or regional level based on comparing the values of indicators with the thresholds set by the expert method.

The difficulty of forecasting energy development indicators remains so the transition to a dangerous state of crisis and a sharp decline in the level of energy security is not completely ruled out. If energy security management measures are not taken on time with full mobilization of domestic material, labour, raw materials and other resources, the situation in the region and the country as a whole can become significantly worse.

As a rule, the security system can't be restored by itself and the process requires an outside interference. The set of the key indicators for monitoring the level of energy security proposed by the authors is quite various. According to our calculations of the energy security level of the Kemerovo region it is possible to conclude that all indicators of energy security except a certain degree of depreciation of the fixed assets of the fuel and energy complex enterprises have acceptable pre-crisis values.

A significant threat to the energy security of the region is observed in the high depreciation of the fixed assets of enterprises operating in the electricity sector, both in manufacturing and mining industries. Its value corresponds to the highest crisis threat level. Besides, among the negative trends we can name the energy capacity of the gross regional product of Kuzbass region which is three times higher than the national average. This indicator can be used as an additional criterion for assessing the level of the energy security. Its advantage lies in the simplicity of calculation and comparability with the average Russian level. Efficiency in the use of resources including energy is becoming a crucial element of the economic development, innovation and management. This efficiency can be

evaluated in a variety of ways from simple and more qualitatively focused to complex and multifaceted with taking into account different factors and their correlation.

According to our calculations the Kemerovo region can be character-ized by a high level of energy security. According to the share of its own sources in the balance of electricity, Kuzbass region is in the pre-crisis zone with the disposable capacity of power plants and the capacity of the largest power plant, which determine the region's energy independence. These indicators have also a positive impact on the investment of the re-gion, determining social and economic stability. In its turn this situation determines a positive trend in financial security, as any investor in making decisions will be guided by the assessment of the security of their invest-ments both from the energy complex and on positive decision-making is-sues of social, food and financial security.

This speaks for the necessity to adjust the methodology of determining energy security. We propose to supplement the methodology of energy se-curity assessment with indicators that take into account the diversification of electricity sources both as a main resource and the possibility of com-mercial accounting of electricity consumption. Such criteria may include parameters for accounting for the degree of electricity sources diversifica-tion, the criterion of the consumer share with the established system of automatic commercial electricity accounting in the total number of electric-ity consumers in the region. An important element in the energy security assessment system can be considered a criterion that characterizes the availability and adequacy of fuel and energy resources in the region. Moni-toring of these criteria in combination with those applied earlier will provide an opportunity for a more comprehensive assessment of the state of the energy situation in the region. In the long run a comparative analysis be-tween the regions of the Russian Federation can be carried out as well. Given that the energy is one of the accelerators for innovation a more ac-curate assessment of energy and financial security will allow to deepen the assessment of the dynamics of the innovation process.

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THE ACTUALIZATION OF THE DEVELOPMENT OF MODERN RUSSIAN STATEHOOD (FROM ARCHAIC TO NETWORK)

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Abstract. The article is devoted to the idea of state failure in the Russian Federation. This is compensated to some extent by the adopted constitutional amendments, which eliminate the "fossilization" of the Basic Law. The specifics of both the hierarchical network approach to Russian statehood and the non-hierarchical path of development are considered. If the first acts as part of the state, then in the second case the state is part of the network. The positivity and negativity of this point of view are revealed. The proposed cognitive science substantiates the existence of a non-hierarchical network Russian statehood in equilibrium with legal and social statehood. Which requires additional constitutional understanding.

Keywords: network state, corporatism, hierarchy, archaic power vertical, cognitive science, political practice.

I. Contemporary Russian specifics in this area.

In the Russian Federation, the functionality of formal institutions is clearly lagging behind the corresponding development paradigm of the XXI century. Therefore, the question arises: how does the Leviathan of the Russian state organism function at the present moment? This functionality, as evidenced by political practice, is implemented by networks, often more formal, taking the form of sub-institutions, and sometimes less formal. The Russian government that runs the country - is a network structure consisting of key nodes of the national network and nodes of key corporate networks. Among such "nodes" are the government and the apparatus, the Presidential Administration and its apparatus, the main power structures, the largest state corporations and business empires. It is this network structure, and not the official power, that governs the functionality of transactions. The power vertical, which in reality represents a node of departmental verticals, is hierarchical networks.

This partly coincides with the concept of a network state introduced into scientific circulation by M. Castells. The network state is characterized by the sharing of power, right up to the possibility of carrying out legitimate violence within the framework of a certain network.

Hence, the network statehood in the Russian Federation is very specific. Basically, this is the interception by some network structures of part of the state's functions belonging to formal institutions. The analytics correctly noted that here it is not the state that is part of the network, but the network that is part of the state. Therefore, the problem in the Russian Federation is that the listed network resources are used not in the interests of the state as a whole, but in the interests of a network structure with both political and business potential. Moreover, this megastructure works nationwide.

The specificity here is that the "network" here should be understood in an abstract sense. Really operating network structures are more compact and more specific, they are characterized by clear functional connections. And then the question in relation to the official leader of the country should be addressed not so much to the individual as to a specific node in the network, or rather, various networks.

II. Cognitive studies and political practice on the landmarks of the development of Russian statehood.

From the standpoint of the country's development, the mentioned network statehood is fundamentally ineffective. Hence the delay in decision making and the so-called manual control mode.

Analytics rightly substantiates the need to strengthen network institutions outside the aforementioned megastructures. Then the network structures of the latter and their functionality will be significantly weakened.

The Russian Federation - is not a federation of regions, but mainly of corporations. In conditions of weak institutions, the state is organized and works as a network - with informal connections and agreements, with internal norms ("concepts") and loyalties. The consequence of this is non-publicity and non-transparency, since the very structure of the state excludes normal communication with society. At the same time, the regionalization with 86 regions was replaced by corporatization. We can also speak of a two-dimensional model, where both regional and corporate dimensions are preserved, but they have partially changed places, that is, the corporate has become the main one.

The corporate structure, in which the "building blocks" are closed corporations that have little contact with each other, leads to an insufficient level or even a complete absence of specialization, duplication of functions

by different parts of the system and, as a consequence, low efficiency of the system as a whole. The actions of corporations are often mismatched, and competition between them, carried out outside of public policy, often harms the system.

The current Russian state itself is built on the model of a corporation, and one where the main word is always with the shareholders. However, having no relation to management, it is difficult to maintain the position of a major shareholder. Therefore, shareholders sometimes - but not necessarily - simultaneously act as managers. Power - is not just an arbiter, but the main shareholder, or, rather, because the main shareholder is also an arbiter. Ordinary citizens are excluded from this scheme; for a corporation engaged in the extraction and redistribution of natural rent, - they are a burden, with the exception of that small part of them that serves this "statehood".

The problems listed above make the system ineffective even at the central level; at the regional level - various federal structures coordinate their actions even less, and sometimes directly compete with each other. Such a system is inefficient and resource intensive. It is ineffective from the point of view of a "normal" state, where the state apparatus is called upon to perform an important function in the system and is controlled from the outside. However, in the Russian bureaucratic regime, the basis of which is a gigantic natural rent, considerations of external, system-wide competitiveness are not too important and, on the contrary, the motives of internal competition are strengthened - between individual subsystems and networks. What is costs and inefficiency for the entire system, for its individual parts, whose interests dominate over system-wide interests, are incomes and the meaning of their activities.

The situation turns out to be unstable due to the weakness of control mechanisms and the fact that the overgrown and at the same time fragmented system of power is not able to realize the system-wide interest, and even more so to exercise it.

In political science, it is noted that changes must be systemic and universal, the main of which is a radical reduction in the scope of functions performed by the state machine. Parasitic functions - feeding the bureaucracy instead of solving national problems - that hinder the life of business and society should be abolished, and the remaining ones should be redistributed between hierarchical levels, according to the principle of subsidiarity, while eliminating imbalances between horizontal and vertical elements.

Some hopes are inspired by the constitutional amendments adopted in 2020, which will possibly correct, and perhaps fix the current situation.

The functional of statehood in this context is due to the emergence of new meanings in the political space of the Russian Federation. It is impossible to explain or expand this thesis without appropriate cognitive science. So, the state is the organization of the life of society, the power is its organizer. However, these functions "stall" because of the illusions constantly instilled by the authorities about the expediency of an unrealistic political course. "Closely adjacent to it is the so-called deliberate utopia, ideologically sanctioned and consciously applied. It is an aberrative, wishful thinking. " [2] Strengthening the potential of the illusion of a successfully continuing policy signals a "depletion" of power potential. Utopian politics can also be the result of a mismatch between political and social relations.

Undoubtedly, today's political regime, to put it mildly, firmly holds the state in its "embrace". But, of course, it is also the fact that the state in its essence - is a constant, and the political regime - is a variable predicate. Regimes come and go, but the state remains, and in this case the idea of a network state in the Russian Federation is actualized. But not in the same capacity as previously mentioned.

According to M. Castells, this is explained by a significantly different structure of society - a decentralized, de-hierarchized community of coalitions and cooperatives - which he called "network". Reality has confirmed the priority of his network approach in the development of socio-political space. M. Castells went further, putting forward the concept of "network state". For the first time, the politico-regulatory functional was formulated in relation to the virtual field. However, long before M. Castells, the domestic scientist P. Novgorodtsev drew attention to the double definition of the idea of the state, only legal. On the one hand, it is the organization of the general connection of its members, on the other, it is a system of freedom [3].

In a way, there are common signs of a network and the rule of law, which are in mutual diffusion. This view allows us to fix the so-called "complex observable": the mentioned state forms do not exist as parallel substances, but as immanently functioning and coinciding in their essential characteristics. This requires a separate cognitive science, which is beyond the scope of this work.

We only note that a priori the network state outside the legal framework is not viable, since the latter is a necessary framework for the functioning of the network space. It is in this legal mediation that we can talk about the form of existence of the political meaning of social networks, and, consequently, the actualization of the idea of a network state in the Russian Federation.

At the moment, the concepts of "network state" and "network society" have received a modus of actual. This is evidenced by the long-term target project "On the State Program of the Russian Federation" Information Society (2011–2020) ", where it is planned to form a network society. There is a process of diffusion of the state with the network society, and this, in turn, forms the network state. But the result is barely discernible due to the incomprehensible position of the Russian political bureaucracy [1]. In analytics, the idea of developing appropriate concepts is constantly pulsating, aimed at researching key decisions made throughout the Soviet and post-Soviet periods. The concepts will work if the functionality of a legal, network and social state is operational. But these institutions are still only on the way to their establishment.

Political practice shows that the actualization of the idea of network statehood is promising and dominant. This model is followed by a number of countries. Thus, France actively supports the institutions of participatory democracy and local self-government. But "such a model is very demanding on the population as an accomplice in the process of public administration from the standpoint of its readiness to become responsible for the fulfillment of state tasks, strategic vision of its prospects and readiness for meaningful dialogue, constant increase in human capital" [4].

As for the lag of the Russian state behind the modern information and communication dynamics, it should be said about the need to balance the legal and social state with the network state. Such cognitive science and political practice in this area will "push" a new state form along the path of constitutional comprehension.

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THE FEATURES OF THE MUSIC CONTENT IN RADIO ARCHIVES

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Annotation. The universal nature of music as a special language of communication, enshrined in the system of phonodocument communication and based on the use of understandable for most people musical notes determines the internationality of musical art. The article is devoted to the scientific problem of radiorepositories of musical sound documents. Archival radiophonodocuments are defined as a special cluster of the world communication space. The methodological basis of the publication is a socio-communicative approach the use as well as to determine the components of the system of storage and use of musical radiophonodocuments. The author stresses out the basic patterns of formation the musical content in the radioarchives and then he concludes that the radiorepositories are a special communication cluster of music phonodocuments, which has specific characteristics.
Keywords: Archive, Sound Recording Collections, Music, Phonodocument, Radio.

The largest collections of music recordings on radio occupy an important place in the funds of the world's repositories of phonodocuments. Therefore the relevance of the presented research is primarily due to the timeliness of scientific understanding of the problems of storage of musical phonodocuments in radioarchives. Relevance of the article is due to the important social role played by archival, museum, library and collection phonograms with recordings of musical works in the life of society as a guarantor of cultural heritage and social memory in general.

Some problems concerning the functioning of musical radiorepositories are studied by Finnish authors M. Petaya and P. Gronov, L. Kenosi from the Republic of Botswana and Austrian scientists J.-K. Kummer, P. Kuhnle and S. Gabler. Bulgarian researcher A. Krandeva separately considers the problems of integration of phonogram collections, formed in the «Bulgarian National Radio», into the existing system of audiovisual archives [1].

The subject of the publication is the specifics of the circulation of phonodocuments with recordings of musical works in radio archives.

The purpose of the article is to characterize the features of musical content in radiorepositories, to clarify the classification and determine the prospects for development.

The use of methods of comparative and terminological analysis as well as scientific forecasting allowed to systematically consider the processes of circulation of the phonodocument in the radio arhcives. Based on the interdisciplinary synthesis of system-functional and typological approaches the features that distinguish archival music phonograms from audio documents and service sources of other types are revealed. The typological approach made it possible to clarify the features of musical phonodocuments in the radiofunds.

There are many definitions of the document. But a special type of documents are radiophonodocuments, which have very specific characteristics. As you know, communication in music can be carried out directly at concert performances, various radio and club sessions, as well as in the so-called «home sessions», and recorded on a medium. The whole array of phonodocuments is systematized by types of records – phonographical, gramophonic, optical, magnetic, laser. More often three groups stand out – phonograms on phonograph records, on magnetic tape and on optical CD. One of the types of sound archives are studio archives created in large recording companies (studios). The purpose of such phonoarchives is to preserve the materials of the «parent» record company in order to be able to use them in the future. Archival radiophonodocuments can be inseparable and separable (those which consist of separate parts in the form of tracks that are not compositionally interconnected or combined into a single structure on the basis of secondary features). The profile of the repository is important, by which we mean the composition of phonodocuments established for a certain archive on radio. Boxes with phonograms on a magnetic tape 6.25 mm wide are stored on shelves in a vertical position, 35 and 16 mm wide - in a horizontal position.

In general, the history of music radio has a long way from state radio to commercial radio, so in this publication at the beginning of the main material we will recall only the main events. Experimental radio broadcasting in Ukraine began not with the dissemination of political and news information, but with the broadcasting of literary, artistic and musical programs called "radio concerts". Several trial radio concerts were held in the period 1922-1923. The beginning of regular radio broadcasting was on November 23, 1924. So music lovers of that time were forced to listen

to the sounds of instruments and try to distinguish the voices of their favorite singers.

In the period from 1920 to 1926, audio messages were played on the radio once without recording on the media. The resolution of the Central Committee of the CPSU (b) of January 10, 1927, obliged to keep in the radio archive materials recorded for censorship - on paper ("microphone document") or on film (sound films). Tape recorders in the work of radio studios in the USSR began to be used only in the second half of the 1940s.

On September 20, 1936, the Soviet Union took part in the Second World Radio Concert. Yes, music radio began to gain popularity quickly. Most radio stations tried not only to broadcast and organize "radio concerts", but also to create music recordings themselves, ie to form the music fund of the radio station. During the 1930s, more or less powerful radio companies began to create their own music groups. In 1938, the State House of Radio and Recording (Moscow) opened. From the second half of 1945, the USSR Radio Committee first used sound recording on a magnetic tape to create phonograms of classical music. Since the 1960s, the State House of Radio and Recording has been recording all types and genres.

Thus, musical and non-musical phonograms that have been specially created for radio, as well as combined radio phonodocuments (radio productions, audio tales, audiobooks, children's programs - for example, «Radio Nanny», etc.) include service and support elements of official documents. In December 1997, the editorial office of the All-Union Radio Music Broadcasting was liquidated. By the end of the 1990s, national radio was almost entirely commercialized, and various types of youth music radio stations played an important role in this process.

In 1927, the British company De Wolfe began releasing albums at 78 rpm specifically for the use of music on discs in radio programs. In 1933, the director of the acoustic department of the American company "Velle Telephone" G. Fletcher organized a special radio program from the hall of the Philadelphia Academy of Music in "stereo" mode. In 1950, the Department of Radio and Radio Information of Bulgaria established a gramophone recording company "radio reception" and since then phonograms in full in this country are produced in the studio "Radio Sofia". During the 1960s, the broadcast of recordings of beat music was actively carried out by numerous "pirate" radio stations - such as «Radio Mercury», «Radio Caroline», «Radio Jackie», «Capital Radio», «Radio Nord», «Radio Swan», «The Big-Q», «WLE», «Radio Suburbia», «Radio Prosh», «Radio Draft Resistance », etc. It is not possible to restore the chronology of all such releases, but in recent years CDs have been released containing re-

cordings of mp3 tracks that were played on the radio (in particular, "Radio Veronica" in the period from 1960 to 1966). In the early 1960s, the promotion of singles on the radio was reduced to broadcasting on the BBC Light Program and Radio Luxemburg. In 1967, the first digital tape recorder was created in the technical laboratory of the Japanese radio company NHK. In the same year, the legendary music radio program "BBC's Radio One" was created. In 1975, in New York, the phenomenon of "The Record Pool" or "Music Pool" ("General Record Fund" or "Music General Fund"), which was a new at the time centralized method of distribution of musical phonograms, through which radio -DJs promptly received recordings of new music [1]. It should be noted that in the 2000s, this communication link of the relay was virtualized for the online distribution of containers with music content "Digital Pools" (digital mutual funds).

During the 1960s and 1980s, some radio stations, being producers of sound documents, produced records. Radio stations used acetate discs for direct reproduction (sometimes "acetate copies of discs" or "acetate copies", understood as a "by-product"). These sound carriers stand out as another additional category of musical sound documents - corporate trial releases. Such records were produced in limited quantities (from 10 to 100 copies) to represent the sound of the disc and were used mainly within record companies. Acetate disks were made industrially from hard, brittle plastic or metal with a thin vinyl coating, could be one-sided and two-sided. The service life of such discs, the quality of broadcasting sound from which was significantly higher than usual, under standard storage conditions, there were about 12 reproductions. Collectors are interested in acetate records as rare phonogram documents containing tracks that have not been released on standard releases. For example, only for radio in limited quantities, as well as versions of musical compositions, the performance of which differs from the versions placed on the media, released officially in mass circulation. Labels (labels) of acetate and promotional discs, copies for radio stations and DJs, as well as other phonograms from this series - unlicensed for broadcasting, were provided with the inscriptions: Radio Edit, Radio Transmission, For Radio Station Use Only, Audition Copy, D.J. Copy, Sample Copy - Not For Sale, Promotional Copy, Promotional Album, Not Licensed For Public Broadcasting, Not For Resale, Acetate Masters, Acetate Copy, etc.

Radio New Zealand Sound Archive phonogramm archive functions in New Zealand and it contains 100 thousand of gramophone records and 31 thousand of magnetic tapes collection.

Today the «BBC Archive Center» has formed one of the world's best

collections of phonographic documents, with 7 million recordings, including those made on music radio. The archival center stores 5,600,000 reels of magnetic tape recordings and vinyl records are placed on 700 special shelves. The British Library Sound Archive's collection of phonodocuments contains more than a million vinyl records and 200,000 records on magnetic tape. One of the largest music collections of audio recordings in the world is located in the British Library – the largest institution of its kind in the world. Many of the artifacts of the recording, from the wax rollers from 1890 to the latest vinyl box sets, are stored in the basement, where you need to go down to a depth of 30 meters by elevator. The history of the sound archive dates back to 1906. At first it was a private enterprise. At that time phonoarchives already existed in Germany, Austria and Italy, so in Britain the task of preserving the sound heritage was taken over by the Grammophone Company and in 1899 they began collecting Metal Masters. In 1983 the British Recording Institute was incorporated into the British Library. In 1998 the Library moved to a new building, the construction of which cost 511 million pounds. In total the British Library covers 115,000 square meters. There is a second archive in West Yorkshire. The largest building in London employs 1,700 people, many of whom are «sick of the collection virus.» The reading rooms have seats for 1,200 readers (140,000 readers have a library card). The card allows its owner to access most of the rarest materials. By the beginning of 2020 the British Library has collected about 200 million items. It contains musical phonograms made on the radio, recordings made by composers from unpublished works, as well as recordings containing linguistically unique dialects. In addition, literary records, historical languages and recorded sounds of nature are preserved. You can hear the noise of locomotives, the melody of an old bakelite phone ...

Thus the British Library presents the full range of planetary background noise. Copies of records are added by the thousands every year. About 70 per cent of all UK record companies send their new material directly to the British Library. Gradually, the sound archive moves to the selective acquisition of the most significant real and potential artifacts. The collection of records of the classical year is slowly but surely approaching musealization. The punk exhibition organized by the library attracted 120,000 visitors in a few months. Some private anonymous large donations are kept secret. Archivists are in contact with different agents. This communication extends possibilities for archive replenishment. Among specific subjects of this kind of professional activity "the collection curator" stands out.

Let's take a look at example. British Library was addresses by woman from Oxford with music cassette, that she bought almost 30 years ago at

RADIOHEAD gig. But at that time because she hadn't already had a record player, she called the library and asked if this cultural institution employees were interested in this object. In general, this woman could anytime sell this cassette on Ebay for several thousand pounds but instead of that she donated it to British Library.

One day anonymous virtue appeared in British Library archive with acoustic version of David Bowie's "Space Oddity" that was sadly remembered only by foreign radio listeners. The record came from British production company fund and made a program material radio broadcasting in Australia and soon invited Bowie into the studio. After company bankruptcy these (and most of others) materials were thrown away. But an indifferent person appeared at this junkyard and managed to save these invaluable sound rarities. He decided to send them to British Library. At British Library around 5000 bootlegs are stored and they all came from BPI (British Phonographic Industry) - agency that struggles with theses pirate copies. Beside racks with bootlegs on them there is a reggae sound collection that includes more than 1200 plates. These records were bequeathed to the library by a collector - a personal friend Lee "Scratch" Perry. This collector was considered as an expert of that genre. The curator of a popular music section Andy Linehan once said that the library could have never received these rarities according to the standard communication channels. Generally there are around 1,5 million of plates in the collection and a lot of other phonodocument demo recordings. If you are willing to listen to the whole audio collection it will take almost 120 years. A. Linehan pointed out that he pays a great respect to the music records collectors but most of the times these are the people who want to buy unique plates for themselves. Library, from the other side, offers these treasures to the public with a confidence in the fact that a great amount of people will enjoy it.

It is important to point out that special musical phonograms are created at special radio sessions that first was used only for radioprogrammes, but soon such rarities demand grew significantly. It led to radioarchive phonograms reissue. Wherein stereo radio broadcasts records had some technical specialities. Recent times more often the point is told that formats and mediums that store music phonomaterials are losing relevance [3]. Since 2017 until the beginning of the 2020 the amount of foreign companies that produce their own analogue releases on the magnetic tapes has increased from 23 to 42 (ATR, RTM, Capture Reel Audio and others). Wherein the number of the official phonogram editions of that format has increased almost by three. Representatives of French company "Analog Audio Design" declared that they would secure the future of the Reeel-T-Reel record

players "Thorens" (TM 1600). "René Laflamme" that used to produce DSD transfers from magnetic tapes started producing authorized copies on the tape every month. Summarizing these events it could be said that archive phonograms are transforming into the economy category and they are becoming buildings as "informational raw materials" [4].

One of the world's largest archives of music recordings for radio is the Russian State Fund for Television and Radio Programs (since 2014 as a branch of the holding VGTRK). The obligatory copy of the phonogram, which was specially made for television and radio broadcasting, is delivered in two copies in MPEG-1 Layers I, II, III (MP3) format, 48 kHz, 16 bit, 64 kbps, Stereo. Moreover, defective copies manufacturers are required to replace within a month.

It should be noted that special music sessions create special music phonograms, which were initially used exclusively for radio programs, but later such rarities were in high demand, which led to reprints of radio archival phonograms. At the same time, recordings of stereo music radio programs had certain technical features [5]. Recently, there is an increasing opinion that the formats and media on which audiovisual archives store, in particular, radio materials created over many years of work by radio companies, are losing relevance. However, the generalization of such events allowed us to conclude that archival phonograms are steadily becoming an economic category, representing building blocks in the form of "information raw materials" for placement on new generation media.

A separate subgroup of non-musical phonograms created specifically for radio and combined radio phonodocuments should be mentioned separately. This subgroup contains many interesting materials, including the multi-series sound film "VIA" (vocal and instrumental ensembles), presented by the Ministry of Culture of the USSR, the All-Union record company "Melody", Gosteleradio and Radio "Mayak" (2016-2017). Additional evidence of the rationality of the separation of radio documents can be the tendency to return to the relatively mass production of radio productions - both completely new and archival, which occupy an important place in cultural and historical heritage ("Collections of radio performances", "Theater at the microphone", "Golden Fund"). radio performances ", Radio program" Time of Fiction "and similar issues of foreign media companies - BBC Radio 4 extra (Radio Drama Collection) ... Recordings marked" radio performance "or" audiobook "(in appropriate cases, indicate the type of publication" Radio recording ") , recorded on media, but can also be in a "media-free" form on the Internet.The studio "Sound Book" produces similar "spoken" phonograms, using the funds of the radio "Petersburg". The

radio play "Letters Tell" (the original was recorded in 1962 in Bashkir on the German tape "ORWO") was digitized.

So, during the process of research such conclusions were made.

A study of the peculiarities of the formation and content of collections of records and sound recordings in radiorepositories showed the existence of a flexible system of division in the storage of phonograms. Interaction between different archives, when included in the communication network, allows to implement joint research, information, cultural programs for the exchange of phonogramm documents.

The storage of «musical phonograms» is carried out in information resources of four types: archival, library, museum and private-collection, the integration between which is increasing. Radio archives are a separate subtype of phonogram repositories [6].

It should be emphasized that in some cases (and often) profile clusters of musical sound documents can intersect, forming «hybrid zones». In general, the stock collections of musical sound documents on radio should be represented in a dualistic way: as a component of a higher-level subsystem and a relatively autonomous element (private collections).

The current state of formation of radio archival musical collections is largely due to dynamic changes in the field of acquisition, which are dictated by external and internal factors. The collections on radio are no longer completed exclusively with analog sound documents (records, audio cassettes), but are intensively replenished with a digital component. First of all, we are talking about the formation of a «hybrid» model as one that cares about both components of its collection – analog and digital, while the share of the latter is growing.

Within the interaction of radio repositories of music records there are prospects for the creation of appropriate digital thematic interrepository cultural projects (phonogram centers), which are close to the hybrid formula – «storage + use» [7].

Thus, the world's repositories of music sound documents in radio archives are a special cluster of the sound record communication system, which has specific characteristics of the service grade. This area requires additional synergetic scientific research and, above all, on the development and implementation of advanced technologies for the restoration and preservation of repository music sound documents.

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INFUSION THERAPY DURING TOXEMIA PERIOD IN SEVERE BURNS IN PRESCHOOL CHILDREN

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Abstract. The authors showed that in children aged 3.1-7 years with a burn area of 37-59% on average, the total daily volume of injected fluid on day 1 in 1 (37%) and 2 (48%) groups of heavily burned patients slightly exceeded the physiological need was the largest in 3 groups of children (59%) mainly due to intravenous infusion therapy. The stability of the average daily level of systolic and diastolic blood pressure during the period of burn disease toxemia, regardless of the severity of the injury, confirms the effectiveness of complex intensive care. During the period of burn disease toxemia in children aged 3.1-7 years, an increase in the average daily value of heart rate by 40-50% was detected from the first day, which continued throughout the observation period. The revealed tachycardia, had not only compensatory significance in the process of adaptation, but was due to secondary myocarditis.

Keywords: toxemia, burn, children, infusion therapy, preschool age

Relevance

Among the total number of persons with burn injury, children make up 20-30%. The mortality rate due to burns among children reaches 2-4%, in addition, about 35% of children annually remain disabled. The high prevalence of burns in the children's population, the tendency to develop burn disease and severe post-burn disorders make the prevention and treatment of burn injury in children a priority.

The cardiovascular system in children 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 during the period of burn disease toxemia remains relevant. The most important, often determining during the period of toxemia in severe thermal burns in children are the timely correction of water balance disturbances with the compensation of very rapidly developing dysfunctions of vital organs and inevitable in the absence of prompt timely medication and other types of correction of complications leading to the destruction of tissues and organs caused by severe pain stress, shock, impaired tissue perfusion, pulmonary circulation, the formation of a large area of the entrance gate for infection, the inflammatory reaction that has remained around the necrotic tissue burn sites. Moreover, the deeper the damage to the skin, the stronger the local and generalized inflammatory reaction with its characteristic generalized disturbance of the membrane wall, vascular permeability, and hypercatabolism.

Purpose of the work

To study and evaluate infusion therapy during toxemia, depending on the severity of the damage in severe burns in children aged 3.1-7 years.

Clinical material and research methods

The research data of 24 children aged 3.1 to 7 years was studied. Patients were examined depending on the severity and area of damage, age, duration of treatment in the ICU. So, the number of children in ICU up to 10 days was 10 (1 subgroup), 11-20 days - 8 children (2 subgroup), more than 21 days (21-54 days –6 children). Assessment of the severity of the burn was carried out by calculating the surface area of the damaged skin and using the Frank index. A detailed analysis of reliably significant deviations, intergroup differences of the studied parameters 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 means (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 removing from burn shock, adequate analgesia and intravenous administration of crystalloids, volemic solutions under the control of hemodynamics, volume of diuresis. Intensive therapy also consisted in the regular, every 8-12 hours, administration of cardiotonic, desensitizing, stress-limiting, vasodilating agents. According to indications, hormones and blood substitutes were used. Inhalation of moistened oxygen, physical methods of heat-

ing were conducted. 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, delayed surgical necrectomy, prevention of coagulopathy, energy-deficient state, volemic disorders, and correction of the "tachycardial syndrome" were successfully carried out.

Table 1
Characteristics of patients aged 3.1-7 years

Groups	Body weight, kg	Age in years	Height in cm	Area of the burn of 2-3A degree in%	The area of the burn of 3B degree in%	FI in cu	The duration of treatment in the hospital	Number of days in ICU
1	15,8±1,8	4,7±0,8	99,7±5,9	37,3±14,7	3,1±4,4	42,5±15,7	25,5±10,3	8,1±1,3
2	16,6±2,4	4,0±0,1	103,5±8,3	47,9±17,1	18,1±12,2	85,1±28,7	49,9±16,9	13,1±1,9*
3	16,4±2,4	4,4±0,6	107,3±9,8	59,2±12,2	36,7±13,3*	127,5±33,3*	61,8±13,5*	27,3±3,2*

The average age of children with severe burns in the age group from 3.1 to 7 years ranged from 4 to 4.7 years, height from 99.7 to 107.3 cm, body weight 15.8 - 16.4 kg (Table 1). There were no significant differences between the groups and in the area of the burn area of grade 2-3A, which amounted to 37.3±14.7% in group 1, 47.9±17.1% in group 2, and 59.2±12 in group 3.2%. However, a significant difference was found in the area of burns of grade 3B in groups 1 and 3, which in the heaviest group of children exceeded the burn of grade 3B in group 1 by 11 times (p <0.05) and was more than 6 times in group 2. At the same time, the Frank index in the 2nd group turned out to be twice as much as in the first one (unreliable due to the large spread of the indicator in the group), and in the 3rd group it was significantly more than three times in the first (p <0.05) In accordance with the severity of the condition, the duration of intensive therapy in ICU conditions in group 2 was more than 62% (p <0.05) in the first group, more than three times longer in group 3 (p <0.05) than in the first. Accordingly, the severity of the condition, the duration of inpatient therapy in group 1 was 25.5±10.3 days, in 2 - 49.9±16.9, in group 3 61.8±13.5 days. Thus, such indicators as the size of the burn area of 3B degree, the Frank index indicator, the duration of intensive care in ICU turned out to be determining in the need for treatment in a hospital.

In group 1 there were 6 girls, 4 boys, in 2 - 4 girls, 4 boys, in group 3 – 1 girl, 5 boys. A distinctive feature of groups 2 and 3 was that, in group 1, the burns of 3b degree were detected in 2 patients (20% of patients), in group 2 - in 5 patients (62% of patients), in group 3 in all children (100%), and the burn area of 3B degree was more than 15% to 70% of the body surface.

The duration of intensive care in ICU and inpatient treatment corre-sponded to the severity and depth of damage to the skin surface and FI (tab. 1).

Results and discussion

Table 2

Hemodynamic changes during toxemia period

DAYS	Systolic blood pressure			Diastolic blood pressure			Heart rate		
Groups	1	2	3	1	2	3	1	2	3
1	101±6	107±4	101±4	60±7	62±3	60±4	128±7*	124±11**	136±8**
2	104±6	105±5	106±4	59±6	64±4	62±4	130±7	122±12	126±11
3	103±4	111±6	112±8	61±5	65±4	64±6	124±9	117±15	128±8
4	103±4	106±4	110±5	61±4	63±3	63±5	127±3	122±12	131±8
5	105±3	107±4	113±4	62±3	63±2	66±4	126±5	124±12	129±9
6	107±7	107±6	110±4	64±6	63±2	63±5	130±5	121±15	132±5
7	105±6	109±5	107±5	62±4	63±4	61±3	131±4	125±13	129±6
8	107±5	107±4	107±4	61±2	62±4	60±2	131±7	125±14	133±10
9	106±7	107±5	113±4	63±3	64±2	64±2	136±12	127±12	134±10
10	108±2	105±6	114±8	64±2	62±4	68±6	132±5	127±13	133±5
11		107±4	112±4		61±4	62±2		128±11	135±5
12		105±7	112±5		63±3	62±2		123±15	137±5
13		108±4	113±4		66±4	64±3		121±16	137±4
14		111±1	111±5		63±2	61±3		131±8	138±7
15		118±5	111±3		66±4	65±3		139±2	139±10
16		110±1	116±12		61±5	65±6		138±3	143±6
17			112±4			61±3			135±9
18			111±7			60±6			144±7
19			109±2*			64±4			144±5
20			118±4*			65±3			137±8
21			118±6*			65±3			134±8
22			114±4*			65±4			139±7
23			113±5*			66±6			140±6
24			112±4*			64±5			146±5
25			103±6			64±7			137±9
26			107±5			63±4			141±7
27			116±4*			69±3			139±7
28			116±2*			70±2			143±5
29			110±5			64±4			142±1
30			111±4			67±5			148±2

* deviation from the indicator in the first day

** deviation from the norm

As can be seen from the hemodynamic monitoring results presented in Table 2, the SBP of children in group 1 differed from the age norm by 9 mmHg (norm 92 ± 12 mmHg), in group 2 - by 15 mmHg, 3 - by 9 mmHg. A tendency toward an increase in the mesor of the circadian rhythm of the DBP indicator in group 1 by mmHg, 2 by 7 mmHg, and in group 3 by 5 mmHg (normal 55 ± 6 mmHg) was revealed. Deviations of SBP and DBP from normative data on day 1 of observation were unreliable. Deviations of the average daily heart rate in group 1 by 40 beats per minute (normal 88 ± 9 per minute) (p <0.05), in 2 – by 36 per minute (p <0.05), in 3– by 48 per minute (p <0.05). Thus, on the first day after a burn injury, the most significant changes were revealed in the average daily heart rate, which in the 1st group was increased by 45%, in 2 - by 40%, in 3 - by 54% (p <0.05, respectively) The stability of SBP, DBP, and HR indices in all groups over the period of burn disease toxemia, regardless of the severity of the damage, is noteworthy, which confirms the effectiveness of complex intensive care. However, throughout the observation period, tachycardia persisted, with the most significant increase in heart rate observed in group 3 (Table 2).

The data revealed indicate that in children aged 3.1-7 years, even under conditions of effective correction of detected deviations of homeostasis, anti-inflammatory therapy, tachycardia persists, most likely having not only compensatory significance in the process of adaptation during burn toxicity in children aged 3.1-7 years, but also a sign of secondary myocarditis. In addition, corrective fluid, electrolyte imbalance, compensating for blood volume deficiency, detoxification infusion therapy, and parenteral nutrition cause a fairly significant increase in the daily volume of fluid, which is an additional burden on the cardiovascular system. These factors increase the risk of developing cardiac decompensation during toxemia in children.

Table 3.
The volume of infusion therapy during toxemia in children aged 3.1-7 years.

days	Total daily volume, ml/kg day			Intravenously, in ml/kg per day			Ingestion in ml / kg per day			diuresis ml/kg per day		
	Group 1	2	3	1	2	3	1	2	3	1	2	3
1	126,3±37,1	123±24	169±33	91±25	88±21	103±19	44±18	36±12	66±27	46±17	45±1	48±9
2	196,2±43,3	145±84	193±14	96±18	75±38	110±7	100±2*	72±37	86±10	77±22	67±3	87±22
3	183,5±34,4	193±33	210±46	98±24	89±17	101±19	85±20	104±2*	110±3*	100±2	96±1	116±3
4	173,7±23,1	152±46	194±25	82±12	73±23	84±14	91±22*	86±34*	110±1*	102±1	90±3	101±1
5	178,1±30,1	166±43	191±26	90±16	66±20	93±15	88±23	100±3*	97±20	91±15	81±2	97±19
6	184,7±24,5	161±45	177±27	82±19	68±20	82±17	103±2*	92±35*	95±15	105±3	97±2	83±18
7	179,4±26,1	167±36	211±25	73±19	77±19	94±19	106±1*	91±22*	117±11*	100±18	85±27	119±23
8	176,1±25,3	180±25	203±14	76±17	84±16	78±7	99±16*	95±13*	125±21*	87±11	96±23	104±18

9	180,5±34,3	161±35	173±30	81±20	71±15	83±17	99±22*	89±20*	90±19	101±15	87±32	86±14
10	128,4±12	133±50	185±29	70±9	77±22	90±9	59±11	81±22*	105±14	90±12	83±22	109±22
11		156±53	176±25		61±30	83±19		94±28*	92±13		72±29	106±20
12		117±74	201±36		50±34	93±17		67±42	109±21		68±20	80±17
13		165±39	184±18		72±16	86±16		93±23*	80±28		92±35	89±12
14		120±80	180±28		47±31	80±13		73±49	100±18		74±29	97±21
15		192±5	170±23		69±6	80±17		93±10*	89±18		89±17	91±34
16		100±11	168±9		44±14	76±10		56±15	93±11		52±13	79±7
17			178±32			76±14			101±18			96±19
18			171±18			80±7			90±18			113±22
19			180±35			86±12			94±30			71±5
20			184±25			69±12			114±17			99±34
21			158±24			71±12			87±13			84±27
22			152±34			71±9			81±25			68±30
23			160±35			65±9			96±30			95±20
24			179±38			73±8			107±30			90±10
25			175±5			70±5			105±7			102±8
26			196±45			71±8			116±28			104±12
27			176±32			65±6			112±28			77±9
28			171±39			72±15			99±24			96±24
29			185±37			69±7			116±30			98±28
30			157±28			65±11			92± 13			79±9

* reliable relative to the data in 1 day

As shown in table 3, the total daily volume of injected fluid in 1 day was the largest in the 3rd group of children, mainly due to intravenous infusion therapy. In the following days, both parenteral and enteric administration increased. A significant increase in only enteral administration was found in all patients from 2 days. So, in children of the 1st group, the enteral volume on the 2nd day doubled, remaining at this level up to 9 days. In group 2, a significant increase in enteral administration was detected almost three times on the 3rd day (p <0.05), remaining at this level for 15 days. In group 3, a statistically significant increase in enteral volume of compensation by 64% (p <0.05) was detected on day 3, remaining elevated for 30 days of treatment. Thus, the detected increase in water load on day 2 can be explained by the need not only to compensate for the loss of proteins, blood volume in general, but also to correct rheological disorders, the need to restore capillary blood flow, and to ensure the necessary adequate venous blood flow in conditions of large irreversible fluid loss in conditions of a systemic inflammatory reaction of the body to a severe burn injury.

The amount of parenteral administration in the 1st group on day 1 amounted to 72% of the total daily amount, on day 2 it was 49%, on day 3 it was 50%, on the following days it was about 50% (Fig. 1). In children

of the 2nd group, 71% of the daily volume was parenterally administered on the 1st day, about 50% of the daily water load was administered on the 2nd day and on the following days of the centuries (Fig. 2). In group 3, 67% of the daily intake was administered parenterally at 1 day, 56% at 2 days, 43% at 3, 43% at 4, 5 48% (Fig. 3). The revealed ratio of the amount of infusion parenterally and the total daily amount was observed throughout the treatment in ICU. Thus, throughout the entire period of toxemia, the amount of parenteral administration in 1 day was 72%, 71%, 67% of the daily fluid load. In the following days, about half of the total daily water load was administered parenterally in all patients.

Conducted infusion therapy led to moderate polyuria in all groups, regardless of the severity of the condition, which we regarded as effective prevention of prerenal acute renal failure, detoxification effect of infusion therapy.
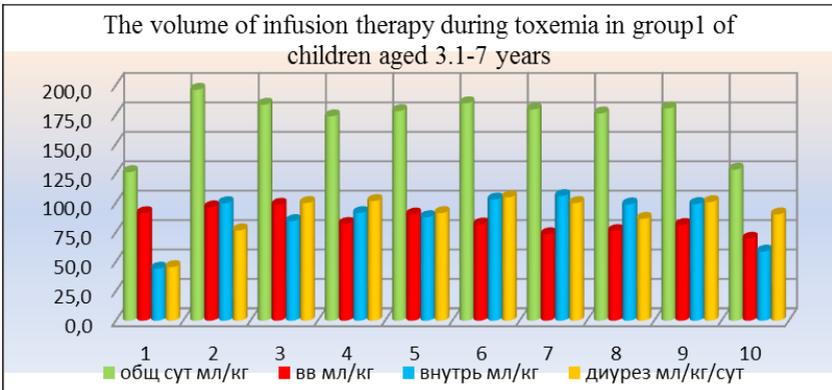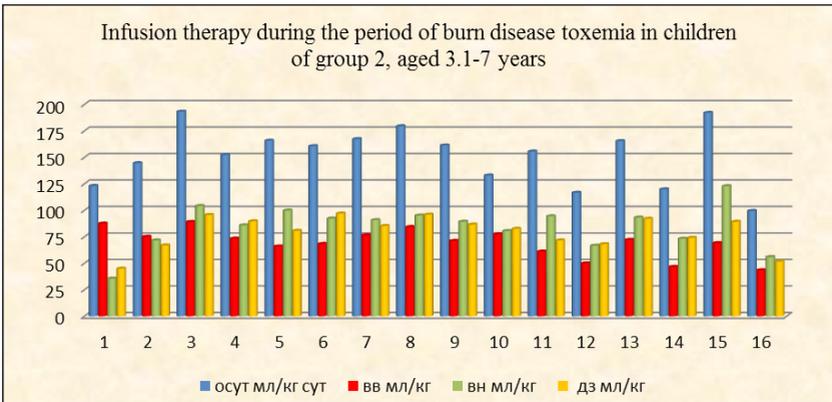

Fig. 1

Fig. 2
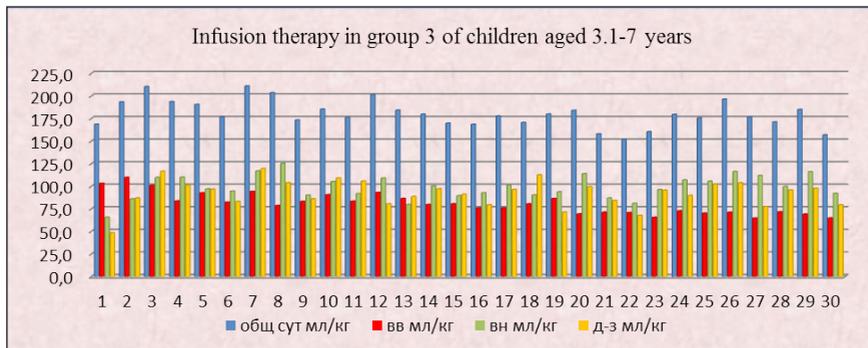
Fig. 3

Conclusions

The total daily volume of injected fluid on day 1 in groups 1 and 2 of heavily burned did not significantly exceed the physiological need, was greatest in the 3 group of children, mainly due to intravenous infusion therapy. The stability of the average daily level of systolic and diastolic blood pressure during the period of burn disease toxemia, regardless of the severity of the injury, confirms the effectiveness of complex intensive care. During the period of burn disease toxemia in children aged 3.1-7 years from the first day, an increase in the average daily value of the heart rate by 40-50% was revealed, which continued throughout the observation period. The revealed tachycardia, had not only compensatory significance in the process of adaptation, but was due to secondary myocarditis.

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THE EFFECTIVENESS OF APPLICATION PHYTOREFLEXOTHERAPY IN THE TREATMENT AND PREVENTION OF ACUTE RESPIRATORY VIRAL INFECTIONS IN THE CONTEXT OF THE COVID-19 PANDEMIC

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Abstract. The problem of population morbidity and the selection of effective treatment in the event of acute respiratory diseases, especially in the context of the COVID-19 pandemic, as well as taking into account objective reasons - the introduction of restrictions for the population in routine medical care, served as the basis for studying the possibilities of non-drug methods of influencing the body for the purpose of treatment and prevention of acute respiratory diseases. Patients for 14 days or more (according to indications) were treated using the method of application phytoreflexotherapy. The results of interviewing and treating 85 patients were analyzed. During the application, plant materials were used in a predetermined proportion, placed in a capsule, applied and fixed with a bracelet (fixator). The therapeutic effect is manifested by a decrease in the intensity of clinical symptoms of the disease within 24-48 hours and their complete disappearance within a period of up to 15 days. The study demonstrated the effectiveness of application phytoreflexotherapy in the treatment of acute respiratory viral infections on an outpatient basis, as well as in the mode of remote interaction with patients.

Keywords: application phytoreflexotherapy, non-drug therapy, prevention, comorbid conditions.

Problem and purpose

In the XXI century, mankind is faced with a new formation of infectious diseases. Viruses have replaced bacterial infections. Deterioration of the ecological situation, high anthropotechnogenic load, environmental pollu-

tion, climate warming predispose to the formation of new viruses. High migration and tourist activity of the population also contributes to the accelerated spread of pathogens and the globalization of the problem.

Medical science knows the mechanisms of the emergence of new viruses, their clinical and epidemiological features, factors that determine the risks to public health, the effectiveness of preventive measures. At the same time, not enough attention is paid to the methods of non-drug treatment and prevention of acute respiratory diseases, assessment of their significance and effectiveness, despite the great potential. Most of the research is devoted to the effectiveness of phytotherapy methods when using various herbal preparations [1-6]. Recently, there are studies devoted to the use of herbal medicine in the treatment of acute respiratory viral infections during the COVID-19 pandemic, and there are practically no studies in the field of phytoreflexotherapy [7 -10].

For the purpose of non-invasive treatment of respiratory diseases of viral etiology, an innovative method of treatment was developed and tested using a biocorrector in the form of application phytoreflexotherapy.

Methods

The method is aimed at correcting the pathogenetic mechanisms triggered by viral exposure and normalizing the body's immune response. Biocorrector is a dry crushed substance of medicinal plants (ginger root; turmeric root; white pepper fruits; nimbus leaves; yellow mustard seeds; needles, bark and root of pine; needles, bark and root of fir; needles, bark and root of thuja; needles, fruits, bark and root of juniper).

The biocorrector has an effective impact through applications on reflex zones, excludes direct percutaneous contact with plant components. Reflex zones - lateral surfaces of the wrists and lateral surfaces of the ankles. The duration of wearing the applications is at least 7 days, the change of the plant substance is carried out once every 24 hours of direct wearing. To carry out applications, plant materials in a given proportion are placed in a capsule, applied and fixed with a bracelet (fixer). The therapeutic effect is manifested by a decrease in the intensity of the clinical symptoms of the disease within 24-48 hours and their complete disappearance within a period of up to 15 days. The expected positive antiviral effect of the application phytoreflexotherapy on the body is due to the wave properties of the applied plant raw materials.

In order to assess the therapeutic and prophylactic effect of the phytoreflexotherapy method, a study was organized and conducted on the results of the use of a biocorrector in the treatment of patients with clinical symptoms of acute respiratory infections, including COVID-19.

The database contains the results of interviews and treatment for 85 patients, of which the first age group - up to 40 years old - 45 people; the second age group from 40 to 50 years old - 19 people, the third from 50 to 60 years old - 16 people, the fourth - over 60 years old - 5 people. 24 patients were tested on COVID-19, of which 18 received laboratory confirmation of the disease.

Results and discussion

To assess the effectiveness of treatment based on the results of therapy, the results of treatment of 85 patients with signs of acute respiratory infections who fell ill and received treatment in the form of application phytoreflexotherapy (April-June 2020) were analyzed. 58.8% of patients had chronic diseases. In the structure of chronic morbidity, the leading place was occupied by: overweight and obesity - 29.0%, hypertension - 18.2%; diabetes mellitus - 11.3%; respiratory diseases - 10.5%, others - 22.6%. The patients had the following symptoms at the time of seeking help: low-grade fever - in 38.8% of patients, febrile temperature - in 8.2%, myalgia was observed in 60.0% of cases; general weakness - in 100%; loss of smell - in 94.1%, taste - in 32.9% (while loss of taste was always combined with loss of smell), sore throat was noted in 55.3%, shortness of breath - in 34.1%.

All patients for 14 days or more (according to indications) were treated using the method of applied phytoreflexotherapy. Treatment was started 1-10 days after the onset of the first symptoms (mean 3.8 days). At the end of the first day of treatment, 87.0% of patients noted a general improvement in their condition, 2.4% of patients - the disappearance of all symptoms, in 10.6% of patients within 24 hours there was no subjective improvement in their condition. In addition to applications, 63.5% of patients did not receive any additional drug therapy. All patients recovered, including 92.9% within 14 days and 7.1% within 15 days. The average rate of recovery from the start of treatment was 5.7 days.

Conclusions

The study confirms the effectiveness of application phytoreflexotherapy in the treatment of acute respiratory viral infections, including COVID-19 and can be recommended for use in the treatment and prevention of acute respiratory diseases during tourist travel, attending public events, moving in public transport, trains, airplanes and in other public places.

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THE COMPARATIVE CHARACTERISTICS OF AGE, SEXUAL AND TYPOLOGICAL MORPHOMETRIC PARAMETERS OF UNPAIRED BRANCHES OF THE ABDOMINAL PART OF AORTA OF ADULTS

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Abstract. The rapid development of transplantation, endovascular and minimally invasive surgery necessitates a detailed study of the structural features of the vessels of the abdominal cavity. The purpose of the study is the characteristics of the morphometric parameters of the abdominal aorta and its unpaired branches in men and women at different ages and depending on the body type. The analysis of 190 computer tomograms of unpaired branches of the abdominal part of aorta and its was carried out in adult men women divided into three age groups (first and second periods of mature age and elderly age), as well as into three groups according to the Pignet index (asthenic, normosthenic and hypersthenic body types). It was established that individual morphometric parameters of unpaired branches of the abdominal part of aorta in men and women significantly change with age. In men, the length of the celiac trunk and main trunk of the superior mesenteric artery does not change with age. In women, the length of the celiac trunk increases with age at 6.2 mm, the length of the main trunk of the superior mesenteric artery – at 17 mm. The aorto-mesenteric distance changes with age only in women. In elderly age, it is on average 4.4 mm larger than in the first period of mature age. It was also found that there are significant differences between constitutional types identified using the Pignet Index in the overwhelming majority of the morphometric parameters studied. The obtained information has a significant clinical importance, since it will allow objectifying the diagnostic criteria of various vascular syndromes and minimizing the risk of endovascular interventions.

Keywords: unpaired branches of the abdominal part of aorta, celiac trunk, superior mesenteric artery, inferior mesenteric artery, aorto-mesenteric distance.

Introduction

The abdominal of aorta is the main source of blood supply to the organs of the abdominal cavity and retroperitoneal space and is located on the front surface of the spine slightly to the left of the median plane [1, 2, 3, 4]. Most often, aortic bifurcation is located at the level of the IV lumbar vertebra, in 15% of cases – at the level of the intervertebral disc between the IV and V vertebrae and in 15% of cases – at the level of the V vertebra [5]. The unpaired branches of the abdominal part of the aorta are: celiac trunk, superior (hereinafter – SMA) and inferior (hereinafter – IMA) mesenteric arteries. The the points start of the celiac trunk is located at the level of the lower edge of the XII thoracic vertebra, which coincides approximately with the upper edge of the pancreas [6, 7]. Cases of its discharge at the level of the upper edge of the lumbar vertebra I are described [8]. SMA departs from the anterior wall of the aorta, or deviates slightly to its right or left wall. The level of SMA discharge can range from the XII thoracic vertebra to the intervertebral disc between the I-II lumbar vertebrae [5]. IMA departs from the distal aorta at the level of II-IV lumbar vertebrae [6]. According to some authors, IMA departs from the lower edge of the III lumbar vertebra [2]. Sinkeet et al. (2013) indicate that in 91.4% of cases it begins between the L_2-L_4 vertebrae [9].

In the literature, information on age, gender, and type characteristics of the morphometric parameters of unpaired branches of the abdominal part of aorta is not presented in sufficient detail. The rapid development of transplantology, endovascular and minimally invasive surgery causes increased interest in this problem [10, 11, 12].

The purpose of the study was to study, according to computed tomography, the features of the morphometric parameters of unpaired branches of the abdominal part of aorta in men and women at different age periods and depending on the type of physique.

Material and methods

The analysis of morphometric indicators of unpaired branches of the abdominal part of aorta of adults belonging to different age groups according to the classification of Markosyan [13]. Cases of tomography were divided into three age groups: I – 1st period of mature age (34 men and 25 women); II – 2nd period of mature age (31 men, 30 women); III – elderly age (28 men and 42 women). To determine the type of physique, the Pignet Index was used, which is determined by the formula Pignet Index=H-(W+VC), in which H is the height of the person, W is the body weight; VC is

the volume of the chest at rest. Chernorutsky (1929) used the values of this index to determine the type of constitution. According to his classification, in normostenics, the Pignet index is 10-30, asthenics are more than 30, hypersthenics are less than 10. According to the value of the Pignet index, three groups of observed cases are distinguished: group I – asthenic; II – normosthenic; III – hypersthenic body types.

Each subject underwent multislice spiral computed tomography. The thickness of the reconstructive slice of the resulting images is 0.5 mm.

Analysis of the data was carried out using the RadiAnt DICOM Viewer (64-bit) program. Morphometric data (vessel length, angles of departure, diameter, etc.) were obtained in the most representative projections for each parameter (two-dimensional, curvilinear, multiplanar, maximum intensity projections, volumetric rendering).

Statistical processing of the results was performed with the Statistica software package 13.3. Trial. The normality of the distribution of numerical signs was determined using the Lilliefors test. The results are presented in the format (M±SD), where M is the arithmetic mean, SD is the standard deviation [14]. To identify the significance of the difference between the average values, the Student t-test was determined (for the normal distribution of numerical signs). Analysis results were considered statistically significant at $p < 0.05$. The data obtained are interpreted and presented in the form of tables in the article.

Results and discussion

It was found that individual morphometric parameters of unpaired branches of the abdominal aorta significantly change with age in both men and women (table 1).

Changes in the diameter of the celiac trunk and its branches (left gastric and splenic arteries) with age do not occur so significantly and proceed differently depending on gender. So, in older men, the largest diameter of the celiac trunk is 0.9 mm (11.1%) less than in men of the first period of mature age. In women, age-related changes in this parameter are weakly expressed.

The diameter of the left gastric and splenic arteries in men also significantly decreases with age by an average of 10.8 and 7.7%, respectively. In women, the diameter of the left gastric artery does not have statistically significant differences between the groups, and the diameter of the splenic artery increases with age by 7.4%.

The diameter of the common hepatic artery, as well as the diameter of the SMA and IMA, do not significantly change with age either in men or women ($p > 0.05$).

It has been established that in men the length of the celiac trunk and the length of the main trunk of the superior mesenteric artery do not significantly change with age (p<0.05), while in women the length of the celiac trunk increases by 6.2 mm with age, and the length of the main trunk of the SMA – by 17 mm.

Thus, in women, the relative increase in the length of the celiac trunk with age is 28.7%, and the length of the main trunk of the superior mesenteric artery is 13.7%, while in men the length of these vessels does not have age features.

In men, significant differences in terms of the length of the main trunk of the superior mesenteric artery are between groups of the 1st and 2nd periods of mature age. The relative increase in the diameter of this vessel with age is 12.8%.

Table 1. – Morphometric characteristics of unpaired aortic branches in men and women belonging to different age groups, M ± SD

Morphometric parameter	Sex	Age group		
		1st period of mature age	2nd period of mature age	Elderly age
Length of the CT, mm	M	24.8±1.2	26.7±0.8	27.2±0.8
	W	21.6±0.9×	23.1±0.8*×	27.8±0.7*#
Largest diameter of the CT, mm	M	8.1±0.3×	8.8±0.2	7.2±0.1#
	W	7.1±0.3	7.1±0.2	7.3±0.1
CT Departure angle, °	M	38.2±3.0#	26.4±2.3*#	41.1±2.4#
	W	32.7±2.6×	39.4±2.6	42.3±2.2*#
Diameter of the splenic artery, mm	M	6.5±0.1	6.6±0.3	6.0±0.1
	W	5.8±0.2	5.83±0.1	6.23±0.1
Diameter of the common hepatic artery, mm	M	5.7±0.2	5.9±0.2	5.3±0.2
	W	5.6±0.2	5.1±0.1	5.2±0.1
Diameter of the left gastric artery, mm	M	3.7±0.1	3.6±0.1	3.3±0.1
	W	3.1±0.1	3.2±0.1	3.02±0.1
The distance between the centers of points start of the CT and the SMA, mm	M	19.2±0.2	18.5±0.6	18.9±0.3
	W	17.8±0.8	17.2±0.6	17.93±0.4
Length of the main trunk of the SMA, mm	M	206.7±2.6	204.8±3.9	202.1±3.0
	W	184.1±4.2×	183.2±3.9#	201.1±2.9*#
The largest diameter of the SMA (initial departments), mm	M	7.9±0.2	8.1±0.2	7.8±0.1
	W	6.6±0.2	6.1±0.1	6.9±0.1

The diameter of the SMA at a level of 5 mm distal to the point start of the ileo-colonic artery, mm	M	5.2±0.1	5.4±0.1	5.3±0.2
	W	4.1±0.1	3.6±0.1	4.5±0.1
SMA Departure Angle, °	M	51.8±3.6	61.1±3.0	56.2±4.2
	W	39.3±3.8	42.3±4.1	47.6±2.1
Aorto-mesenteric distance, mm	M	17.3±1.1	17.7±0.9	15.5±1.2
	W	8.8±0.6×	11.1±1.0	13.2±0.8*
The distance between the centers of points start of the SMA and proximal to the expanded renal artery, mm	M	11.1±1.4	8.6±0.8×	12.2±1.7
	W	11.8±1.6	9.8±1.2	9.6±0.8
The distance between the centers of points start of the SMA and the IMA, mm	M	75.8±2.1	74.3±1.8	77.2±1.5
	W	74.5±1.3	72.1±2.1	74.5±1.0
The length of the main trunk of the IMA, mm	M	54.2±2.0#	62.2±2.8	58.8±3.2
	W	51.0±2.2	55.3±2.2	58.0±1.4
The largest diameter of the IMA (initial departments), mm	M	4.3±0.1	4.3±0.1	4.1±0.2
	W	3.6±0.2	3.4±0.1	3.8±0.1
The distance between the centers of points start of the IMA and distal to the expanded renal artery, mm	M	62.6±2.1	60.3±1.7	58.8±1.5
	W	56.6±2.1	55.4±1.7×	59.9±1.0
The distance between the centers of points start of the IMA and the bifurcation of aorta, mm	M	41.7±1.8	43.7±1.6	41.5±1.6
	W	37.8±1.5	40.9±1.4	41.1±1.1

Note: CT – celiac trunk; SMA – superior mesenteric artery; IMA – inferior mesenteric artery; * – differences with the group of the 1st period of adulthood; # – differences with the group of the 2nd period of adulthood; × – differences with the elderly group (p <0.05).

Along with the above, an age-related change in two more parameters is noted: the angle of the celiac trunk and the aorto-mesenteric distance (the largest distance between these vessels at the level of the horizontal part of the duodenum). So, in men, the angle of passage of the celiac trunk varies unevenly with age – first, in the 2nd period of mature age, its significant decrease occurs on average by 11.8° (37.5%), then in elderly age – an increase of 14.7° (55.7%). Moreover, in women the values of this indicator change more evenly, and significant differences exist only between groups of the 1st period of mature age and elderly age and make up 9.6° (relative increase of 29.4%).

The aortic-mesenteric distance varies with age only in women: in elderly age it is 4.4 mm (50%) more than in the 1st period of mature age. The angles of discharge of other vessels of a clear age dependence did not show, since this parameter is more due to constitutional features [13]. Thus, a number of morphometric indicators of unpaired branches of the abdominal part of the aorta statistically significantly changes with age.

According to Barsukov [15], atrophy of the elastic type arteries increases with age atrophy of the elastic skeleton of the walls with its parallel collagenization, which leads to gradual dilatation of the vessel due to the low ability of collagen fibers to contract after stretching, which leads to an increase in their diameter. In arteries of muscle-elastic and muscle types, this tendency can be observed indistinctly, or it can be reversed [16].

As noted by Zhirnova et al. [17], vessel elongation with age may be due to the fact that as the artery ages, smooth muscle cells diffusely accumulate in its inner membrane and connective tissue grows. This leads to a thickening, first of all, of intimacy. The accumulation of individual lipids (sphingomyelin and cholesterol-linoleate) is also noted. From a functional point of view, these age-related changes lead to a gradual decrease in elasticity and increased vascular stiffness. The arteries at the same time become crimped, can expand and lengthen. The severity of the external supporting frame of extraorgan arteries also determines the ability of the vessels to withstand blood pressure. The walls of the unpaired branches of the abdominal aorta have reduced elasticity. This mechanism of change is most important in hypertension. Apparently, the lengthening of blood vessels in our sample is due to precisely these factors.

There are no clear opinions in the literature as to why age-related changes in blood vessels in women are more pronounced than in men. As noted by Scuteri et al. [18], in women in the postmenopausal period or after surgical and (or) chemical castration, progression of changes in the vascular wall is observed. Also, some authors describe the reduction of thickening of the arterial wall in women during the postmenopausal period against the background of prolonged hormone replacement therapy [19]. It can be assumed that it is hormonal factors that underlie pronounced changes in the length of the visceral arteries in elderly women.

An analysis of the results of the study shows that statistically significant differences in men of various of body types are 13 in each, and in women 11 of the parameters studied (table 2).

Table 2. – Morphometric characteristics of the abdominal aorta and its unpaired branches in men and women depending on the type of physique according to Pignet Index, M ± SD

Morphometric parameter	Sex	Body type		
		Asthenic	Normosthenic	Hypersthenic
Length of the CT, mm	M	22.3±1.2#	26.8±1.0	27.0±0.8*
	W	25.3±0.7	25.2±0.9	26.5±0.6
Largest diameter of the CT, mm	M	7.5±0.1#	8.1±0.2	8.2±0.2*
	W	7.2±0.1#	7.6±0.2×	7.2±0.1
CT Departure angle, °	M	29.1±2.0#	40.3±2.5	41.7±2.2*
	W	33.2±2.1	35.3±2.3×	49.7±2.8*
Diameter of the splenic artery, mm	M	5.7±0.2#	6.3±0.2	6.6±0.1*
	W	5.7±0.2#	6.3±0.2	6.1±0.1*
Diameter of the common hepatic artery, mm	M	5.6±0.3	5.5±0.2	6.1±0.2
	W	5.1±0.1	5.3±0.2	5.2±0.2
Diameter of the left gastric artery, mm	M	3.2±0.1#	3.8±0.1	3.9±0.1*
	W	2.8±0.1	3.3±0.2	3.0±0.2
The distance between the centers of points start of the CT and the SMA, mm	M	18.2±0.5	19.0±0.5	19.3±0.4
	W	17.4±0.4	17.8±0.6	17.7±0.5
Length of the main trunk of the SMA, mm	M	213.1±3.3#	198.2±3.1×	207.0±2.8
	W	192.0±3.8	192.2±3.1	200.0±4.2
The largest diameter of the SMA (initial departments), mm	M	7.1±0.2#	7.8±0.1×	8.5 ±0.3*
	W	6.7±0.2*	6.6±0.2	6.7±0.3
The diameter of the SMA at a level of 5 mm distal to the point start of the ileo-colonic artery, mm	M	4.3±0.1#	5.1±0.1×	5.6±0.2*
	W	4.0±0.2#	4.3±0.2	4.3±0.2*
SMA Departure Angle, °	M	33.1±3.7#	56.3±2.9	64.1±2.5*
	W	33.1±1.7	38.7±2.2×	59.1±2.4×
Aorto-mesenteric distance, mm	M	8.3±0.6#	17.1±0.6	19.5±1.2*
	W	8.1±0.2#	10.2±0.6×	17.0±1.2*
The distance between the centers of points start of the SMA and proximal to the expanded renal artery, mm	M	8.3±1.1	10.2±0.9	11.3±0.8
	W	9.8±1.1	8.6±0.9×	11.6±0.8
The distance between the centers of points start of the SMA and the IMA, mm	M	73.7±3.2	77.6±1.1	75.1±1.7
	W	74.6±1.6	71.8±1.1×	76.1±1.6
The length of the main trunk of the IMA, mm	M	50.2±2.6#	57.4±1.9	62.3±2.5*
	W	53.1±2.2	54.4±2.2×	62.3±2.5#

The largest diameter of the IMA (initial departments), mm	M	3.4±0.1#	4.3±0.1×	4.8±0.1*
	W	3.4±0.1	3.6±0.1×	4.1±0.1*
The distance between the centers of points start of the IMA and distal to the expanded renal artery, mm	M	63.8±2.7	63.7±1.6×	57.2±1.5*
	W	58.1±1.2	57.3±1.3	60.2±1.3
The distance between the centers of points start of the IMA and the bifurcation of aorta, mm	M	39.9±2.7	41.1±1.6	44.2±1.2
	W	38.9±1.0	40.1±1.6	42.2±1.1*

Note: * – differences with the asthenic type group; # – differences with the group of normosthenic type; × – differences with the hypersthenic type group. ($p < 0.05$).

It was found that in men, the largest diameter of the IMA is 41.2%, and the diameter of the SMA is 5 mm distal to the point start of the ileo-colonic artery by 36.1% significantly more with the hypersthenic body type compared with the asthenic one. At the same time, the difference in the diameter of the left gastric artery between the extreme groups is 21.9%, the diameter of the splenic artery is 15.8%, and the largest diameter of the celiac trunk is only 9.3%. The largest diameter of the celiac trunk, as well as the diameters of the left gastric and hepatic arteries, have significant differences only between extreme body types. In women, typical differences in the largest diameter of the celiac trunk, splenic, common hepatic arteries, the largest diameter of the IMA and SMA are not pronounced and are on average 0.5 mm. The diameter of the left gastric artery does not depend on the type of physique.

In men, the length of the celiac trunk and the main trunks of the SMA and IMA also has pronounced typical features. If the values of the first two parameters are significantly larger for the hypersthenic type, then the values of the length of the main trunk of the SMA are on average 6.1 mm longer for the asthenic type. In women in the group of asthenics, the length of the main trunk of the IMA is 53.1±2.2 mm, and in the group of hypersthenics – 9.2 mm longer – 62.3±2.5 mm. The length of the celiac trunk and the main trunk of the SMA does not depend on the strength of the physique. The aorto-mesenteric distance significantly differs between normo- and asthenics (by 8.8 mm) and between hyper- and asthenics (by 11.2 mm). In women in the group of asthenics, the values of this indicator are 8.1±0.2 mm, in the group of normosthenics – 10.2±0.6 mm (2.1 mm more than in asthenics), and in the group of hypersthenics – 17.0±1.2 mm (8.9 mm more than asthenics). The severity of changes in angular parameters

depending on the type of physique varies depending on gender. In men, the Departure Angle of the celiac trunk in the group of normosthenics is on average 11.2° larger than for asthenics (in percentage terms – 38.5%), and for hypersthenics – 12.6° than asthenics (43.3% more), for women – in the group of normosthenics, on average, 2.1° more than asthenics (in percentage terms – 6.3%), and in hypersthenics – 16.5° (49.7% more). Differences in the values of the angle of SMA discharge between extreme body types according to Pignet Index reach 26°, which in percentage terms is 78.5%

The presence of statistically significant differences in the morphometric parameters of unpaired branches of the abdominal part of aorta between the constitutional types identified using the Pignet Index is most likely due to the fact that the body calculation formula (chest girth, body weight) is included in the formula for its calculation. Therefore, its use as a grouping factor reveals a sufficient number of differences in the compared parameters, including those depending on the type and degree of development of abdominal fatty tissue.

Conclusion

Thus, as a result of the study, it was found that the vast majority of morphometric parameters of unpaired branches of the abdominal part aorta, measured on computed tomograms, have pronounced gender, age, and type characteristics. The data obtained are of great clinical importance, make it possible to objectify the diagnostic criteria of various vascular syndromes and minimize the risk of endovascular interventions.

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MODERN PROBLEMS AND PERSPECTIVE TECHNOLOGIES IN WOMEN'S SPORTS

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The paper evaluates the situation prevailing in women's sports. The authors offer an automated assessment for the coordination of an athlete's load with her current hormonal status, leading to the proposed concept of rationing the training load in different phases of the menstrual cycle based on heart rate variability.

Keywords: training load, hormonal status, phases of the menstrual cycle.

In recent years, the number of women participating in athletic events has increased significantly. Women have been taking part in the Olympics since 1900 and made up almost 50% of all participants in the last Games of 2018.

As competition increases, the demand for higher results grows, and it becomes clear that continuing to work with female athletes, without altering their training scheme, is not promising for many reasons. This issue can be confirmed by looking at the work of various authors on the main problems of training highly qualified athletes [1, 2, and 3].

The results of complicated research and long-term statistics indicate that in order to achieve successful preparation, while preventing the occurrence of health problems in female athletes, it is necessary to consider pedagogical, biomedical, and psychological aspects of their training process. It is important to say that the pedagogical would be the primary aspect, consisting of rational planning of an athlete's load, in accordance with the functional capabilities of the body.

It is known that every training process is based on the occurrence of adaptation. However, modern ideas about adaptation in sports are based on

patterns commonly identified in studies on male athletes [4, 5]. Both male and female athletes contain the same hormones, but their ratio, amount and long-term dynamics are significantly different – hence the difference in functional capabilities. The noted fact strongly affects the strategy for working with female athletes and the preservation of their health.

In addition to pedagogical problems, the concept of biomedical issues of women in sports has also been gaining significance. Among these issues is the symptomatology called the "female sports triad" [1]. This triad includes eating disorders, amenorrhea, and osteoporosis.

Numerous studies of Ukrainian scientists from the school of Professor L. G. Shakhlina showed shocking statistics on the destruction of the reproductive function of female athletes due to their coaches' lack of understanding of how important it is to consider the functioning of a woman's body.

The general public is unaware of the sufferings of numerous women who were forced to abandon their career in sports due to their coaches ignoring the peculiarities of the body adapting to great physical and mental stress. While awarding the champion's coach, most of us don't consider all those who had to stop training, injured and damaged by his improper system.

All these misconceptions are based on the insufficient knowledge of the trainers and the lack of a working methodology that they would be able to understand and follow.

The following question arises: Why does biomedical research in sports provide us with enough (sometimes even redundant) information about the functioning features of the female body, while the practice of sports dismisses most of the important recommendations based on this research? Not to mention the fact that these issues are studied and discussed throughout the academic course of sports medicine at various universities of physical education around the world. So what could be the reasons for this incomprehension?

First and foremost, actual theories and methods for the training of female athletes do not exist. While analyzing 15 textbooks on the general theory and methodology of training, and 12 written tutorials, nothing was found to help both an effective and efficient training process for the female group of athletes [4]. All this leads to the fact that, even though "women's sports' has been for 120 years, we are still lacking a well-built theory and methodology for coaching women athletes.

The second reason is that coaches are not inclined to calculate the phases of the menstrual cycle for each athlete, as this is a time-consum-

ing procedure. In addition, if the training process is organized by a group method, then individualization of the training program is extremely difficult. Obviously, it is necessary to provide the trainer with a software product located on his mobile phone (tablet), promptly providing him/her with the necessary information about what phase of the cycle the athlete is in, the state of her functional systems, and basic recommendations on the content of the training program.

In practice, it is widely believed that taking into account the variability of the hormonal background during planning is not possible due to the instability of the menstrual cycle or its absence (amenorrhea). It is obvious that it is difficult to expect a regular hormonal balance due to the mismatch of the training load, planned by the athlete's coach, with the dynamics of the hormonal background. In fact, there is a long-term systematic destruction of the body's natural biorhythm takes place.

A promising technology for coordinating a female athlete's training load with the dynamics of her menstrual cycle.

In order to match each athelte's training load to her individual hormonal status we have developed a computer **Navigator** consisting of a program for calculating the phases of the biological cycle as well as a system for analysing heart rate variability called «Varicard». The calculations are based on the data provided in the table below (Table 1) which includes five phases of the menstrual cycle (MC). These phases are characterized by substantial variability of an individual athlete's **hormonal status**, affecting her performance in every way. The following calculations are based on a cycle with a duration from 21 to 36 days. It is important to know the duration of the athlete's previous cycle and match it to the table's data in order to determine the phase in which the athlete will be during her next training period [3].

Table 1. - Calculation of the phases of the MC depending on its duration

Phases of MC **	Duration of the cycle (days) *				
	21—22	22- 26	27—28	29—30	32—36
Menstrual	1—4	1—4	1—5	1—5	1—5
Postmenstrual	5—9	5—11	6—12	6—13	6—16
Ovulatory	10—12	12—14	13—15	14—16	17—19
Postovulatory	13—18	15—22	16—24	16—26	20—31
Premenstrual	19—22	23—26	25—28	27—30	32—36

* The duration of the menstrual cycle is determined from the first day of the onset of menstruation to the first day of the next menstruation

** The beginning of each phase is calculated from the first day of the start of the MC

To automate the procedure for calculating the phases and obtaining recommendations we have developed a navigator program that can be located on the trainer's mobile phone or tablet. After entering information about the duration and start date of the previous cycle a message appears on the screen about the phase in which the athlete is currently in, as well as a set of recommendations for planning the training process. In addition, the navigator provides information on the physiological, biochemical, and psychological characteristics of the athlete's body in a particular phase of the cycle. This information gives us a general idea of the athlete's capabilities in that particular phase of the cycle.

However, we would still need information on the possible limits of adjusting the maximum load in phases 2 and 4 (favorable for maximum power training load). Similarly, in the phases (1,3,5) requiring a reduction in training load it is important to know the limits for adjusting the athlete's minimum. The system «Varicard» allows us to accurately determine the required training load for each individual athlete, in accordance with the phase of the cycle which she is currently in.

"Varicard" is a standalone device that works in conjunction with a personal computer and provides the analysis of records in the duration of 5 minutes up until several hours with a frequency of 1200 Hz. The "Varicard" actually tells us how much stress your body is under. How much total cellular power your body has. And, how that energy is being used in the body for things like balancing your hormones and repairing damage in your body.

Coordinating the intensity of the training load with the adaptive capabilities of the body will significantly increase the athlete's performance, help maintain their health, and prolong their career in sports.

Findings

1. At present, without success in the development of women's sports, no country will be able to achieve serious results in the international arena. The process of feminization of sports is activated by numerous sports organizations interested in developing the sports business, business circles, and politicians. In accordance with this, active work is underway in the world to develop women's sports, the training load continues to grow, high technology is involved, and competition is growing rapidly.

2. At the same time, the current level of knowledge about the specifics of the reaction of the female body to extreme training and competition loads is insufficient for confident and safe management of the training of athletes. In the practice of women's sports, the means and methods of training the male contingent prevail. It can be argued that the development

of the theory and methodology of women's sports training is today an extremely urgent task.

3. The proposed concept of matching planning with the dynamics of the athletes' functional capabilities will make the training process less hazardous to health, reduce the time and cost of training, extend life in sports, and allow you to effectively manage the training process and the functional systems of the body to achieve the desired result.

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CHARACTERISTIC OF THE FALLOPIAN TUBES OF THE SEXUALLY MATURE OFFSPRING OF FEMALE RATS WITH EXPERIMENTAL TYPE 1 DIABETES MELLITUS

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Abstract. The article examines the structural and functional state of the folds of the fallopian tubes and analyzes the content of mast cells in the mature offspring of female rats with experimental type 1 diabetes mellitus. Considering that mast cells accumulate preformed mediators, which are genetically determined, and are responsible for the regulation of tissue homeostasis, the authors conducted a study, during which the quantitative composition of mast cells was analyzed and the indices of granular saturation and degranulation were calculated, and the height of epithelial cells and the height of folds were also measured.

Keywords: type 1 diabetes mellitus, fallopian tubes, folds, mast cells.

Introduction

Currently, diabetes mellitus ranks 1st in prevalence among endocrine diseases and is considered "as a threat to national security" [1, 6]. Due to the high mortality rate, a large number of complications and the need for constant lifelong therapy and control, diabetes mellitus causes not only physical suffering, but also a huge socio-economic problem [2]. It is known that type 1 diabetes mellitus has a negative effect on the formation and functioning of the organs of the reproductive system (uterus, ovaries, fallopian tubes, mammary glands) [5]. However, despite a large number of studies on this topic, the main cause of reproductive dysfunction cannot be identified. At the same time, it is known that mast cells, thanks to preformed biologically active substances, take an active part in the implementation of homeostatic-type defense reactions [7]. There are numerous studies indicating a change in the content of mast cells, their secretory activity in the reproductive system, which indicates their participation in the

paracrine regulation of the functioning of structural elements and confirms the opinion about mast cells as cells of the diffuse endocrine system, actively supporting tissue homeostasis of the reproductive system organs [4].

Analysis of literature data shows that the influence of type 1 diabetes mellitus of the mother on the morphofunctional formation of the reproductive system of the offspring has been insufficiently studied. In connection with the above, the aim of this study was to analyze the effect of experimental type 1 diabetes mellitus on the morphofunctional state of the mucous membrane of the fallopian tubes in the offspring of female rats.

Materials and research methods

The object of the study was sexually mature white laboratory rats of the "Wistar" line with experimental type 1 diabetes mellitus and their sexually mature offspring. To achieve this goal, the experimental animals were divided into 2 groups. The first group consisted of 10 animals from intact mothers - the control group. The second group included 10 animals of sexually mature offspring from mothers with experimental type 1 diabetes mellitus (experimental group).

To simulate type 1 diabetes mellitus, we used the generally accepted technique using streptozotocin, since streptozotocin is the most common chemical inducer of diabetes in rodents and causes persistent hyperglycemia with fewer deaths [8]. Streptozotocin was injected into the experimental rat pups 3 times intraperitoneally with an interval of 7 days. As a result, the laboratory animals developed diabetes mellitus, as evidenced by the constant elevated values of glucose in the peripheral blood, which persisted for at least 3 months. For mating, 1 week after the last injection of streptozotocin, female rats were transferred to intact males. As a result, experimental rats were born.

The work with experimental animals was carried out in accordance with the "European Convention for the Protection of Vertebrate Animals" (Strasbourg, March 18, 1986), used in experiments and for other scientific purposes.

The studies were carried out on the fallopian tubes of sexually mature (90 days old) offspring of female rats with experimental type 1 diabetes mellitus. The implementation of the assigned research tasks was carried out using the following methods: cytological, histological, histochemical, morphometric and statistical research methods. For cytological studies, vaginal smears were stained according to the Romanovsky-Giemsa method, and the phase of the sexual cycle of experimental animals was determined. The fallopian tubes were fixed in 10% neutral formalin. The preparations were made according to the generally accepted scheme. For sur-

vey purposes and for morphometric studies, the preparations were stained with hematoxylin and eosin, and the height of the folds and the height of epithelial cells were measured. When identifying mast cells, serial histological sections of fallopian tubes stained with 0.1% toluidine blue solution were used. To assess the morphological and functional state of mast cells, their number was counted using a generally accepted technique, followed by the calculation of the indices of granular saturation and degranulation of mast cells [9].

Statistical processing of the results was carried out using the PAST program (v.3.13). During statistical processing of data using the method of variation statistics, the arithmetic mean and its error were determined. The nonparametric Mann - Whitney test was used to identify differences in the compared indicators. In this case, the results were taken into account, where the level of significance (p) of the detected differences was less than or equal to 0.05 (95%).

Research results and discussion

Analysis of the cytological picture of the obtained vaginal smears makes it possible to establish that the rat pups in the experimental and control groups were in the proestrus phase. The data obtained allow us to state that in sexually mature offspring of female rats with experimental type 1 diabetes mellitus, morphological changes are observed, which is manifested, first of all, in an increase in the height of folds. It was found that in experimental rat pups the height of the folds is 63.68±1.499 μm, while in intact animals the investigated indicator was 57.31±0.902 μm (Table № 1). It is known that high insulin levels stimulate anabolic mechanisms in connective tissue [10]. Based on this, it is logical to assume that the anabolic effect of insulin on the connective tissue, which is an integral part of the folds of the fallopian tube, leads to an increase in the height of the folds. At the same time, the height of epithelial cells was calculated in experimental animals, there is a tendency to an increase in this indicator, which is 12.35±0.207 μm, while in intact animals the studied indicator is 11.87±0.219 μm (Table № 1).

Table 1

Height of the mucous membrane of the fallopian tubes of intact and experimental animals

Groups	Height of epithelial cells (M±m), μm	Height of folds (M±m), μm
Control	11,87±0,219	57,31±0,902
Test	12,35±0,207	63,68±1,499*

* – the results are statistically significant (p <0.05) compared to control

The results obtained indicate that the number of mast cells in the folds of the fallopian tubes in rat pups of the experimental group is reduced and amounts to 4.3±0.85 per 1 rat, while the quantitative composition of mast cells in intact animals is 7.8±1.07. When studying the subpopulation composition of mast cells in the folds of the fallopian tubes of experimental and intact animals according to the degree of granular saturation, we found that in experimental rat pups there is a significant increase in the granular saturation index, which is 6.36±0.81, while in intact rat pups this the indicator is 2.21±0.52. At the same time, the analysis of the subpopulation composition of mast cells by the degree of degranulation made it possible to ascertain a violation of the excretory function of cells, which is indicated by a decrease in their degranulation index. In control animals, the degranulation index is 3.59±0.59, while in experimental rat pups the studied indicator was only 1.53±0.33. Due to the fact that mast cells saturated with biologically active substances predominate in experimental animals, it can be assumed that the secretory activity of mast cells is suppressed, and heparin cannot manifest its antioxidant and antidiabetic properties [3, 7].

Conclusion

Thus, we can conclude that in the offspring of female rats with experimental type 1 diabetes mellitus, there are changes in the height of the folds of the fallopian tubes, the content of mast cells in the folds of the fallopian tubes, as well as a significant increase in the index of granular saturation of mast cells in experimental animals and a decrease in the degranulation index. Considering that, according to the literature, reproductive health disorders occur in the offspring of mothers with diabetes mellitus, the results obtained suggest that one of the pathogenetic factors of these disorders is a change in the height of the folds, as well as the content of mast cells in the folds of the fallopian tubes and a violation of their secretory activity.

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THE BIOLOGICAL MEMBRANES CONDITION AT VARIOUS MODES OF TUBERCULOSIS TREATMENT IN PATIENTS CO-INFECTED WITH TUBERCULOSIS AND HIV-INFECTION

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Abstract. The aim of the work is to determine the phospholipid markers reflecting the state of biological membranes in different modes of pulmonary tuberculosis treatment in patients with tuberculosis/ HIV co - infection on the background of antiretroviral therapy (ARVT).

Method of research. The blood serum lipid spectrum was studied in 150 patients with tuberculosis/HIV co-infection. The relative content of the following fractions of total phospholipids (PL) was studied: total lysophospholipids (LPL), sphingomyelin (CM), phosphatidylcholine (PH), phosphatidylethanolamine (PE). Membrane destruction was determined on the basis of the destruction coefficient developed by V. K. Makarov. The degree of membrane permeability was determined by the permeability coefficient. To determine the activity of endogenous phospholipases, the phospholipase activity coefficient was used. Also, the viscosity coefficient of biomembranes was used, which is the ratio of free cholesterol to total phospholipids, from which cell membranes are composed.

Results. Patients with tuberculosis and HIV according to the first standard mode differed from patients with multi-drug resistant higher numbers of activity coefficient of phospholipase, the coefficient of viscosity of biomembranes and the coefficient of degradation of the membranes.

Both modes of treatment of tuberculosis in patients with tuberculosis/ HIV co-infection on the background of antiretroviral therapy cause a change in the phospholipid spectrum, reflecting an increase in the activity of phospholipases and the membranes destruction coefficient.

Conclusion.

The use of antiretroviral therapy in patients with tuberculosis/HIV co-infection, coupled with the treatment of tuberculosis as the first standard mode of therapy (HRZE), and with multiple drug resistance cause significant changes in the state of phospholipid indicators that reflect the state of biological membranes.

Antiretroviral therapy in the treatment of pulmonary tuberculosis according to the standard regimen of therapy (HRZE) led to a significant more intense destruction of the membranes of pulmonary tissue, provided a higher therapeutic effect, as there was an intensive destruction of mycobacterium-affected tissues compared with the treatment of patients with multiple drug resistance and antiretroviral therapy.

In the absence of antiretroviral therapy, low destruction or absence of affected tissues destruction was observed, which contributes to the spread, infiltration by mycobacteria of pulmonary fields.

Keywords: HIV infection, tuberculosis, lipids, biomembranes

Introduction

In the last decade, a significant increase in the combined pathology – tuberculosis and HIV infection (TB/HIV) has been reported. This leads to the formation of a new epidemic process – HIV-associated tuberculosis. The situation becomes epidemic [1, 2, 3].

The world health organization (WHO) predicts that the increase in the prevalence of HIV infection among the population will increase the incidence of tuberculosis [4, 5]. Tuberculosis remains the second leading cause of death in HIV infection [6].

The Russian Federation is one of the countries with a high burden of tuberculosis and a deteriorating HIV epidemiological situation. The incidence of tuberculosis in patients with HIV infection is 21-37 times higher than in people without HIV infection, and in some studies, the risk of tuberculosis in the early stages of HIV infection is 113 times [7]. Mortality from tuberculosis (TB) reaches 43-89% in patients with HIV infection [8].

Among the deceased patients with tuberculosis, patients with HIV/TB co-infection account for more than a quarter, and their share is growing [9].

It is known that lipids are a major component of all body cells [10]. Directly involved in ensuring the integrity of the membrane structure, phospholipids support many cellular functions. To determine the state of the membranes, it is advisable to study the phospholipid fractions of blood serum, since it is known that phospholipids (PL) are part of the cell membranes [11, 12] and, accordingly, any change in their content on the membrane leads to a change in their content in the blood.

The aim of the work is to determine phospholipid markers reflecting the state of biological membranes in different modes of treatment of pulmonary tuberculosis in patients with HIV/tuberculosis co - infection against the background of antiretroviral therapy (ART).

Materials and methods

The criteria for inclusion of patients in the study were: the presence of HIV infection (observation examination and treatment in the AIDS center), primary diagnosis of tuberculosis, as well as the presence of CD4 lymphocytes below 250 cells/mm3. Phospholipid spectrum of blood serum was studied in 50 patients (group 1) with HIV infection in stage 4B with drug-sensitive infiltrative pulmonary tuberculosis (ART rejection); group II - 50 patients with HIV-infection in stage 4B with drug-sensitive infiltrative lung tuberculosis treated with standard therapy regimen (HRZE) + ART; group III, 50 patients with HIV-infection in stage 4B of drug-resistant infiltrative pulmonary tuberculosis receiving treatment for multi-drug resistance (MDR) + ART.

The mode of chemotherapy of tuberculosis was formed in accordance with Federal clinical recommendations on the basis of information about the drug resistance of the pathogen.

Immunological studies to determine the absolute number of CD4 lymphocytes were carried out by flow cytometry on the cytomic FC 500 analyzer using monoclonal antibodies.

Viral load was determined by polymerase chain reaction on the Abbott m2000rt instrument.

Lipids were isolated by Folch [13] and fractionated by a modified method [14] with the determination of the percentage of minor lipid components of blood serum simultaneously with the main lipid fractions using the method of densitometry and modern high–precision densitometer Shimadzu CS-9000 (Japan).

The relative content of the following fractions of total phospholipids (PL) - total lysophospholipids (LPL), sphingomyelin (CM), phosphatidylcholine (PH), phosphatidylethanolamine (PE) was studied. The results of each lipid content were expressed as a percentage of total phospholipids and in absolute values.

Membrane destruction was determined on the basis of the coefficient $PH^2/CM \times LPL$ developed by V. K. Makarov [15].

The degree of membrane permeability was determined by the permeability coefficient [CM]/[PH] developed by V. I. Gurin [16]. A decrease in the values of this coefficient indicated a decrease in the lipid "liquid" of the membranes, that is, an increase in its permeability. To determine the activity of endogenous phospholipases, the phospholipase activity coef-

ficient [PH]/[LPH] was used by E.Kucharenko et al.[17] in our modification [PH+PE]/[LPL].

The degree of membrane permeability was determined by the permeability coefficient [CM]/[PH]. A decrease in the values of this coefficient indicates a decrease in the lipid "liquid" of the membranes, that is, an increase in its permeability. To determine the activity of endogenous phospholipases, the phospholipase activity coefficient [PH+PE]/[LPL] was used. The increase in its values is inversely proportional to the decrease in phospholipase activity, i.e. indicates a decrease in the activity of endogenous phospholipase used the activity coefficient of phospholipase [PH+PE]/[LPL]. The increase in its values is inversely proportional to the decrease in phospholipase activity, i.e. indicates a decrease in the activity of endogenous phospholipases, which leads to the accumulation of lysophospholipids on biological membranes and their destruction. In addition, the viscosity coefficient of biomembranes [8] was used, which is the ratio of free cholesterol to total phospholipids, of which the cell membranes [FC/PL] are composed. There is an optimal ratio of the level of free cholesterol and total phospholipids (FC/PL) in the cells of the macroorganism. Each change in this ratio is manifested by a change in its values in the blood serum. Statistical processing of the data was carried out using a computer program Biostat.

Results and discussion

Patients with HIV/tuberculosis who did not receive ART differed from healthy individuals by lower values of the phospholipase activity coefficient [PH+PE]/[LPL], the biomembrane permeability coefficient [CM/PH], the membrane destruction coefficient [PH+PE]2/[CM x LPL] and high biomembrane viscosity coefficients [CX / PL].

In group 2 patients, the digital values of the coefficients [PH+PE]/[LPL], [CX/PL] and [PH+PE]2/[CM x LPL] were significantly higher than in healthy individuals.

Patients of group 3 were characterized by higher values of coefficients [CM/PH], [FC/PL] and [PH+PE]2/[CM x LFL] compared to healthy individuals .

Patients of the 2nd and 3rd groups receiving ART had significantly higher values of the coefficients [PH+PE]/[LPL], [CX/PL] and [PH+PE]2/[CM x LPL] and lower [CM/PH] compared to patients of the first group of HIV/tuberculosis, who did not receive antiretroviral therapy (table.1).

The numerical values of the biomembrane permeability coefficient [CM/PH] in patients treated with art were significantly lower than in patients of group 1 who did not receive this type of treatment.

Table 1.
The values of the ratio of l phosphatidylcholine +
phosphatidylethanolamine to total lysophospholipids,
sphingomyelin to phosphatidylcholine, free cholesterol to
phospholipids and the ratio [PH+PE]2/[CM x LPL] in patients with
HIV/TB groups

Compare group	n	Name coefficients			
		[PH+PE]/[LPL]	[CM]/[PH].	[FC/PL]	[PH+PE]2/[CM x LPL]
HIV / tuberculosis (group 1)	50	1,0±	0,8±	0,5±	1,6±
HIV / tuberculosis (group 2)	50	2,0±	0,6±	1,2±	4,7±
HIV / tuberculosis (group 3)	50	1,5±	0,7±	0,8±	3,0±
P_1		<0,001	<0,001	<0,001	<0,001
P_2		<0,001	<0,002	<0,001	<0,001
P_3		<0,001	<0,02	<0,001	<0,001

Note:

P1-reliability of differences in indicators in patients with HIV / tuberculosis of the 1st and 2nd groups;

P2-reliability of differences in indicators in patients with HIV / tuberculosis of the 1st and 3rd groups;

P3-reliability of differences in indicators in patients with HIV / tuberculosis of the 2nd and 3rd groups.

Patients of the 2nd group with the treatment of tuberculosis for 1st standard mode in the background art differed from the patients of the 3rd group with MDR and ART larger the activity coefficient of phospholipase [PH+PE]/[LPL], the coefficient of viscosity of biomembranes [FC/PL] and coefficient of destruction of membranes [PH+PE]2/[CM x LPL].

Thus, both treatment regimens of tuberculosis in patients with HIV/tuberculosis co-infection on the background of art causes an increase in the activity of phospholipases (inversely proportional to the increase in the digital values of the coefficient [PH+PE]/[LPL]) and the coefficient of membrane destruction [PH+PE]2/[CM x LPL], indicate the suppression of phospholipase activity, which induces pathological changes in pulmonary tissue.

This, in turn, can lead to the accumulation of lysophospholipids on biological membranes, their destruction, the stratification of the membrane gel into several phases, a change in the transition temperature and, as a result, to a significant destruction of pulmonary tissue affected by mycobacterium tuberculosis.

Decrease in the ratio of CM/PH in patients with co-infection with HIV / tuberculosis receiving ART compared with not receiving shows that ART causes an increase in "fluidity", and hence permeability, promotes the penetration of tuberculosis drugs in mycobacterium-affected cells of pulmonary tissue.

Significant increase in the values of the coefficient FC/PL shows that, in general, characteristic of patients with co-infection with HIV / tuberculosis in the preparation of ART is an increase in the activity of the enzyme lecetinholesterinesterase (LHAT), which can lead to an increase in the microviscosity of membranes, and for group 3 almost to normal.

Conclusions

The use of antiretroviral therapy in patients with HIV/tuberculosis co-infection, coupled with the treatment of tuberculosis as the first standard mode of therapy (HRZE), and with multiple drug resistance cause significant changes in the state of phospholipid indicators that reflect the state of biological membranes.

Antiretroviral therapy in the treatment of pulmonary tuberculosis according to the standard regimen of therapy (HRZE) led to more intensive destruction of the membranes of pulmonary tissue, provided a higher therapeutic effect, as there was an intensive destruction of mycobacterium-affected pulmonary tuberculosis tissues compared to the treatment of patients with MDR and ART.

In the absence of ART, low destruction or absence of destruction of the affected tissues was observed, which contributes to the spread, infiltration by mycobacteria of pulmonary fields.

The author States that there is no conflict of interest under the article.

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TO THE PROBLEM OF THE SEAWATER DESALINATION

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Abstract. The article estimates the size of hydrated ions, the components of seawater.
Keywords: seawater desalination, hydrated ions, size of hydrated ions.

Facing severe and increasing shortage of fresh water on the planet that can even lead to local conflicts, methods of seawater desalination for industrial and municipal purposes become urgent.

Distillation desalination method leads to huge electricity consumption and therefore alternative, less expensive ways are being searched for. Construction and operation methods of desalination with the help of various membranes (e.g., the method of reverse osmosis) involve large energy and economic costs. In particular, for desalination of 1 cubic meter seawater not less than 400 kilowatts of electricity and the pressure to 6,5 MPa (65 atm) are required. When the mesh size has a radius of 0.1 nm, the costs are much more than the production of the membrane with a radius of 0.2 nm. Since the radii of hydrated ions are significantly (almost twice) larger than the radius of a water molecule (0.138 nm) passed through the membrane, then the estimation of the size of hydrated ions, the components of sea water (mainly: Na^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, SO_4^{2-}) for the manufacture of membranes with optimal size becomes meaningful because of lowering operating pressures and reducing costs of manufacturing devices for desalination.

As a rule available information on individual n_S ions, benchmarks for assessing the size of hydrated ions, determined by Russian and foreign researchers differ by several units. For example, the hydration number of K^+ ion is 16 by Remy and 1.9 - by Robinson-Stokes equations. The high value of the hydrated potassium ion by Remy can be explained by the fact that the model of ionic hydration involving all water molecules in the formation of hydration shells, which, of course, could not be possible.

For some ions these numbers are given in Table 1.

Table 1
Values of ions hydration according to various authors

Author	Method	Hydration numbers					
		Na^+	K^+	Mg^{2+}	Ca^{2+}	Cl^-	SO_4^{2-}
I	a	–	16	–	–	–	–
II	b	8.4	5.4	–	–	–	–
III	b	–	22	–	–	–	–
IV	b	16.9	9.6	–	–	–	–
V	c	3	4	–	–	–	–
VI	d	3.5	1.9	–	–	–	–
VII	e	4.03	2.69	5.33	3.64	1.70	2.34

Notes: *I - Remy; II - Washbourne; III - Rosenfeld; IV - Smith; V - Brinttsmiger; VI - Robinson and Stokes; VII - Baldanov and Tanganov. Methods: a - ion mobility; b - coefficient of diffusion; c - speed of diffusion through the membrane; d - dependence of activity coefficients on concentration; e - plasma-like theory of electrolyte solutions.*

A non-empirical method for calculating hydration numbers of ions in solutions [1, 2] is elaborated, according to which the ion charge $q_i = z_i e$ in liquid, incompressible polar dielectric is screened by the nearest environment of solvent molecules forming the hydration shell.

The interaction of ion is dipole. The relevant potentials are equal:

$$\varphi_i = z_i e / \varepsilon r_i, \qquad \varphi_d = p / \varepsilon R_s^2 , \qquad (1)$$

where ε is dielectric constant, R_s is radius of the solvent molecule.
The potential of the central ion in a dielectric medium is neutralized by the dipole potentials φ_d of solvent molecule (by the number of n_s):

$$\varphi_i - n_s \varphi_d = \varphi_p \qquad (2)$$

where φ_p is the resulting potential.

If equation (1) transform into the finite-difference equation of ion-dipole energy, then from the obtained equation (2), the boundary of the hydrated complex is cut by energy of thermal motion $5 k_Б T/2$, in the form of evident condition $e\varphi_p = 5 k_Б T/2$, which means that the obtained difference between the energies of ions and water molecules is compensated at the boundary of the thermal energy of the medium itself $5 k_Б T/2$:

$$z_i e^2 / \varepsilon r_i - n_s p e / \varepsilon R_s^2 = 5 k_Б T/2 \qquad (3)$$

Here n_s is the number of solvent molecules in the hydration complex and $k_Б$ is Boltzmann constant. Thus, the hydration number n_s will be determined by the relation:

$$n_s = z_i e \, R_s^2 / r_i p \, -5k_БTεR_s^2 /2 \, pe \tag{4}$$

where z_i and r_i are charge and ionic radius.

Now let's consider the size of nanoparticles, the radii of hydrated ions. According to our concept [3, 4, 5], they can be calculated basically on the model of oscillating with a plasma-like frequency of particles in electrolyte solutions using the dispersion of the Vlasov's equation:

$$ω = ω_L \cdot (1 + (3/2) \cdot k^2 r_D^2) \tag{5}$$

Here $ω_L = (4\pi z_i z_D e^2 n_o/m)$ – Langmuir's plasma frequency; $z_i e$, $z_D e$ are ion charge and dipole of the solvent; $n_o = n_s/V = n_s/(4/3) \cdot \pi r_s^3$ - is - density of charges, in this case the number of solvent molecules in the hydrate complex, n_s is hydration number, M is mass of the solvent molecules, r_s is the radius of hydrated ion.

The dipole charge is $z_D e = p/l$, where p is the dipole moment and l is dipole distance for the solvent.

Damping parameter kr_D, where k is a wave number, r_D is Debye radius, has limits of changing $0 \le kr_D \le 1$. In considering the ions of electrolyte in the solution as a system of charges, $kr_D = 1$ takes place, i.e. spatial dispersion is at maximum, oscillations are damping, but they are maintained at a frequency of external perturbation.

$$ω = 5/2ω_L = (5/2) \cdot (4\pi z_i z_D e^2 n_o/m)^{1/2} \tag{6}$$

Table 2
Characteristics of hydrated ions

Ion	Ion radius, r_i, nm	Hydrate number, n_s	The radius of hydrated ion, r_s, nm (7)	The radius of hydrated ion, r_s, nm [6]
Na^+	0.098	4.03	0.360	0.330, 0.386
K^+	0.133	2.69	0.315	0.301
Mg^{2+}	0.078	5.33	0.395	-
Ca^{2+}	0.106	3.64	0.348	-
Cl^-	0.181	1.70	0.270	0.291
SO_4^{2-}	0.147	2.34	0.300	-

If you multiply the expression (6) on the Planck constant ħ, and bear in mind that the total energy $hω$ is $(3/2)k_БT$ (for spherically - symmetric distribution all three degrees of freedom are taken into account), then we obtain formula (7), in which values n_o и $z_D e$, given earlier, are introduced:

$$r_s = (25z_i pen_s ħ^2 /3mlk_Б^2 T^2)^{1/2} \tag{7}$$

The values of the radii of solvated ions in water, calculated according to equation (7), are also listed in Table 2.

As it seen from Table 1 and 2, the estimated hydration numbers and the radii of hydrated ions (the size of nanoparticles) are in satisfactory agreement with scientific literature data. The given model estimates the size of hydrated ions of seawater and the obtained values rs can be recommended for the development of more energy-and resource-saving technologies of seawater desalination not only for the regions with a harsh shortage of drinking water.

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HYDROGEN AS A CORROSION PROTECTION AND AN ALTERNATIVE ENERGY SOURCE

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Abstract. The reliability of technological equipment is one of the main tasks of any production. Identification of the influence of the working environment, in particular the presence of hydrogen sulfide and hydrogen in the working mixture, on equipment is one of the important tasks in solving this problem. The study of the influence of such an environment on technological equipment associated with hydrocarbon production processes is an urgent problem in oil and gas production, transportation and further processing. The use of hydrogen sulfide-containing gas utilization products as protective coatings, as well as sources of additional energy, is of scientific and practical interest.

Keywords: Hydrogen, hydrogen sulfide, global energy source, utilization, processing, metal catalyst, metal structures, process piping, oil, gas condensate field.

In the processing of hydrogen sulfide-containing gases, hydrogen becomes an integral by-product. In turn, hydrogen, according to scientists, becomes the most popular of the elements of the periodic table, which are used in most production processes. Demand for this chemical element of the periodic table is growing, as it is recommended by many scientists as the main energy carrier of the future.

Another advantage in favor of using hydrogen as an element of anti-corrosion coatings and an energy source is that only water remains as a result of the combustion of hydrogen by the reaction product. This fact speaks in favor of using hydrogen as a source of global energy. One of the most effective sources of hydrogen production can be the utilization of hy-

drogen sulfide-containing gases, whose reserves are estimated at billions of tons, followed by the breakdown of hydrogen sulfide. It should be noted that annually, according to statistical data, in the oil and gas industries and oil and gas refineries, hydrogen sulfide is produced in significant quantities. It is known that hydrogen sulfide is a very toxic substance. That is why special attention is paid to its removal from the exhaust gases of industrial plants and industrial wastewater. Unfortunately, the methods of utilizing hydrogen sulfide used in industry are based on its oxidation with atmospheric oxygen, resulting in solid sulfur, water or sulfuric acid. As a result of these processes, hydrogen is invariably released in connection with water. This fact excludes the possibility of using hydrogen as an environmentally friendly fuel [1].

The decomposition of hydrogen sulfide is carried out in the presence of honeycomb catalysts, aluminosilicate, phosphoric acid and other catalysts. Scientists consider catalysts coated with iron dioxide to be especially effective, that is, practically using metal catalysts. Laboratory studies show that both hydrogen and diatomic gaseous sulfur are the reaction product. The essence of the experiments is that the solid-based catalyst is placed in a solvent capable of dissolving the hydrogen sulfide cleavage products. The fact that the metal catalyst was placed under a layer of water. The conversion of hydrogen sulfide is significantly increased, even in the case of immersion of the catalyst under a layer of water, compared with the gas phase. This is apparently due to the good solubility of gaseous sulfur in water. Subsequent studies in this direction showed that the greatest effect is achieved when using aqueous solutions of monoethanolamine (MEA) and sodium carbonate. Such solutions are popular in industrial processes for the extraction of sulfur from the "tail" gases of Klaus plants.

The analysis allows us to state that the decomposition of hydrogen sulfide at room temperature on metal-coated catalysts opens up wide possibilities for producing hydrogen. It is worth noting that the goal of the oxidation processes is the disposal of hydrogen sulfide, which is being successfully implemented. The experimental results suggest that the low-temperature catalytic decomposition of hydrogen sulfide into hydrogen and sulfur is quite effective, and hydrogen, in turn, can be considered an environmentally friendly energy carrier.

At the same time, it is worth noting that the process of oil, gas and gas condensate production with a high content of hydrogen sulfide has been and remains a rather significant problem. In addition to this problem, the problem of hydrogen sulfide and hydrogen corrosion of both technological pipelines and industrial equipment is also important.

Hydrogen corrosion of technological equipment is a phenomenon that accompanies almost all technological processes, the product of which is hydrogen.

Hydrogen corrosion is characterized in that the destruction of the equipment casings and pipelines proceeds practically without deformation of the equipment parts, metal structures and process pipelines. This type of corrosion is most often affected by the surface of shielded pipes, which are under direct thermal influence at high pressure. As a result of this effect, fractures arise in the form of a longitudinal rupture of both the internal and external surfaces of pipes and metal structures. Deformation-free destruction is characteristic of almost all cases. At the same time, there is no increase in the outer diameter or it is substantially small. After such an impact, the metal loses its strength and ductility in comparison with the metal on the opposite side of the impact. Numerous observations have shown that the destruction is intergranular in nature and is caused by deposits on the inner surface of metal structures, consisting of iron and copper oxides.

It is also necessary to focus on the fact that in the presence of borehole water in the transported oil and gas condensate, such a method as forced introduction of hydrogen into the pipeline system helps to reduce corrosion. This is explained by the fact that the interaction of water oxygen with hydrogen results in the formation of a hydroxyl group. This fact is the very chip that leads to the neutralization of the negative impact on the metal.

However, despite the negative consequences in the process of obtaining hydrogen for equipment, interest in such studies is only growing in the world. This is due, on the one hand, to a decline in oil and gas production, increasing difficulties in the operation of wells and transportation of raw materials, and other reasons. Scientists all over the world pay great attention to the search for alternative sources of global energy.

Thus, interest in research on the problems of using hydrogen as an alternative fuel has been growing rapidly in recent years in leading world scientific centers. A lot of research has been done at research centers in Germany. The work carried out in Japan is widely known, where the use of gaseous and liquid hydrogen is studied, as well as additives of this fuel to the fuel-air mixture. Similar studies were conducted in Norway, Poland, France, Australia, India, etc.

Significant contribution to the development of the direction of the use of hydrogen was made by such famous Russian scientists as V.A. Wagner, V.A. Zvonov, Yu.V. Galyshev, N.A. Ivashchenko, A.A. Kapustinin and others. There were attempts to organize work on the "Norilsk Nickel – RAS" hydrogen energy program, but in 2008 this program was closed [2].

Along with scientists from all over the world, large companies pay great attention to the search for environmentally friendly energy sources, highly efficient and cheap. According to many researchers, this kind of substance should be inexhaustible as a resource and easily accessible. Regarding hydrogen, it should be noted that the use of hydrogen as an energy source will have both positive and negative effects.

Therefore, the attention paid to the search for an alternative energy source is becoming not only relevant, but also crucial, since the climate is changing due to anthropogenic impact, traditional energy resources are gradually being depleted in the bowels of the earth, and their cost is constantly increasing. This kind of energy source is necessary not only for the development of humanity, but also for the existence of the planet itself.

The main contender for a universal source of energy, in our opinion, is hydrogen, which has long been known for its both negative and positive properties. Today, there are many reasons for the large-scale use of hydrogen energy.

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ENERGY OF THE PROCESS OF MIXING MATERIALS IN ELECTROMAGNETIC MIXERS

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Abstract. The article presents the results of modeling the process of mixing materials in devices with a magnetically fluidized bed of a ferrothel. The main factors that determine the energy performance of electromagnetic stirrers are identified.

Keywords: mixing, electromagnetic mixers, modeling.

Mixing materials with the unconventional use of electromagnetic field energy is a promising direction for the intensification of hardware and technological systems of agricultural processing industries [1]. Presently, agitators with a magnetized fluid bed (MFB) of a ferrothel — mixing non-equiaxed ferrothelial agitators, for example, cylinders, needles, etc., are known. [2]. magnetic fluidized bed (MFB) is formed in a rotating electro-magnetic field of the working chambers of the apparatus in a mixture with the processed product. Meanwhile, despite the significant intensification of the mixing processes in these devices due to additional mechanical, thermal, acoustic and electromagnetic effects that alter the physicochemical properties of materials, vortex electromagnetic devices (VEA) there are a number of significant drawbacks that inhibit their widespread adoption in production: high energy intensity, insufficient degree of energy management of shear deformations. These factors make it difficult to obtain products with particle sizes in a narrow and optimal dispersion range.

One of the promising methods of mixing is a method of turbulizing the flow of mixing components in the MFB using the energy of a constant electro-magnetic field. As shown in the practice, devices implementing this method in electromagnetic mechanical activators (EMMA) eliminate these disad-

vantages and above all, provide an increase in the intensity and efficiency of mixing due to the rational use of the volume of product processing [3].

The basic equation for determining the concentration equalization time in the process of electromagnetic mixing in electromagnetic stirrers with a magnetically fluidized bed takes the form [2]:

$$\tau_i = k_t R^2 = R\!\big/\!r_0 \,,$$

(1)

Where k_t – Coefficient of homogeneity of the mixture;

R – Radius of the cylindrical body;

r – Radius of the mixing element.

The simulation was carried out by the zone method, according to which the working volume of the mixer is divided into elementary volumes (zones). In this case, the central and peripheral zones are considered [3]. The zones are separated by a surface located at a distance of radius r_m.

For the zones under consideration in the presence of turbulent diffusion and an axisymmetric distribution of concentrations, the one-parameter diffusion model is described by the equations:

$$F_1 \frac{\partial e_1}{\partial \tau} = -q \frac{\partial e_1}{\partial h} + S_{t1} F_1 \frac{\partial^2 e_1}{\partial h^2}\,,$$

(2)

$$F_2 \frac{\partial e_2}{\partial \tau} = -q \frac{\partial e_2}{\partial h} + S_{t2} F_2 \frac{\partial^2 e_2}{\partial h^2}\,,$$

with boundary initial conditions:

$$q(e_2 - e_1) + S_{t1} F_1 \frac{\partial e_1}{\partial h} = 0; \quad \frac{\partial e_2}{\partial h} = 0, \quad \text{at } h = Y, t > 0\,,$$

(3)

$$q(e_1 - e_2) + S_{t2} F_2 \frac{\partial e_2}{\partial h} = 0; \quad \frac{\partial e_1}{\partial h} = 0, \quad \text{at } h = 0, t > 0\,,$$

(4)

$$e_{1,2} = \delta(Y - h)\,, \quad \text{at } t = 0\,,$$

(5)

Where

$$e_{1,2} = \frac{e_{1,2}(\tau, h) - e_H}{e_K - e_H}\,,$$

(6)

Where $e_{1,2}$, e_K, e_H – respectively, dimensionless and average concentrations

$$(t = 0 \text{ и } t = \infty);$$

q– volume of the suspension to be changed between the zones, м³/c;

$F_1 = \pi\, r_m^2$, $F_2 = \pi\left(R^2 - r_m^2\right)$ – respectively, the cross-sectional area of the considered zones in the volume of the mixer, м²;

Y – the geometric size of the mixer along the coordinate h (vertical), м;

S_{t1}, S_{t2} – the average cross-section of the mixer for the coefficients of turbulent diffusion along the height of the considered zones, м²/c.

To calculate the values S_{t1}, S_{t2} the equalities are valid:

$$S_{t1} = 2/r_m^2 \int_0^{r_m} S_{t1}^{JI}\, rdr \tag{7}$$

$$S_{t2} = 2/\left(R^2 - r_m^2\right)\int_{r_m}^{R} S_{t2}^{\ddot{E}}\, rdr \quad.$$

When solving the equations, each zone is represented as an elementary volume along the vertical of the mixer.

If the volume of the mixers is divided into a large number of zones, then the concentration gradient in the elementary volumes i and i + 1 can be represented as:

$$\left(\frac{de}{dh}\right)_{i,i+1} = \frac{e_{i+1} - e_i}{\dfrac{Y}{z}}, \tag{8}$$

Then equations 1 can be represented by a system of differential equations:

$$\frac{YF_1}{z}\frac{\partial e_1}{\partial \tau} = q(e_{2z} - e_1) + S_1 F_1(e_2 - e_1)\left(\frac{z}{Y}\right)$$

$$\frac{YF_1}{z}\frac{\partial e_i}{\partial \tau} = q(e_{i-1} - e_i) + S_1 F_1\left(e_{i-q} - 2e_i + e_{i+1}\right)\left(\frac{z}{Y}\right)$$

$$\frac{YF_1}{z}\frac{\partial e_z}{\partial \tau} = q(e_{z-1} - e_z) + S_1 F_1 (e_{z-1} - e_z)\left(\frac{z}{Y}\right)$$

$$\frac{YF_2}{z}\frac{\partial e_{z+1}}{\partial \tau} = q(e_z - e_{z+1}) + S_2 F_2 (e_{z+2} - e_{z+1})\left(\frac{z}{Y}\right)$$

(9)

$$\frac{YF_2}{z}\frac{\partial e_\kappa}{\partial \tau} = q(e_{k-1} - e_k) + S_2 F_2 (e_{k-1} - 2e_k + e_{k+1})\left(\frac{z}{Y}\right)$$

$$\frac{YF_2}{z}\frac{\partial e_{2z}}{\partial \tau} = q(e_{2z-1} - e_{2z}) + S_2 F_2 (e_{2z-1} - e_{2z})\left(\frac{z}{Y}\right)$$

where e_i, e_k – the values of the concentration indicators of the mixed substance in the i-th and k-th elementary volumes,

S_1, S_2 – turbulent diffusion coefficients in the central and peripheral zones, м²/c.

In the equations, the inequalities 2 <l <(z-1) and (z + 1) <k> (2z-1) are valid.

The presented mathematical model is introduced into the design calculation of electromagnetic mixers to calculate the kinetics of concentration equalization in suspensions according to the working volume of the apparatus.

When the stirrer (ferroelement) rotates in a cylindrical shape, the field strength has the form

$$\vec{H} = H_{II}\vec{e}_{II} + H_\perp \vec{e}_\perp$$

(10)

Where H_{II} and $H_\perp$ – parallel and perpendicular components of the vector $\vec{H}$

$$H_{II} = H \sin \varphi, \quad H_\perp = H \cos \varphi.$$

Then the rotation moments and the rotation vector of the ferromagnetic stirrer in the EMM can be described by the expressions

$$M'_{II} = \left(H_{II} - N_{II}M'_{II}\right)\left(\mu - 1\right)$$

$$M'_{\perp} = \left(H_{\perp} - N_{\perp}M'_{\perp}\right)\left(\mu - 1\right)$$

$$\vec{M}_{вр} = \mu_0\left[\vec{M} \cdot \vec{H}\right] = \mu_0\left(M_{II}\vec{e}_{II} + M_{\perp}\vec{e}_{\perp}\right) \cdot \left(H_{II}\vec{e}_{II} + H_{\perp}\vec{e}_{\perp}\right) =$$

$$= \mu_0\left(M_{II}H_{\perp} - M_{\perp}H_{II}\right)\left(\vec{e}_{II} \cdot \vec{e}_{\perp}\right) \tag{11}$$

For values of the angle of rotation $\varphi = 45^0$ the moment has a maximum value

$$M_{вр.\max} = \mu_0 \frac{1}{2} H^2 V\left(\mu - 1\right)\left[\frac{1}{1 + N_{II}\left(\mu - 1\right)} - \frac{1}{1 + N_{\perp}\left(\mu - 1\right)}\right] \tag{12}$$

The average torque is

$$\left|M_{вр}\right|_{cp} = \frac{2}{\pi}\int\limits_0^{\pi/2}\left|M_{вр}\left(\varphi\right)\right|d\varphi = \mu_0\frac{H^2 V\left(\mu - 1\right)}{\pi} \cdot$$

$$\tag{13}$$

$$\left[\frac{1}{1 + N_{II}\left(\mu - 1\right)} - \frac{1}{1 + N_{\perp}\left(\mu - 1\right)}\right]_.$$

Mixing of the product is carried out in a magnetically fluidized bed of ferromagnetic stirrers of cylindrical design. The power spent on mixing at the Nth number of mixers is expressed as:

$$P = N\frac{2\pi\left|M_{вр}\right|_{cp}}{T}_. \tag{14}$$

Based on the analysis of formula (14), it can be concluded that the power consumption in the EMM depends, first of all, on the fill factor of the working volume of the magnetically fluidized bed. The data obtained were used in the design of energy-efficient EMM.

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FAT CONFECTIONERY CREAMS FOR DIETARY NUTRITION

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Currently, about 6% of the world's population suffers from diabetes and about 30% are overweight or obese, which in turn is often associated with the development of diabetes. Confectionery items belongs to the category of food products that are not prohibited for diabetics, but have limitations both in quantity (due to their high calorie content) and in composition. The objective of the study was to develop medium-calorie fat confectionery creams without easily digestible carbohydrates, enriched with dietary fibers, omega-3 fatty acids and vitamins. The result was the development of fat confectionery creams with a caloric value of 200-270 kcal / 100 g, not containing mono- and disaccharides, with a dietary fiber content up to 10 g / 100 g (more than 1 g / 100 kcal), omega-3 fatty acids over 0.2 g / 100 g and vitamin E more than 5 mg / 100 g. The developed products can be used for the preparation of desserts intended for people suffering from diabetes and obesity.

Keywords: diabetes, obesity, fat confectionery cream, dietary fiber, omega-3 fatty acids, vitamins

Currently, about 6% of the world's population suffers from diabetes and about 30% are overweight or obese. Obesity is often associated with the development of insulin resistance and diabetes mellitus. Therefore, the annual increase in the percentage of people who are overweight or obese is directly related to the increase in the incidence of type 2 diabetes. In the Russian Federation in 2016, 9.3% of the population was diagnosed with diabetes, overweight or obesity was recorded in 21.7% of boys and 18.6% of girls 14-20 years old, 54.3% of men and 58.9% of women. In general,

the prevalence of obesity in Russia in 2016 was 30%. Very often obesity and diabetes mellitus are accompanied by disorders in the work of the cardiovascular system [1].

In recent years, modern dietology has significantly narrowed the list of absolutely prohibited foods for patients with diabetes mellitus. At the moment, dishes based on refined, easily digestible carbohydrates (sucrose, glucose), as well as foods containing refractory fats and a lot of cholesterol (beef, lamb fat, etc.) are absolutely contraindicated for them. To compensate for carbohydrate metabolism, instead of easily digestible carbohydrates, it is recommended to consume dietary fibers fermented in the body.

Confectionery items belongs to the category of food products that are not prohibited for diabetics, but they have restrictions both in quantity (due to their high calorie content) and in composition. As a result, the market of confectionery products for diabetics in the EurAsEC countries is represented by a small number of items. Replacement of easily digestible carbohydrates with dietary fiber in food products for diabetics is urgent.

As you know, dietary fiber has a prebiotic effect, positively affecting the intestinal microflora and stimulating the growth of lacto- and bifidobacteria, stimulating the motor function of the intestine and bile secretion. Due to the normalization of the gastrointestinal tract, dietary fiber prevents the onset and development of cancer of the colon and other parts of the intestine. High absorption properties and antioxidant activity contribute to the elimination of endo- and exotoxins from the body. Dietary fiber creates a feeling of fullness and reduces energy consumption, which is so important for people who are overweight or obese. They slow down the rate of absorption of glucose from the intestine, thereby lowering the level of glucose in the blood and, accordingly, the need for insulin, which is so important for patients with diabetes. One of the physiological actions of dietary fiber is to lower blood cholesterol, which in turn has a beneficial effect on the prevention of cardiovascular disease. The physiological need for dietary fiber for an adult in the EurAsEC countries is 20 g / day [2].

Analysis of patents shows the absence the developments of dietary confectionery creams and fat spreads and blended fat spreads with a dietary fiber content of more than 1 g per 100 kcal of the product [3-7].

The objective of the study was to expand the range of dietary products by developing medium-calorie fat confectionery creams that do not contain easily digestible carbohydrates, enriched with dietary fiber (more than 1 g per 100 kcal), omega-3 fatty acids and vitamins.

As the basis for the development of new recipes for dietary confectionery creams was chosen butter cream "New" with a minimum set of

initial ingredients [8], prepared from butter and sugar-milk syrup with fat content 39%, moisture 23.5 ± 2% and density 750-900 kg / m^3. This cream have a caloric content of over 500 kcal / 100 g, and in accordance with the classification adopted by the Russian Diabetes Association, they are classified as "high-calorie" products. Replacing easily digestible carbohydrates with sweeteners in its recipe makes it possible to use this product in small quantites in the manufacture of confectionery items for diabetics. An additional reduction in the calorie content of this cream allows it to be consumed by overweight or obese people, as well as everyone who monitors their weight.

It was decided to use polyhydric alcohols such as isomalt, xylitol, lactitol, maltitol, mannitol, sorbitol, erythrol as natural sweeteners in the developed formulations of fat creams, which do not have a harmful effect on the body. The use of polyhydric alcohols as sugar substitutes also makes it possible to practically not change the amount of polyol introduced instead of sucrose into the cream recipe without deteriorating its quality. It is best to use low-calorie polyhydric alcohols such as erythrol and isomalt to achieve our goals.

Isomalt (palatinite, E 953) or O-α-D-glucopyranosylmannite has a caloric value of 1.62 kcal / g, the glycemic index is 9, the sweetness coefficient is 0.5. Isomalt intake has little effect on glucose and insulin levels in healthy people and patients with type 1 and 2 diabetes. Due to its low glycemic index, isomalt does not cause sharp fluctuations in blood sugar. It also suppresses appetite by acting as dietary fiber to fill the stomach and reduce hunger. Safe doses up to 50 g / day for adults and 25 g / day for children.

Erythrol (E 968) or 1,2,3,4-butantetraol. It is practically not absorbed by the body and does not take part in metabolic processes, since it has a caloric content of 0.2 kcal / g, the glycemic index is 0, and the sweetness coefficient is 0.7. Does not affect blood sugar levels. A low insulin index does not provoke the production of this hormone by the pancreas. The maximum dosage of erythritol without causing a laxative side effect is 0.66 g / kg body weight.

Intense sweeteners such as sucralose or stevioside can be added to dietary confectionery cream formulations to enhance the sweet taste. Sucralose is an intense sweetener (sweetness coefficient 600), does not promote insulin release, and is completely safe for diabetics. Stevioside, a glycoside obtained from the leaves of the stevia plant, has zero calories (sweetness coefficient 250), lowers blood sugar, strengthens the cardiovascular system, lowers blood pressure, removes toxins and radionuclides,

improves digestion, which allows it to be widely used in the production of dietary and diabetic products.

Dietary recommendations for treating diabetes and obesity include increasing the amount of fiber consumed in the diet. For these purposes, it is best to use dietary fiber with a high ability to lower or prevent an increase in blood glucose levels, and lower cholesterol.

Beta-glucan, (1-3), (1-4) -ß-D-glucan, is a polysaccharide found in the cell wall of fungi, some microorganisms and grains such as oat. The beneficial properties of beta-glucan include the ability to lower glucose levels and insulin response, lower cholesterol and low-density lipoprotein levels in the blood, speed up metabolism, activate the immune system, and have an anti-inflammatory effect, which makes it possible to recommend its use in products for diabetic nutrition, as well as diets for weight loss and strengthening the cardiovascular system. In addition, beta-glucan has antitumor activity. We used high-content oat bran as a source of beta-glucan.

Inulin, reserve polysaccharide of plants, helps insulin to be absorbed, reduces the glycemic index of food, thereby inhibiting the increase in blood glucose levels, takes part in carbohydrate and lipid metabolism: due to the activation of metabolism, the coupled processes of glucose uptake and fat burning are accelerated, and therefore high its benefits in the treatment of type 1 and 2 diabetes, and in lowering blood pressure in hyperlipidemia. It also indirectly affects the reduction of the harm of "bad" cholesterol in the blood, which helps prevent the formation of plaques on the walls of blood vessels and the development of atherosclerosis. With the help of inulin, trace elements such as calcium, magnesium, iron, copper, phosphorus are absorbed 30% better. Acting as an immunomodulator, inulin increases the metabolic rate and adaptive properties of the body.

Arabinogalactan (E 409) - Siberian larch gum is approved in many countries as a direct food additive, emulsifier, stabilizer and sweetener. Arabinogalactan helps to reduce blood sugar and cholesterol levels, has a pronounced antioxidant effect, helping to slow down the processes of lipid peroxidation in the liver, sharply lowering the level of their toxic effects, as well as immunomodulatory effects and antitumor activity.

The introduction of beta-glucan, inulin, arabinogalactan in the formulation of fat confectionery creams (separately or in a mixture, examples in the Table) was carried out at the stage of preparing the syrup so that their content was 1-10 g per 100 kcal of cream. It will allow to meet 5-50% of the daily physiological need for dietary fiber with every 100 kcal of the product (36-50 g).

Table - Indicators and nutritional value of the developed dietary confectionery creams

Indicator	Cream «New»	Examples			
		1	2	3	4
Fat content,%	39	20	20	15	15
Calorie content, kcal / 100 g	780	276	243	193	199
Moisture content, %	23,5±2	22,8	25,4	24,0	21,6
Density, kg/m^3	750-900	864	880	803	799
Sweeteners, ratio	–	Isomalt	Isomalt : Erythrol=1:1	Isomalt : Erythrol=1:2,5	Isomalt : Erythrol=1:2,5
Dietary fibers, ratio		Beta-glucan*: inulin=1:2	Arabinogalactan: inulin=1:1	Arabinogalactan: inulin =1:3,5	Arabinogalactan: inulin =1:2,5
Dietary fibres content:					
g/100 kcal	0	5,2	6,7	9,6	10,1
g/100 g	0	14,5	16,3	18,5	26,2
Omega-3 fatty acid content, g/100 g	0	0,34	0,33	0,25	0,26
Tocoferols content (calculation for tocoferol acetate), mg/100 g	–	8,3	8,1	5,2	5,3

* Beta Glucan - Oat Bran with 28% Beta Glucan

To reduce the adverse effects on the cardiovascular system and the whole body from the combined presence of saturated fats, cholesterol and trans fatty acids found in animal fats, we decided to use in dietary cream formulations as a source of fats instead of milk fat (butter, high fat cream) transesterified vegetable oils without trans-isomers of fatty acids, with an omega-3 fatty acid content of at least 1.7% of the total amount of fatty acids and tocopherols of at least 0.04 g / 100 g of the fat phase [9].

The additional presence of omega-3 fatty acids in the product together with dietary fibers will have a positive effect on the cardiovascular and immune systems. Transesterified oils have better processing properties (plasticity, aeration, ability to retain the liquid phase) in comparison with non-transesterified vegetable oil mixture. Moreover, enzymatic transesteri-fication has undoubted advantages over chemical transesterification in the production of dietary food products. It allows to preserve natural tocopher-

ols, tocotrienols, phytosterols of vegetable oils due to low process temperatures (no more than 70 ° C, during chemical transesterification - 110-120 ° C), it also eliminates the need for strict purification of the final product due to the absence of toxic reaction by-products that occur during chemical transesterification.

The dietary cream can be additionally enriched with vitamins B_1, B_6, B_7, E and C and / or other biologically active substances that help reduce blood glucose levels, strengthen immunity and the cardiovascular system, in an amount of at least 15% of the physiological daily requirement and not more upper safe level of consumption of such substances (taking into account their receipt from all possible sources) per 100 g of product. For fatty products, it is important to enrich them with tocopherols, which exhibit antioxidant and E-vitamin activity. Substances with antioxidant properties help to bind and neutralize oxygen-containing radicals, leading to oxidative stress, and, therefore, prevent the development of inflammation. Thus, they have a positive effect on strengthening and improving the cardiovascular system, and therefore are recommended for use in the diet of patients with type 2 diabetes mellitus and obese people. In addition, these substances help to strengthen the immune system.

To obtain a pleasant creamy taste, increase dry matter and achieve the required density of the confectionery cream, we used skimmed milk powder. In the case of confectionery creams intended for vegetarians, it is recommended to replace milk proteins with vegetable proteins.

To add color to dietary confectionery cream, it is best to use natural dyes such as carotenoids (E 160 a, d), lutein (E 161 b), chlorophyll (E 140), anthocyanin dyes (E 163), riboflavin (E 101), vegetable coal (E 153), sugar color (E 150 ad), red beetroot (E 162).

Taking into account the fact that developed creams are intended for the manufacture of desserts suitable for the diet of patients with diabetes mellitus of the 1st and 2nd types, as well as people with increased body weight or obese, it was decided to limit their fat content to 20%. The fat content of no more than 15% allows to get a confectionery cream with a calorie content of less than 200 kcal / 100 g, which, in accordance with the classification of food calories adopted by the Russian Diabetes Association, will classify it in the category of "medium-calorie" products (100-199 kcal / 100 g).

The table shows the main indicators and nutritional value of some of the developed formulations of confectionery dietic creams. The low calorie content of creams, the absence of easily digestible carbohydrates in them and the high content of dietary fiber that help lower cholesterol and blood

glucose levels, as well as the presence of omega-3 fatty acids and vitamin E, allow them to be classified as dietary products of increased nutritional value.

Further use of dietary creams in the production of confectionery and desserts will allow:

- to increase the nutritional value of the diet due to the high content of dietary fiber in the product (14-26 g/100g or 1-10 g/100 kcal) while reducing the calorie content of the product;

- additionally enrich the diet with deficient omega-3 fatty acids (> 0,2 g/100 g) and vitamins (> 5 mg/100 g);

- to expand the range of confectionery and desserts intended for persons suffering from diabetes, obesity or overweight.

The relevance and novelty of the this research was confirmed by obtaining a patent of the Russian Federation [10].

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NOTES

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