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ОПИСАНИЕ НЕЛИНЕЙНОГО ЗВЕНА В СОСТАВЕ СИСТЕМЫ УПРАВЛЕНИЯ С РАСПРЕДЕЛЕННЫМИ ПАРАМЕТРАМИ

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DESCRIPTION OF A NONLINEAR LINK IN A CONTROL SYSTEM WITH DISTRIBUTED PARAMETERS

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Аннотация

Показана проблема адекватного представления моделей реальных объектов в виде систем линейных уравнений. В качестве решения предлагается методика анализа и синтеза данного класса систем с одним нелинейным элементом. При этом в статье используется критерий абсолютной устойчивости В.М. Попова.

Результат, обсуждения, заключения

Дано описание нелинейного блока, реализованного в виде исполнительного механизма. Сделан вывод о результате моделирования месторождений с учетом нелинейного элемента.

Ключевые слова: нелинейный элемент, объектов с распределенными параметрами, нелинейная система управления, критерий абсолютной устойчивости

Abstract

The problem of adequate representation of models of real objects in the form of systems of linear equations is shown. As a solution, a method of analysis and synthesis of this class of systems with a single nonlinear element is proposed. At the same time, the article uses the criterion of absolute stability of V.M. Popov.

Result, discussions, conclusions

A description of a nonlinear block implemented in the form of an executive mechanism is given. The conclusion is made about the result of modeling deposits taking into account the nonlinear element.

Key words: nonlinear element, objects with distributed parameters, nonlinear control system, absolute stability criterion

Introduction

The study and implementation of nonlinear systems with distributed parameters presents significant difficulties. It is known that a nonlinear system contains at least one link described by a nonlinear equation. In the practical implementation of the theory of systems, the control of the ob-

ject model cannot be adequately represented in the form of systems of linear equations. Most often, such systems are described by ordinary linear differential equations. In many cases, the well-known procedure for linearizing such systems is unacceptable. The most developed technique for the analysis and synthesis of this class of systems refers to systems with one nonlinear element [1].

Let us consider the general case for a certain function depending, in addition to time, on one spatial coordinate. A second-order linear differential equation in partial derivatives can be represented as:

$$L[Q(x,t)] = A(x,t)\frac{\partial^2 Q}{\partial t^2} + 2B(x,t)\frac{\partial^2 Q}{\partial x \partial t} + C(x,t)\frac{\partial^2 Q}{\partial x^2} + A_1(x,t)\frac{\partial Q}{\partial t} + B_1(x,t)\frac{\partial Q}{\partial x} + C(x,t)Q = f(x,t)$$

.

It is more convenient to write this equation in canonical form:

$$A(x,t)\frac{\partial^2 Q}{\partial t^2} + A_1(x,t)\frac{\partial Q}{\partial t} = C(x,t)\frac{\partial^2 Q}{\partial x^2} + B_1(x,t)\frac{\partial Q}{\partial x} + C_1(x,t)Q + f(x,t,u(x,t))$$

$$x_0 < x < x_1;\ t > 0. \qquad (1)$$

Initial conditions:

$$Q(x,0) = Q_0^{(0)}(x)\ ;\ \frac{\partial Q(x,0)}{\partial t} = Q_0^{(1)}(x)\ ;\ x_0 \le x \le x_1.$$

Border conditions:

$$\alpha(x_0,t)Q(x_0,t) + \beta(x_0,t)\frac{\partial Q(x_0,t)}{\partial x} = g_0(t,u_0(t))\ ,\ t > 0;$$

$$\alpha(x_1,t)Q(x_1,t) + \beta(x_1,t)\frac{\partial Q(x_1,t)}{\partial x} = g_1(t,u_1(t))\ ,\ t > 0.$$

It should also be noted that for sufficiently small deviations, many nonlinear systems admit the process of linearization. In this case, one can, for example, use the expansion of the function in a Taylor series and then take into account only the linear parts of the series, discarding the nonlinear ones due to the high order of smallness. In general form, we can write an equation with some non-linear operator L :

$$L\left(x,t,Q(x,t),\frac{\partial^2 Q}{\partial t^2},\frac{\partial Q}{\partial t},\frac{\partial^2 Q}{\partial x^2},\frac{\partial Q}{\partial x},u(x,t)\right) = 0$$

$$; x_0 < x < x_1; \quad t > 0,$$

where:

$Q(x,t) = Q^*(x,t) + \Delta Q(x,t) -$ the state of the object, in the form of a function;

$Q^*(x,t) -$ some distribution;

$u(x,t)$ – input action;

$\Delta Q(x,t) -$ small variation regarding $Q^*(x,t)$.

In this case, one can write a linearized equation, provided that the function *L is twice differentiable* . The linearized equation will be of relatively small variation ΔQ *(* x , t *)* :

$$\left(\frac{\partial L}{\partial Q}\right)\Delta Q(x,t)+\left(\frac{\partial L}{\partial \ddot{Q}}\right)\frac{\partial^2 \Delta Q(x,t)}{\partial t^2}+\left(\frac{\partial L}{\partial \dot{Q}}\right)\frac{\partial \Delta Q(x,t)}{\partial t}+\left(\frac{\partial L}{\partial Q''}\right)\frac{\partial^2 \Delta Q(x,t)}{\partial x^2}+$$

$$+\left(\frac{\partial L}{\partial Q'}\right)\frac{\partial \Delta Q(x,t)}{\partial x}+\left(\frac{\partial L}{\partial u}\right)\Delta u(x,t)=0,$$

where

$$\ddot{Q}=\frac{\partial^2 Q}{\partial t^2},\ \dot{Q}=\frac{\partial Q}{\partial t},\ Q''=\frac{\partial^2 Q}{\partial x^2},\ Q'=\frac{\partial Q}{\partial x},\ \Delta u=u-u^*.$$

Derivatives with equality $Q=Q^*$ play the role of coefficients A, B, A_1, B_1, C_1 of formula (1).

However, in most cases, nonlinear systems, when linearized, cease to adequately describe the real object, that is, they are not subject to linearization.

Nonlinear elements, in turn, are divided into analytical and non-analytical. Currently, there are no unified and accurate methods for the analysis and implementation of nonlinear systems. A unified mathematical apparatus has not been developed, therefore, for each specific problem described by a nonlinear system of differential equations, developers are forced to find their own methods.

One of the most common methods for describing control systems is the use of system transfer functions. It is known that non-linear systems do not have transfer functions [2]. However, for a class of control systems with one non-linear element, it is possible to use the developed apparatus of transfer functions with respect to the linear part. The scheme of the system in the form of a series connection of a non-linear link and the linear part of the system can be generally displayed as follows (Fig. 1).

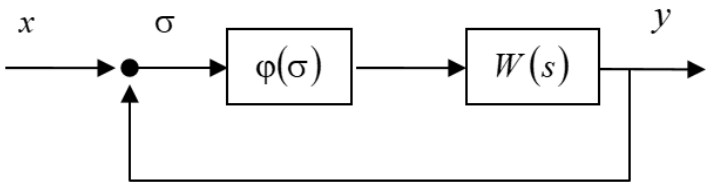


Fig. 1. Block diagram of the system

In the diagram: *x* is the input signal of the system; *y* is the output signal of the system; $\varphi(\sigma)$ – non-linear function; $W(s)$ is the transfer function of the linear part of the system.

non-linear element (*z*) is given by the function $\varphi(\sigma)$, which assigns the value $\sigma(t)$ of the input signal of the nonlinear link to the value $z(t)$ of the output signal of the link: $z(t)=\varphi(\sigma(t))$.

For such systems, the criterion of absolute stability by V.M. Popov [3]. According to this criterion, for the system to be absolutely stable, it is sufficient that on the imaginary axis of the complex plane there is a real value *q* (the real part of the complex number) such that the condition [4-6] is satisfied:

$$\forall \omega \geq 0 : \mathrm{Re}\left[(1+j\omega q)W(j\omega)\right] > -\frac{1}{k}, \quad (2)$$

On the real axis of the complex plane, Popov's line passes through the point $-\frac{1}{k}$. The system is considered stable if the hodograph of the modified frequency response does not intersect with Popov's straight line (Fig. 2) [7, 8].

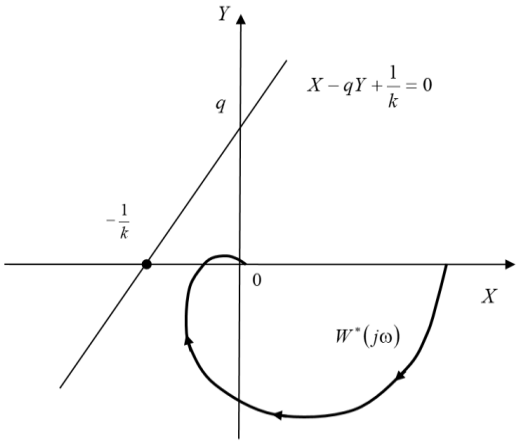


Fig. 2. Graphical interpretation of the absolute stability criterion

The frequency response of the linear part of the system is represented as:

$$W(j\omega) = \mathrm{Re}[W(j\omega)] + j\,\mathrm{Im}[W(j\omega)].$$

According to the criterion of V.M. Popov, a modified amplitude-phase characteristic of the linear part (AFC LP) is used. The imaginary part of the characteristic is multiplied by the value of the circular frequency ω:

$$W^*(j\omega) = \mathrm{Re}[W^*(j\omega)] + j\,\mathrm{Im}[W^*(j\omega)],$$

$$\mathrm{Re}[W^*(j\omega)] = \mathrm{Re}[W(j\omega)],\ \mathrm{Im}[W^*(j\omega)] = \omega\,\mathrm{Im}[W(j\omega)].$$

$$X = \mathrm{Re}[W(j\omega)].\ Y = \omega\,\mathrm{Im}[W(j\omega)].$$

Here *k* is the tangent of the angle formed by the straight line limiting the sector from above, in which the graph of the non-linear characteristic is located (Fig. 3).

$$0 \le \frac{\varphi(\sigma)}{\sigma} \le k,\ \sigma \ne 0;\ \varphi(0) = 0.$$

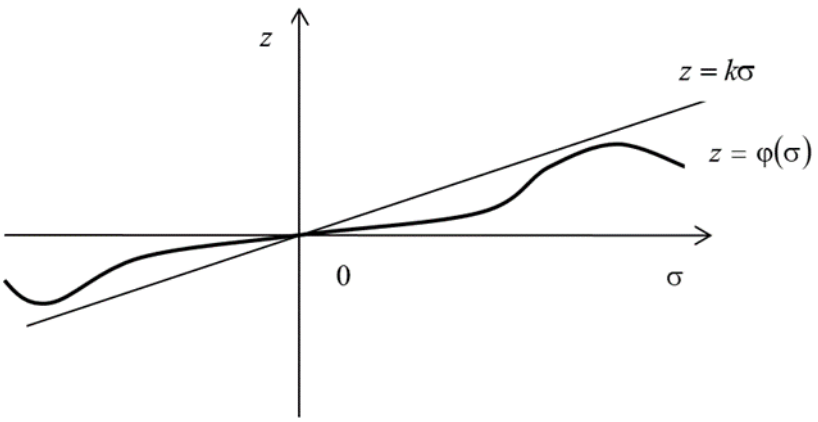


Fig. 3. Sector bounding the graph of the non-linear characteristic

When choosing a slope *k* that defines a straight line as the boundary of a sector that contains a graph of a non-linear characteristic, it is necessary to find one at which the sector will be minimal. This straight line will be tangent to the curve z =φ(σ) passing through the origin (Fig. 4).

$$z - z_1 = \varphi'(\sigma_1)(\sigma - \sigma_1); \quad z = \frac{z_1}{\sigma_1}\sigma .$$

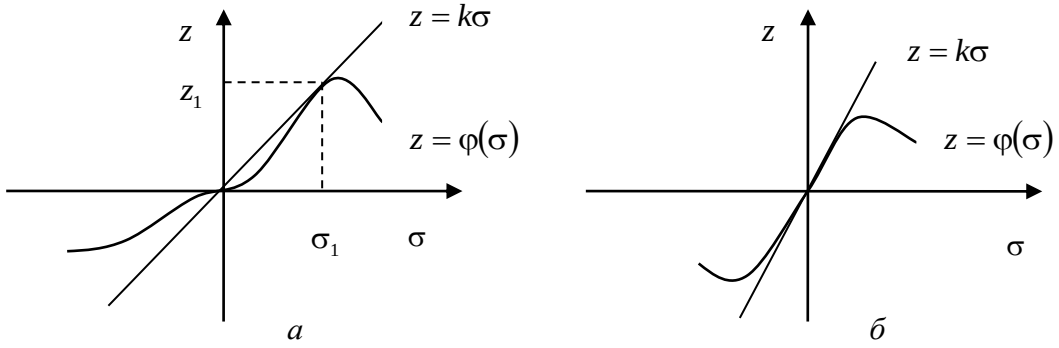


Fig. 4. Construction of the Popov line

Let us consider the implementation of a non-linear link in the process of water withdrawal using the example of one well, in which water withdrawal is carried out as a result of self-discharge (Fig. 5).

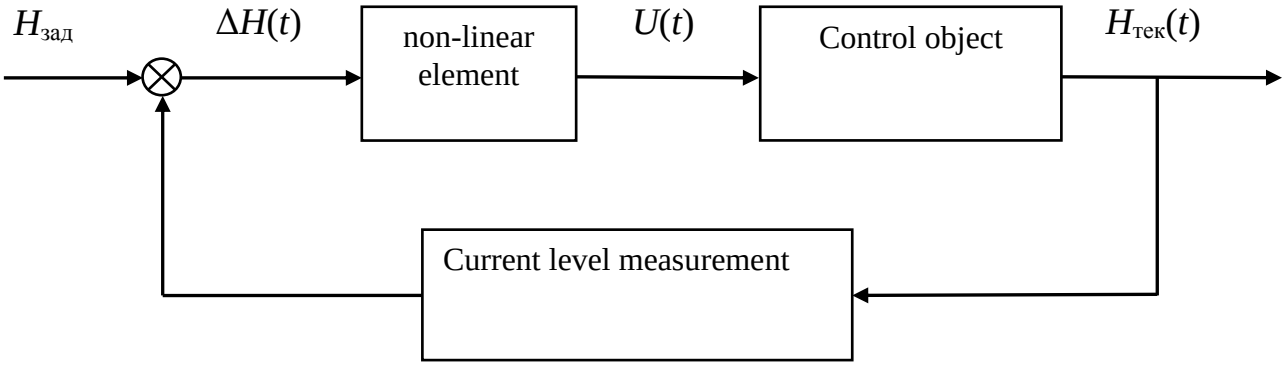


Fig. 5. Block diagram of the control system

If only water is taken from the well and there is no water injection system, then the system provides only unidirectional control action. However, the inclusion of a nonlinear element in the circuit allows both lowering the level value and raising it. In this regard, in wells with self-flowing, the value of $H_{\text{tech}}(t)$ is limited by the minimum and maximum values:

$$Hmin\_ \le H_{\text{current}}(t) \le H_{\max}.$$

The non-linear block is implemented in the form of an actuator, which is the movement of a damper that regulates the useful cross-sectional area of the pipe (Fig. 6).

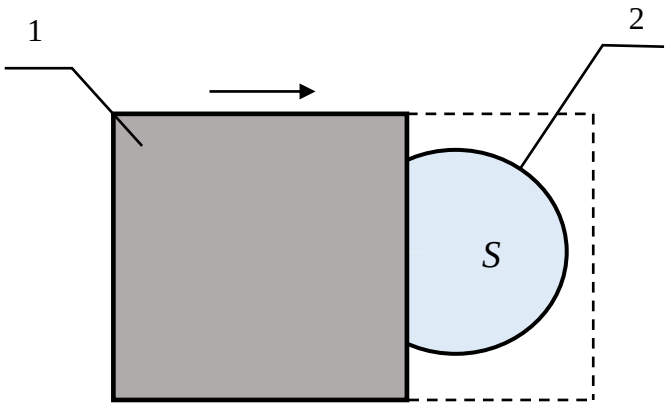


Fig. 6. Scheme of the actuator: 1 - damper, 2 - pipe

With a linear uniform movement of the damper, the size of the useful cross-sectional area will change non-linearly (Fig. 7). A change in cross-sectional area will entail a change in flow rate and, consequently, a change in level. At the same time, with a fully open damper, the area will be maximum, therefore, the flow will be maximum, the level will be the lowest possible. When the damper is fully closed, the flow will be zero, the level is the maximum possible. Wherein:

$0 \leq L \leq d$,

where d is the pipe diameter.

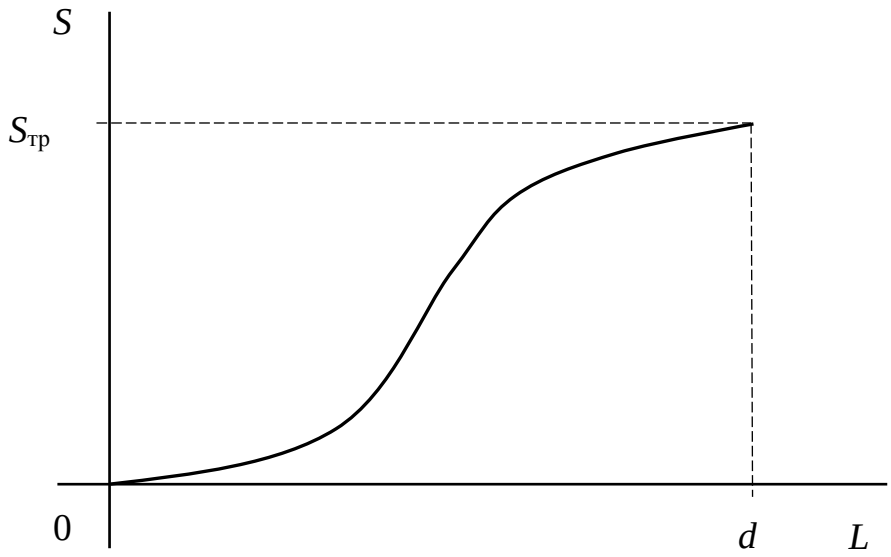
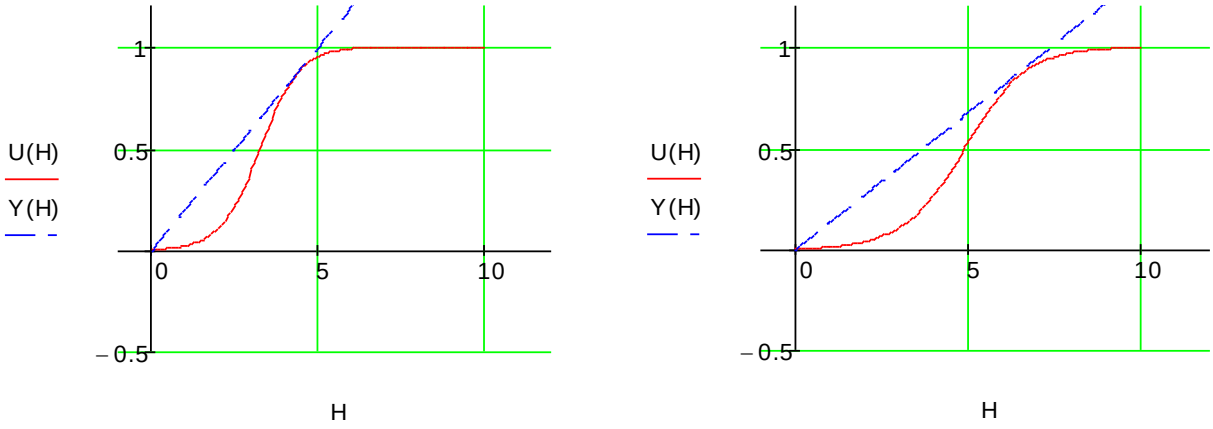


Fig. 7. Nonlinear dependence of the increase in cross-sectional area

The dependence of the cross-sectional area on the damper movement, and, consequently, the flow rate, is sigmoidal. Obviously, the dependence of the output function of the nonlinear element $U(t)$ from the input action $\Delta H(t)$ will also have a sigmoidal character.

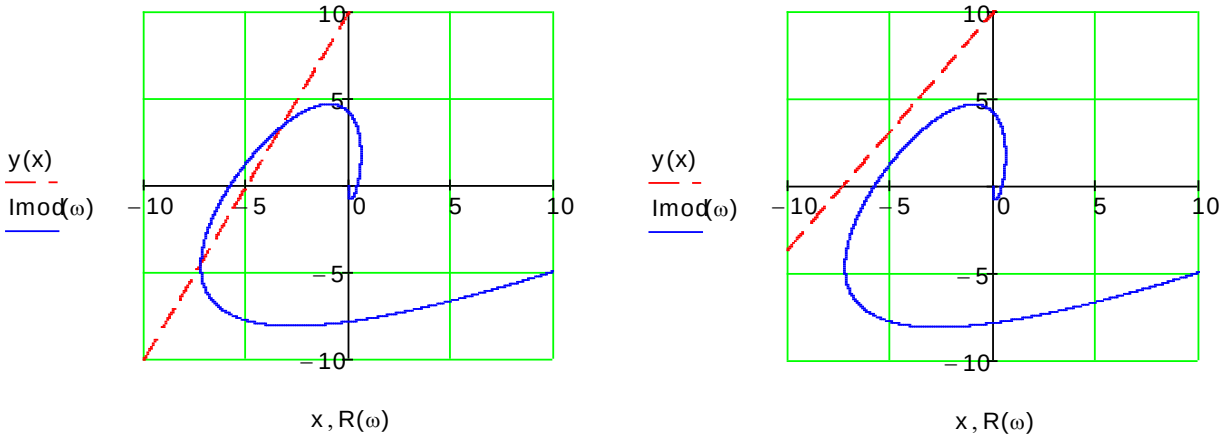
Depending on the maximum possible values of ΔH and U , the graph of the sigmoidal function will be transformed, shrinking or stretching relative to the coordinate axes (Fig. 8).



a) b)

Fig. 8. Tangents of sigmoidal functions for *k* = 0.2 (a) and *k* = 0.136 (b)

Accordingly, the slope of the tangent to the graph will change. Thus, on the complex plane, the point $-\frac{1}{k}$ will change its position, moving along the abscissa axis (Fig. 9).



a) b)

Fig. 9. Stability analysis at *k* = 0.2 (a) and *k* = 0.136 (b)

Depending on the position of this point, the position of the Popov straight line will change, the position of which determines the conclusion about the stability of the system [10]. It is also possible that the stability of the system will depend on the speed of the damper.

Modeling of deposits taking into account the non-linear element *U(t)* will reduce the error of the model and will enable a more accurate description of the process of controlling the production of mineral water from a real well with given parameters. In addition, the inclusion of a nonlinear element in the circuit will make it possible to describe the change in the current level $H_{\text{current}}(t)$ within the given constraints.

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РАЗРАБОТКА ИНТЕЛЛЕКТУАЛЬНОЙ СИСТЕМЫ «НЕЗАВИСИМЫЙ УМНЫЙ ПОМОЩНИК» ДЛЯ ЛЮДЕЙ С ОГРАНИЧЕННЫМИ ВОЗМОЖНОСТЯМИ

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DEVELOPMENT OF THE INTELLECTUAL SYSTEM "INDEPENDENT SMART ASSISTANT" FOR PEOPLE BY VISUALLY DISABILITY IMPAIRED

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Аннотация

В современных реалиях очень остро стоит создания комфортной и безбарьерной среды для людей с ограниченными возможностями. Существуют различные способы оказания помощи различным группам людей с инвалидностью для улучшения их повседневной жизни и культурного досуга. За счет усовершенствования и развития современных технологий и искусственного интеллекта открываются новые способы помощи различным группам граждан.

Материалы и методы, результаты

На санаторно-курортное лечение и отдых нашего Ставропольского края также приезжает большое количество маломобильных групп граждан, в том числе и инвалиды по зрению. В данном проекте предлагается создание ПО направлена на поддержку слабовидящих людей и инвалидов по зрению, а также пожилых людей и маленьких детей путем создания интеллектуальной информационной системы «Независимый Умный Помощник» (НУП). В исследовании описывается способ решения проблемы полноценного отдыха и культурного досуга людей с инвалидностью по зрению, а именно разработка и создание программного обеспечения «Независимый Умный Помощник» и его использования в условиях курортов Ставропольского края Российской Федерации.

Заключение

В исследовательском проекте предлагается способ создания единой информационной системы с использованием нейронных сетей, для облегчения выполнения самостоятельных действий людьми с ограниченными возможностями по зрению, путем взаимодействия с датчиками движения и модулями GPS.

Ключевые слова: цифровизация, люди с ограниченными возможностями, искусственный интеллект, санаторно-курортное лечение, безбарьерная среда, независимый умный помощник, программное обеспечение, искусственная нейронная сеть, сигмоиндальная функция, датчики, интерфейс, GPS.

Abstract

In modern realities, it is very urgent to create a comfortable and barrier-free environment for people with disabilities. There are various ways to help different groups of people with disabilities to improve their daily lives and cultural leisure. Due to the improvement and

development of modern technologies and artificial intelligence, new ways of helping various groups of citizens are opening up.

Materials and methods, results

A large number of low-mobility groups of citizens, including visually impaired people, also come to the sanatorium treatment and recreation of our Stavropol Territory. This project proposes the creation of software aimed at supporting visually impaired people and the visually impaired, as well as the elderly and young children by creating an intelligent information system "Independent Smart Assistant" (NUP).

Conclusion

The study describes a way to solve the problem of good rest recreation and cultural leisure for people with visual impairments disability, namely the development and creation of the Independent Smart Assistant software and its use in the conditions of the resorts of the Stavropol Territory of the Russian Federation. The research project proposes a way to create a unified information system using neural networks to facilitate the performance of independent actions by visually disability impaired people by interacting with motion sensors and GPS modules.

Key words: digitalization, people with disabilities, artificial intelligence, spa treatment, barrier-free environment, independent smart assistant, software, artificial neural network, sigmoindal function, sensors, interface, GPS.

Introduction. In modern realities, it is very urgent to create a comfortable and barrier-free environment for people with disabilities. There are various ways to help different groups of people with disabilities to improve their daily lives and cultural activities. Due to the improvement and development of modern technologies and artificial intelligence, new ways of helping various groups of citizens are opening up. A large number of low-mobility groups of citizens, including the visually impaired, also come to the sanatorium treatment and recreation of our Stavropol Territory. This project proposes the creation of software aimed at supporting visually impaired people and the visually impaired, as well as the elderly and young children by creating an intelligent information system "Independent Smart Assistant" (NUP). The creation of this project also falls under the decrees of the President of the Russian Federation on the development of: culture, digitalization of the population, quality services, a barrier-free environment.

The main goal of the project "Independent Smart Assistant" is to help people with visual impairments, thereby simplifying many of the actions that are given to them with difficulty without outside help, thereby preserving their personal boundaries. Each user of this system will have an individual approach.

Materials and methods. In this project, it is proposed to use modern technologies, namely, an artificial neural network (ANN), which is the basis of the information system of the "Independent Smart Assistant".

ANN was created more than 40 years ago, and at the moment, close attention is directed directly to it from the side of developers, since the artificial network shares some of the physical and behavioral aspects of bionetworks. The foundation of the ANN structure, which is a parallel system, is the biological neural process of the human brain, which is used to solve the complex tasks assigned to it, the connections and processes of which it tries to imitate in mathematical sets of systems [1].

As a rule, at least three layers are required to create ANN systems - input, hidden and output. The number of hidden nodes that are dependent on the particular research problem and that can easily propagate to more hidden layers. At the input there are nodes corresponding to the input variables, and at the output there are nodes corresponding to the output variables [2]. The state of the neuron is determined by the formula (1), (2) :

$$S = \sum_{i=1}^{n} x_i w_i \ , \tag{1}$$

$$\sum_{k=1}^{N} k^2 \ , \tag{2}$$

Where:

n- number of neuron inputs;

$x_i$is the value of the i - th input of the neuron;

$w_i$is the weight of the i - th synapse.

Then the value of the axon of the neuron is determined by the formula (3):

$$Y = f(S), \tag{3}$$

The input layer is used to distribute the inputs to several hidden layers, the output of which is connected to the output layer, where the outputs of the blocks are connected to the inputs of the next connection. Simply put, weighted joins allow data to be passed between layers through it, where a node takes data from the previous layer and calculates a weighted sum of all its net inputs. The sigmoid function (4) [7] is usually used as an activation function.

$$f(z) = \frac{1}{1+\exp(-z)}, \tag{4}$$

The main task in training is to minimize the objective function of the NN error, which is found using the least squares method (5):

$$E(\omega) = \frac{1}{2}\sum_{j=1}^{p} (y_i - d_i)^2 \ , \tag{5}$$

Where:

y_j- the value of the i - th output of the neural network ;

d_j is the target value of the j -th output;

p is the number of neurons in the output layer.

The word "sigmoid" refers to something that is curved in two directions. There are various sigmoid functions, and we are only interested in one. It's called the logistic function, and its mathematical expression is quite simple. According to the function, the program code looks like this:

```
import matplotlib . pylab as plt
import numpy as np
x = np.arange(-8, 8, 0.1)
f = 1 / (1 + np.exp(-x))
plot.plot(x, f)
plt.xlabel('x')
plt.ylabel('f(x)')
plt . show ()
```

In this project, the neural network is the main module, since in the tasks assigned to it, it must perform precise actions and at the same time predict the further actions of the NUP user.

During the development process of this project, great attention will be paid to the accuracy and variation of answers to tasks directly by the user, the accuracy of requests, and so on. It is possible that some of the received information cannot be processed by the intelligent system itself directly on the device or in the digital cloud, therefore, with an additional load, an employee of the resort and health institution will have to control it.

This project positions itself as a digital original application with a built-in voice assistant that processes the information received using neural network algorithms.

Also NUP sets itself the goal, in addition to helping people with visual impairments, simplifying their lives, as well as helping employees of health resorts, on the basis of which it plans to use this product, by introducing modern technologies in the form of geopositioning devices using GPS capabilities (Glonass), motion sensors, mobile devices.

"Independent Smart Assistant" in the form of an application can be installed on devices such as smartphones, smart watches, voice station [8].

The option of using the NUP complex: the vacationer wants to make an independent walk, directly from the place of residence, to the cultural site and return back to his room. To do this, he uses a device in the form of a watch or a smartphone, asking a voice request. By separating information using neural network processing, a route is built and a connection is made with an employee of a sanatorium or boarding house. There is also a connection with motion sensors and GPS , which will be connected to a single network with the vacationer, will help him navigate in space and transmit cultural and reference information directly about the place near which he is located.

Navigation will be provided by preventive tracking of the vacationer (tourist) with recommendations for further movement, which is a novelty of the attached idea. The soundtrack can be performed both through the built-in speaker and using a wired-wireless headset. In an emergency, the soundtrack is completely transferred to a free employee / operator, to further control the actions of the vacationer and direct him in the right direction [6].

Results and discussions. The "Independent Smart Assistant" project can be used not only in the resorts and urban environment of the Stavropol Territory, but also in other regions and regions of the Russian Federation. Due to the flexibility of the developed interface, NUP can be used for the convenience of life for both the elderly and children, helping both groups of the population with safe movement [3].

Also, NUP can be used to help foreign tourists who have chosen the Stavropol Territory as their holiday destination by translating the interface and cultural program into English, helping them learn more about not the most famous, but significant cultural places in our region.

The potential of this project lies in the direct creation of its fundamental system, debugging the process and functionality, design, implementation of neural networks, as well as layout and debugging (of the application interface itself and interaction with it) directly by the author of the idea. A positive set of circumstances, with the successful implementation of the first stage, the NUP will help in the development of its complex, by stimulating the development of a technological cluster and the development of microelectronic systems of domestic production, thereby launching the process of import substitution, which will help resolve the issue during the further implementation of the project in aggregate in other areas.

The project can be implemented within the established limited time frame. During the time period of one year, there will be hardware infrastructures and the development of software methods [5].

"Independent Smart Assistant" is supposed to be carried out in the following sequence: developing your own application, including a mobile one with voice interface support - "Independent Smart Assistant", the package of which can be installed and used on smart devices - smartphones, smart watches, voice stations. Also, the NUP software package can be run on a personal computer. The second step is to bind and use indoors and in complex street routes motion sensors with a voice alert function when the user passes the NUP directly in their vicinity, with proper coordination and position in space. Also in these sensors, GPS technology (Glonnas) should be present, for more accurate location tracking and to perform the function of transmitting historical information about the city and place. This stage is quite complicated, as it requires direct binding of all elements of the Independent Smart Assistant software and sensors, as well as debugging the navigation systems and voice information interface. Navigation will be directly given by means of voice messages. Due to this project, a program will be implemented to create a barrier-free environment

for people with disabilities (blind and visually impaired) by developing the intellectual service "Independent Smart Assistant". With a successful start and development of NUP, the system can be integrated into modern digital systems and spaces of urban municipalities [4].

When creating a project, the question of the duration, cultural richness and convenience of a particular route will be taken into account, since the safety of vacationers depends on this, and the impression of the walk itself.

It is also worth considering the issue of the location of the sensors, for the full operation of the NUP and the control of the vacationer. The routes themselves can be varied, depending on the situation. The cultural and historical program will be worked out directly with a specialist.

Similar systems. Currently, there are many voice assistants based on neural networks and machine learning, as well as a set of given commands. As an example, the developments of the Russian company Yandex, which use in their work direct interactions with a neural network and learning when interacting with a user.

Of the international services of Google , which also perform their tasks due to developed databases.

It is also worth giving an example of the domestic information system "Smart City" in the city of Zheleznovodsk, as a "digital intermediary" between a city resident and information about the elements of the urban ecosystem, such as finding transport, information about events, and so on.

Project costs. "Independent Smart Assistant" is an experimental project, so the cost of its implementation can be quite significant. Options for admission to the implementation of this project may be: interaction with Yandex, as a leader in the development of the Russian IT - sphere. Also due to the fact that the project can be implemented at the expense of the budget, funds, grant support, when included in the Smart City and Barrier-Free Environment programs.

In the future, the costs of this project can be covered by increasing the flow of tourists using the resort fee [8].

Priorities for the region. By attracting tourists with visual impairments, this project will improve the attractiveness of the Stavropol Territory as a convenient, barrier-free resort, which will attract more tourists, thereby improve budget revenues, develop and create a comfortable and convenient urban environment.

The Independent Smart Assistant itself can become an example of the region's ability to create modern and socially significant digital and technological products.

Conclusion. The trend of the modern world requires the creation of modern approaches for the goals and objectives. Improving the quality of life of people with disabilities and their problem-free life in society on an equal footing with everyone can be part of the national idea. This project gives visually impaired people the opportunity to spend their leisure time on their own without outside help, thereby blurring the existing framework. Due to the implementation of such projects, there is also a need for the development of other industries, in addition to the social and cultural issue. The development of the software market and the direct creation of a full-fledged neural system in the form of the "Independent Smart Assistant" algorithm, as well as the requirements for the creation of microelectronics in the form of the simplest sensors and geolocation tools, which certainly gives the development of the region and the state in the modern world, as a human resource and the potential in high-tech ideas plays a critical role in the global and developed society at the moment.

Also, this project is a youth idea, which means that such projects prove the importance of supporting such initiatives to improve the relationship between the developer and the administrative resource, thereby bringing benefits to the people and the country.

All this suggests that this project covers many areas, the development of which is very important for our country.

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НЕЙРОСЕТИ В ПОМОЩЬ ГЛУХОНЕМЫМ

NEURAL NETWORKS TO HELP THE DEAF

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Аннотация

Искусственный интеллект сегодня время совершенствуется и помогает в решении задач в сфере бизнеса, безопасности, образования и др.

В статье рассматривается несколько проектов на основе нейронных технологий, которые делают существенные шаги в помощи инвалидам, анализируются проблемы остающиеся пока ещё не решенными, предлагаются пути решения данных проблем.

Ключевые слова: Нейронные сети, ИИ, машинное обучение, нейронные технологии.

Abstract: *The article discusses several projects based on neural technologies that make significant steps in helping people with disabilities, analyzes the problems that have not yet been solved, and suggests ways to solve these problems.*

Key words: Neural networks, AI, machine learning, neural technologies.

Введение

На сегодняшний день искусственный интеллект прочно вошел в нашу жизнь и помогает с решением многих задач, а одно из самых перспективных направлений в этой сфере это нейронные сети. Уже сейчас они активно используются в бизнесе, безопасности, сфере развлечений и многих других сферах деятельности, но при этом не везде или не все могут пользоваться некоторыми из таких проектов. Язык жестов используется миллионами людей по всему миру, но в отличие от испанского, китайского или даже латыни, для тех, кто не может им пользоваться, почти нет автоматического перевода и несмотря на распространённость нейронных сетей, в сфере проектов для помощи инвалидам почти ничего нет. Поэтому в данной статье будут рассмотрены некоторые проекты, которые пытаются исправить такую ситуацию, проанализированы проблемы остающиеся пока ещё не решенными, предложены пути решения данных проблем.

Исследование проблемы и её состояние на данный момент

Всё общение можно разделить на две части: считывание информации и ее передача. Для людей не испытывающих трудностей с этим все происходит автоматически, наш организм все делает сам, но для инвалидов, лишенных этого, нужны специальные технологии, чтобы компенсировать такого рода неудобства. Поэтому для начала разберем прием информации, на основе технологий распознавания речи или Speech-to-Text (STT) – технология преобразования речи в текст. Это многоуровневый процесс анализа акустических сигналов, их структурирования в слова, фразы, предложения и преобразования в текстовый формат. Технологию распознавания речи можно также называть технологией распознавания голоса. Такой метод используют, в основном, когда необходимо быстро создать много текста в случаях, когда печатать затруднительно, что как нельзя кстати относится к людям с ограниченными возможностями. Обычно весь такой процесс состоит из следующих шагов: анализ сигнала, распознавание сигнала и преобразование сигнала в текст. В качестве примера, обратимся к проекту AVA, что чутко реагирует на речь человека в реальном времени и позво-

ляет наладить общение, преобразуя речь в текстовую информацию на экране. Данное приложение можно использовать при знакомстве с новыми людьми, один на один или в группах, что сделает ваши разговоры доступными.

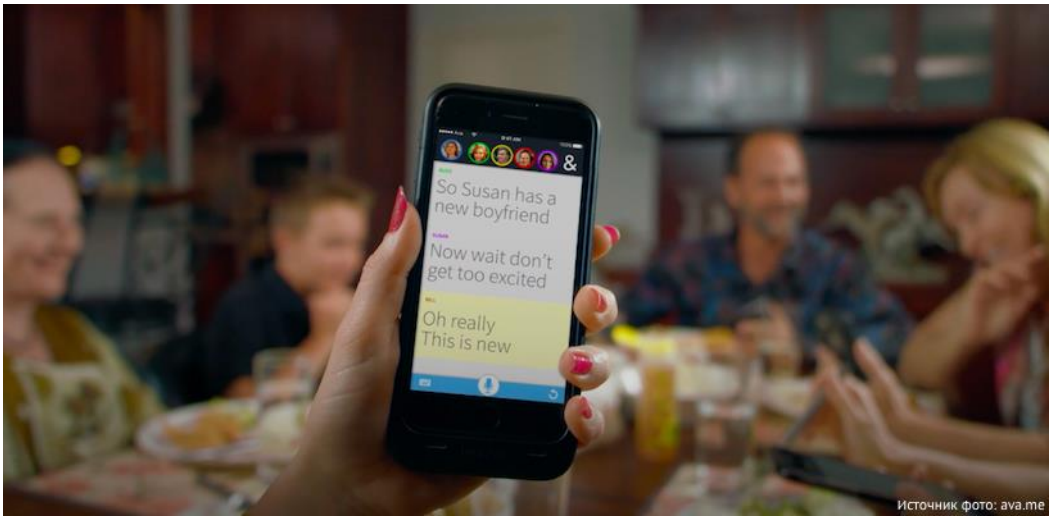

Рис. 1. Мобильное приложение AVA

AVA предоставляет 450 миллионам глухих или слабослышащих людей мгновенные сообщения, чтобы следить за любым разговором и быть в курсе происходящего. Данное приложение, как можно догадаться, реализовано при помощи нейронных сетей, что позволяет ему использовать машинное обучение в процессе работы, что позволяет с каждым новым переводом речи в текст совершенствоваться, исключая ошибки и использование ранее заготовленных шаблонов.

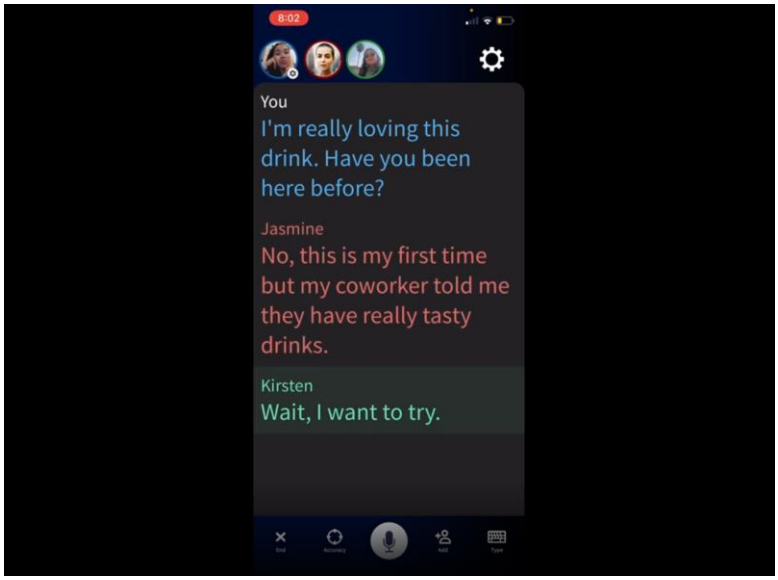

Рис. 2. Демонстрация работы AVA

Также AVA помогает не только слушать, но и говорить, общаясь с собеседником намного быстрее, чем с помощью приложений для пера, бумаги или заметок, благодаря все той же технологии. Кроме того, если вы подключитесь к друзьям через AVA, поделившись с ними своим именем AVA, то каждый человек будет отображаться своим цветом и то, что вы вводите, сразу будет появляться на их экранах.

Однако встает вопрос, что делать людям, которые не могут говорить, а информацию необходимо передать быстро, исключая набор текста? На такие случаи был придуман язык

жестов, но проблема в том, что его знает не каждый человек, а компьютер тем более. В настоящий момент существует множество методов для обнаружения объекта на изображении: скелетные методы, методы на основе 3D и методы на основе 2D.

Однако из всех моделей стоит выделить MediaPipe, так как он не только находится в открытом доступе, но и наиболее перспективен и не требует больших вычислительных мощностей. MediaPipe – кросс-платформа для построения конвейеров для обработки перцептивных данных различных модальностей, таких как видео и аудио. Этот подход обеспечивает высокое качество отслеживания рук и пальцев, используя машинное обучение для определения двадцати одной ключевой точки руки всего из одного кадра. В качестве примера, для наглядности стоит выделить проект «SLAIT». Этот инструмент, доступный для общего пользования, который может переводить около 200 слов и простых предложений для начала, используя только обычный компьютер и веб-камеру.

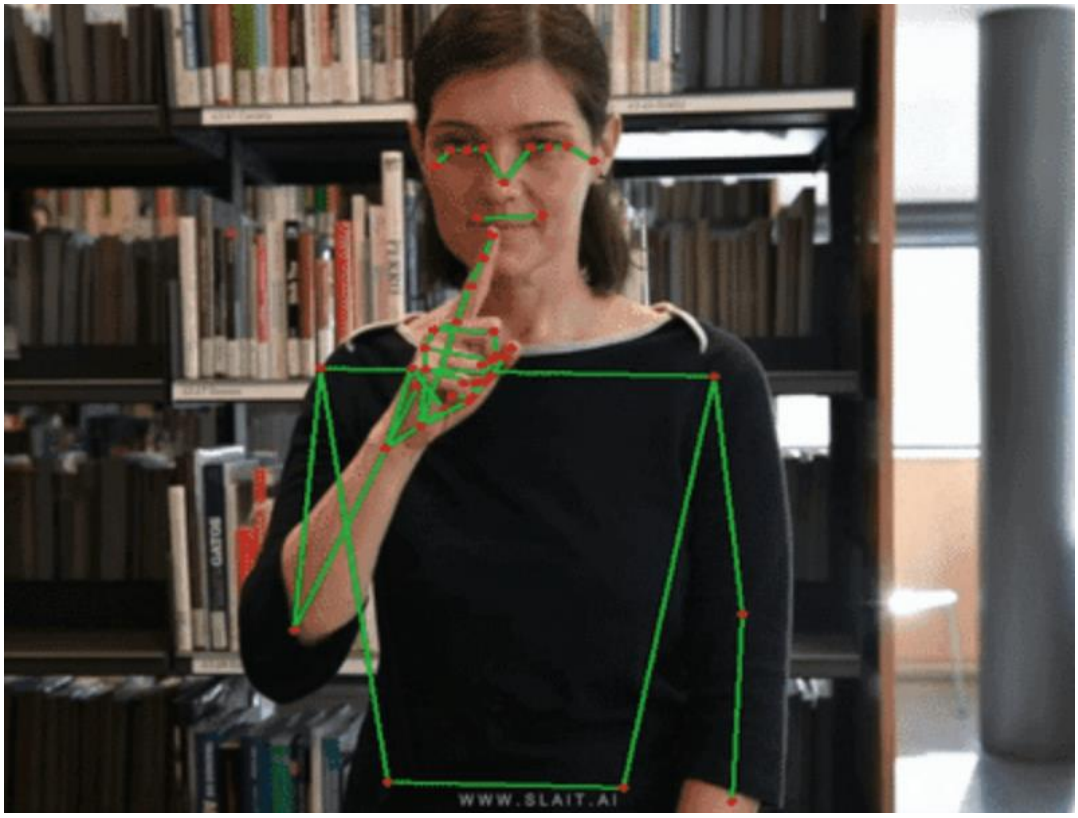

Рис. 3. Демонстрация работы одного из прототипов

Перевод выполняется в автономном режиме и почти в реальном времени на любом телефоне или компьютере.

Перевод – трудная работа, тем более что языки жестов и традиционные языки значительно отличаются друг от друга, не только по значению слов как это имеет место быть в традиционных языках, но и по структуре самого языка. Перевод с французского на испанский или с древнегреческого на эсперанто в наше время не составляет больших трудностей. Но язык жестов-уникальный случай, и перевести его однозначно сложно, потому что он принципиально отличается от разговорного и письменного языков.

Попытки автоматического перевода с языка жестов (для американского ASL (American Sign Language)) происходят уже много лет: технология отслеживания рук (2012 год), SignAll (2018 год), MediaPipe (2019 год) и вот теперь SLAIT.

SLAIT подразумевается, как платформа доступная для сообществ глухих и людей изучающих язык жестов. Но проект только в стадии разработки, хоть и является перспек-

тивным, поскольку модель перевода компании потенциально можно использовать почти везде особенно, учитывая количество видеозвонков, происходящих в наши дни.

Рис. 4. Демонстрация работы SLAIT

Предложения и перспективы решения проблемы

На данный момент рассмотренные продукты являются наиболее перспективными для того, чтобы сделать жизнь людей с проблемами слуха и речи проще и лучше, но даже эти проекты находятся на ранней стадии разработки автоматизации таких сложных процессов. Однако глядя на темпы разработки таких проектов, благодаря использованию наработок других, и на тот факт, что с каждым таким проектом последующие наследуют все самое лучшее из предшественников, то в качестве перспективы развития подобных продуктов мы предлагаем объединить уже рассмотренные технологии: перевод голосов (AVA) и жестов (SLAIT) в текст, в одну информационную систему, которая будет реализована по тем же технологиям, при помощи нейронных сетей и дополняться по мере необходимости новыми функциями. Примерные алгоритмы работы основных функций такого проекта представлены на нижеследующих рисунках.

Основные функции информационной системы можно разделить на две части, соответствующие потребностям пользователя: перевод голоса в текст и перевод жеста в текст. Так, например, со стороны собеседника, который не использует язык жестов реализовывается алгоритм, представленный на рисунке 5.

Обнаружение жеста, реализовывающееся алгоритмом, представленным на рисунке 6, позволит обработать графическую информацию благодаря камере и перевести его в текст, для людей, не обладающих навыками невербального общения.

Помимо вывода текста для пользователя, не использующего язык жестов необходимым является реализация озвучивания этого текста при помощи синтезатора речи, алгоритм которого представлен на рисунке 7.

Технология преобразования текста в речь. Это компьютерное моделирование человеческой речи из текстового представления при помощи методов машинного обучения. Благодаря синтезу речи можно прочитать любой текст голосом, максимально похожим на естественный. Что позволит использовать информационную систему, не опасаясь того, что пользователь не успеет или не сможет прочесть текст, полученный в результате перевода языка жестов.

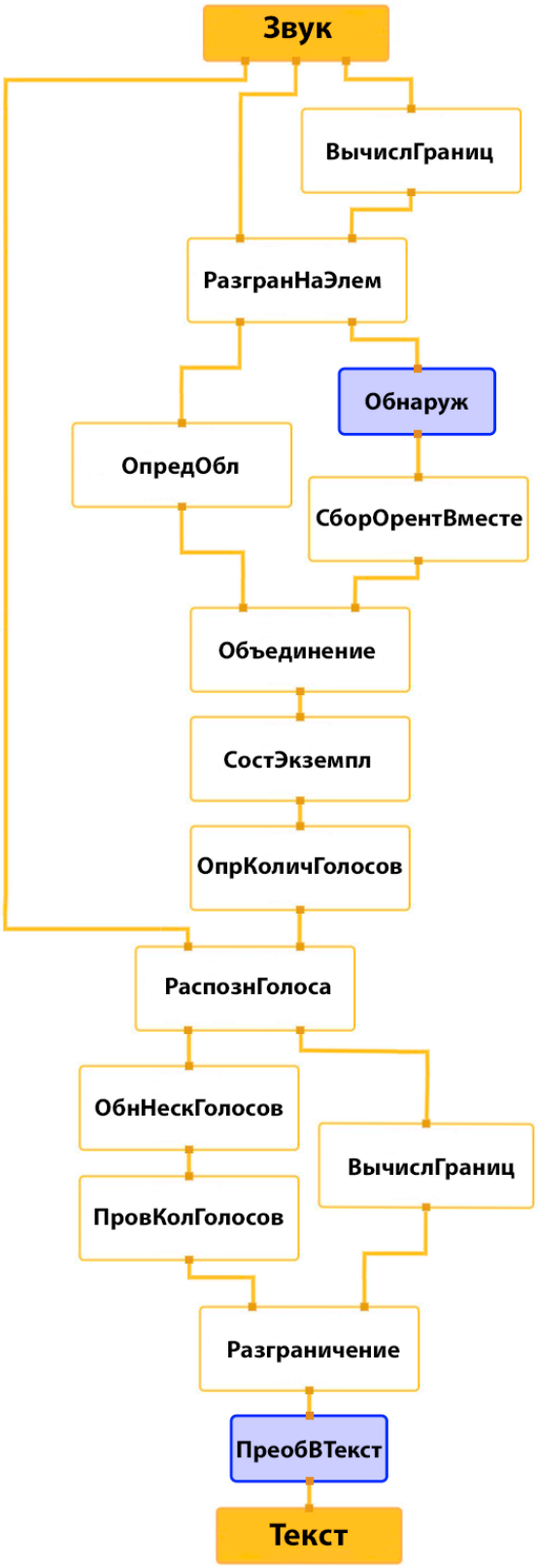

Рис. 5. Алгоритм перевода голоса в текст

Рис. 6. Алгоритм перевода жеста на изображении в текст

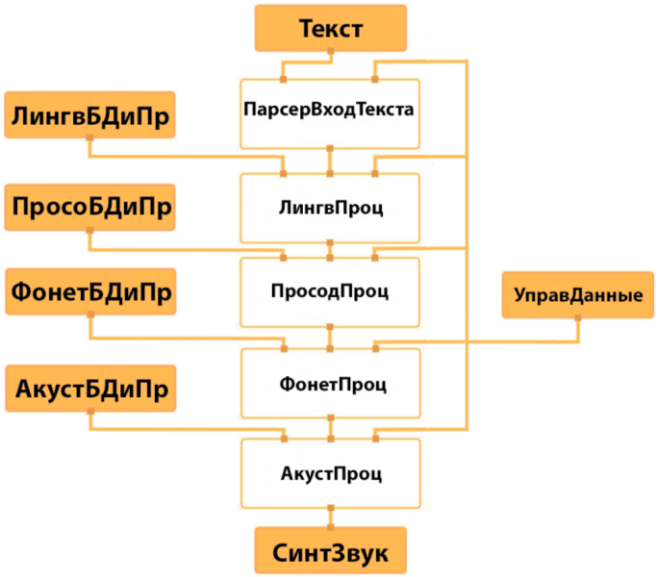

Рис. 7. Алгоритм перевода текста в голосовое сообщение также на основе синтезатора речи

Таким образом, предлагаемая информационная система приобретает вид, представленный в виде алгоритма на рисунке 8.

Для такой системы предусмотрено два режима работы со своими входными и выходными данными, которые зависят от того, что нужно пользователю: перевести вербальный или невербальный язык.

Стоит отметить, что представленные на рисунках алгоритмы представлены, как начальная база, в кратких версиях и будут дорабатываться в дальнейшем.

Выводы

Итак, за технологиями в наше время не угнаться, почти в каждой сфере уже реализуются проекты на основе машинного обучения и даже такие сложные как, например, автоматический перевод языка жестов. Эта цель, которая становится возможной только с развитием компьютерного зрения, нейронных технологий и визуализации. В конце концов, речь идет о классе людей, которые принципиально исключены из того, что большинство считают личной коммуникацией – речью. И в качестве следующего шага реализации такого рода проектов предлагается разработать уникальную информационную систему, где будут со-

браны все необходимые функции, но учитывая и то, чтобы ими могли пользоваться люди без проблем со слухом и голосом.

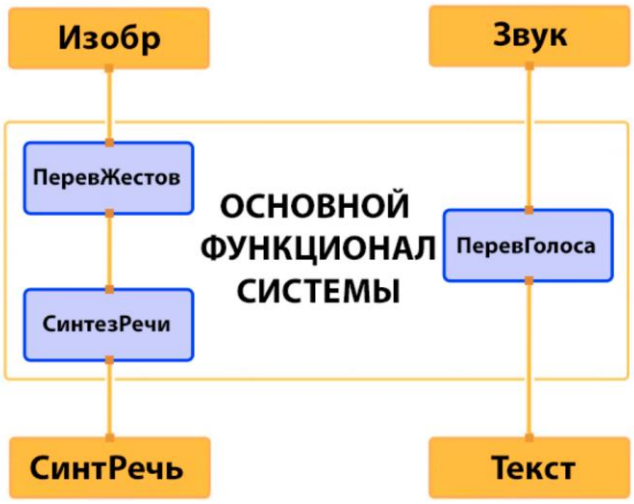

Рис. 8. Общий алгоритм всей информационной системы

Такая система для ввода сообщений будет использовать уже рассмотренные технологии распознавания речи и жеста, на основе MediaPipe и Speech-to-Text технологий, как в AVA и SLAIT, а выводить сообщения оно будет с использованием синтезатора речи, что исключит потребность человеку без проблем со слухом читать много текста. Также данное приложение должно обладать возможностью интеграции в традиционные переводчики, таких компаний как Google и Yandex, что позволит осуществлять перевод на иностранные языки и исключить создание части базы данных, за счет использования уже созданных баз.

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МАТЕМАТИЧЕСКАЯ МОДЕЛЬ КОМПЛЕКСНОЙ ЗАЩИТЫ ИНФОКОММУНИКАЦИОННОГО ОБЪЕКТА НА ОСНОВЕ «ИГРЫ С ПРИРОДОЙ»

MATHEMATICAL MODEL OF COMPLEX PROTECTION OF AN INFOCOMMUNICATION OBJECT BASED ON "PLAYING WITH NATURE"

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Аннотация

Теоретические и методологические подходы к комплексной защите инфокоммуникационных объектов, в основе которых лежит теория игр, определяют актуальность и практическую значимость разработки математических моделей реальных систем в формате конечных матричных игр.

Материалы и методы

Предлагается алгоритм формализации процессов защиты, который обеспечивает эффективность использования ресурсов при обнаружении возможных инцидентов нарушения системы защиты и/или несанкционированного доступа.

Статья посвящена вопросам применения теории игр к решению задачи поиска оптимальной стратегии поведения и обоснования выбора в условиях неопределенности. Сущность проблемы, исследованной автором, заключается в том, что выбор стратегии защиты инфокоммуникационного объекта необходимо осуществлять в условиях активного противодействия со стороны потенциального злоумышленника. Актуальность рассматриваемой проблемы, по словам автора, определяется тем, что в условиях глобальной цифровизации необходимы новые подходы к системе обеспечения безопасности объектов, занятых сбором, обработкой, хранением и передачей данных.

Статья начинается с введения, в котором излагаются цели и задачи исследования, дается общая характеристика проблемы применения теории игр, как инструмента, определяющего норму поведения участников в конфликтной ситуации.

Результаты и обсуждения

В статье автор освещает следующие проблемы: целесообразность применения антагонистических игр к решению задачи обеспечения, безопасности объекта, приводится аргументация в пользу игры одного игрока, подкрепленная расчетами. В статье также затронуты вопросы применения экспертных оценок и метода активного социологического тестирования, анализа и контроля для моделирования стратегий поведения.

Заключение

В заключение автор утверждает, что теоретико-игровой подход к моделированию комплексной защиты инфокоммуникационных объектов расширяет возможности лиц, принимающих решение, и обеспечивает принятие эффективного решения в условиях неопределенности. В статье получили исчерпывающее освещение алгоритмы выбора оптимальной стратегии и нормы поведения в ситуации с несовпадением интересов. Основная ценность работы заключается в анализе возможностей, которые предоставляет теория

игр при моделировании сложных систем как в части определения частных стратегий защиты, так и в части разработки комплексного подхода к обеспечению целостности инфокоммуникационного объекта. С практической точки зрения интерес представляют предложенные автором алгоритмы расчета возможных выигрышей в игре.

Рассмотренные в статье вопросы представляют интерес не только для исследователей проблем информационной безопасности, но и для практиков в сфере проектирования систем обеспечения защиты информации.

Ключевые слова: матричные игры; критерии оптимизации; стратегии поведения; алгоритм выбора.

Abstract

Theoretical and methodological approaches to the complex protection of infocommunication objects, which are based on game theory, determine the relevance and practical significance of the development of mathematical models of real systems in the format of finite matrix games.

Materials and methods

The algorithm of formalization of protection processes is proposed, which ensures efficient use of resources when detecting possible incidents of violation of the protection system and/or unauthorized access.

The article is devoted to the application of game theory to solving the problem of finding the optimal strategy of behavior and justification of choice in conditions of uncertainty. The essence of the problem investigated by the author is that the choice of a strategy for protecting an infocommunication object must be carried out in conditions of active opposition from a potential attacker. The relevance of the problem under consideration, according to the author, is determined by the fact that in the context of global digitalization, new approaches are needed to ensure the security of objects engaged in data collection, processing, storage and transmission.

Results and discussions

The article begins with an introduction, which sets out the goals and objectives of the study, gives a general description of the problem of using game theory as a tool that determines the norm of behavior of participants in a conflict situation. In the article, the author highlights the following problems: the expediency of using antagonistic games to solve the problem of ensuring the safety of an object, an argument is given in favor of a single-player game, supported by calculations. The article also touches upon the application of expert assessments and the method of active sociological testing, analysis and control for modeling behavior strategies.

Conclusion

In conclusion, the author argues that the game-theoretic approach to modeling complex protection of infocommunication objects expands the capabilities of decision makers and ensures effective decision-making in conditions of uncertainty. The article provides exhaustive coverage of algorithms for choosing the optimal strategy and norms of behavior in a situation with a mismatch of interests. The main value of the work lies in the analysis of the possibilities that game theory provides in modeling complex systems, both in terms of determining private protection strategies and in terms of developing an integrated approach to ensuring the integrity of an infocommunication object. From a practical point of view, the algorithms proposed by the author for calculating possible winnings in the game are of interest. The issues discussed in the article are of interest not only for researchers of information security problems, but also for practitioners in the field of designing information security systems.

Key words: matrix games; optimization criteria; behavior strategies; selection algorithm.

Introduction Today, the digitalization of technological processes is becoming an integral feature of infocommunication objects of any nature. In fact, being the basis of the processes of collecting, processing, transmitting, storing data, the digital format involves the design and synthesis of new algorithms for managing the security system of objects. The modeling of the complex protection of an in-

focommunication facility is "burdened" by the duality of the nature of the facility's security system. The discrepancy between the interests of a potential intruder and those responsible for the protection system requires a systematic approach to analyzing the history of incidents, choosing a behavior strategy, predicting possible consequences from data integrity violations and other problematic situations.

Game theory, as a tool that determines the norm of behavior of participants in a conflict situation, in combination with the method of active sociological testing, analysis and control, provides the necessary level of adequacy of the mathematical model, the ability to predict possible damage from an intruder's penetration into the security system of an infocommunication object. The use of a mathematical apparatus to develop a system of practical recommendations for choosing the optimal behavior strategy and analysis of the opportunities that the game-theoretic approach provides when modeling complex systems attracts the interest of researchers both in terms of determining particular protection strategies and in terms of developing an integrated approach to ensuring the integrity of an infocommunication object .

In the studies of G.V. Basalova, A.A. Vorobiev, Yu.V. Sosnin [1-3] consider methods for developing optimization models that provide an effective choice of protection means; separate studies devoted to the use of game theory to protect systems and networks [4,5] present the results of the implementation of software applications that allow finding the optimal set of protection tools; propose to use false network information objects when using binary decision trees. At the same time, it should be noted that the results of research presented at conferences are, as a rule, applied in nature and do not have a shade of fundamentality. An analysis of research directions in the field of applied use of the game-theoretic approach, carried out in the course of the study, suggests that most researchers are focused on solving individual, particular problems of data protection, protection against unauthorized access (AIA), network protection, etc. Practically failed discover monographs on the results of research in the field of modeling of complex protection systems.

All of the above served as a starting point for researching the possibilities that such a section, operations research as game theory, provides to methodologists and practitioners of developing systems for the integrated protection of infocommunication objects. The purpose of the study is mathematical modeling of systems for the complex protection of infocommunication objects, the use of a game-theoretic approach as a fundamental basis for choosing the optimal strategy for ensuring the safety of objects.

Materials and methods. The process of designing the complex protection of an infocommunication facility has a multidimensional character:

– the constructive aspect is of interest to researchers focused on the development of structural and functional diagrams of the facility's security system;

– descriptive aspect designing a conflict situation is the definition of a system through its properties, while under the system it is proposed to consider a set of measures to protect the object;

– the prognostic aspect is the identification of possible options for resolving the conflict;

– the normative aspect of design is the determination of the norm of behavior in a conflict situation, in this case, the determination of the rules for choosing a strategy that minimizes loss.

Game theory considers the normative aspect of a conflict situation in order to formulate specific recommendations to participants on choosing a behavior strategy that minimizes losses from participation in the conflict. The game, in fact, is a mathematical model of a conflict situation. In accordance with the generally accepted classification [6], games can be with payoffs and with preferences.

The subject of this study is the methods of formalization of a conflict situation and the analysis of the possibilities provided by the use of the theory of games with payoffs to develop an algorithm for the behavior of players in determining the strategy and tactics of behavior in the game. The optimality of the chosen strategy is determined by such factors as the profitability of the strategy, its sustainability and fairness.

If the term "profitability" does not require special explanations, it is obvious that this is the maximization of gain or minimization of loss, then the terms "stability" and "fairness" in the con-

text of the game-theoretic approach need, according to the author, to be clarified. Under the stability of a strategy, we mean such a property of it that leads to a reduction / decrease in the gain when deviating from the strategy; justice is the symmetry of the entry of players into the game. Theoretically, the symmetry of the entry implies the existence of such conditions / rules of the game that provide the parties with the same opportunities to obtain the maximum gain. The actual practice of designing security systems has targets that are different from symmetry, which can be the subject of further research.

The game, as a mathematical model of the discrepancy between the interests of the information security service and a potential attacker, assumes the presence of interested parties (players) i , whose set is denoted by I : I = {1, 2,…, n }, i.e. i ∈ I ; each of the parties - participants in the conflict has the ability to perform certain actions, the number of actions is proposed to be considered finite, the set of actions is the strategy of the player xi ; the set of strategies is the situation X = { x 1, x 2, …, xn } ; the completeness of achieving the goal or the degree of satisfaction of the interests of the player i ∈ I in situation X is the payoff Hi (x).

Thus, at first glance, it is advisable to imagine the design of complex protection of an infocommunication object as a paired antagonistic zero-sum game. To solve such a game in pure or mixed strategies, information is needed on the size of the payoff received by each side when implementing both a separate move and the strategy as a whole.

a matrix (Table 1), where the rows are the strategies of player A (defense system designer), the columns are the strategies of player B (potential attacker) his use of strategy **i** and the corresponding response move **j** that player B will make. The procedure for solving a zero- sum pair game in pure strategies is shown in detail in [7].

Table 1

Matrix of paired antagonistic game

The strategies of player B (the attacker ⇒ Player A (Administrator) Strategies ⇓	B1 _	B2 _	…..	bn	a_i - player A's payoff
A_1	a_{11}	a_{12}		a_{1n1}	
A_2	a_{21}	a_{22}		a_{2n}	
….					
A_m	a_{m1}	a_{m2}		amn _	
$_{bj}$ - player B's payoff					

It is proposed to consider the process of designing a complex protection system for an infocommunication object as a game in mixed strategies, since a potential attacker who has many strategies for breaking the protection system should and can be considered by us as an active player, while the activity should be formalized, expressed by a specific number, for example, size potential damage from the implementation of the strategy.

The main task of game theory, as mentioned above, is to give recommendations on the course of action of the participants in the situation under conditions of uncertainty; in a “defense-threat-attack” situation, uncertainty is caused by the lack of information about the intentions of a potential adversary, the presence of force majeure factors.

The system administrator (player A) seeks to choose his behavior in such a way as to get the least loss, player B acts according to his specific plan, which for player A is a set of random actions.

Formulation of the problem. Player A intends to implement seven main methods of protection in the projected system of complex protection: physical, technical, cryptographic, software, hardware, organizational and legal protection and network protection. The response “move” from player B involves threats in five areas: password guessing, system infection with a virus, unauthor-

ized access (UAS) and / or data destruction, the introduction of spyware (SW), DDo S attacks; thus, player A has seven strategies ; Player B has five strategies.

Conventions adopted in the problem: $p_1, p_2, \ldots, p_m$ – probabilities of player A using pure strategies $A_1, A_2, \ldots, A_m$; respectively $q_1, q_2, \ldots, q_n$ are the probabilities of player B applying pure strategies $B_1, B_2, \ldots, B_n$.

In this case, the following conditions must be met:

$$\sum_{i=1}^{m} p_i = 1 \quad \sum_{i=1}^{n} q_j = 1$$

The use of mixed strategies ensures the implementation of flexible defense tactics; in the absence of information about the possible choice of the opponent, the players have certain advantages, and the decisions made have informational stability.

The size of the win is affected by the probability of a particular move (Table 2):

$$M = \sum a_{ij} \cdot p_i \cdot q_j$$

here M is the mathematical expectation of the payoff.

Table 2

Probability of players using available behavioral strategies

The strategies of player B (the attacker Player A (Administrator) Strategies ➡ / ⬇	Probabilities	Guessing passwords - B_1	Infection of the system with a virus - B_2	NSD - B_3	Spyware injection - B_4	DDoS attacks _ - B5 _ _
Physical protection A_1	p_1	0.25	0.13	0.16	0.22	0.07
Technical protection A_2	R_2	0.17	0.11	0.16	0.14	0.14
Cryptographic protection A_3	R_3	0.08	0.19	0.17	0.06	0.15
Software protection A_4	R_4	0.21	0.06	0.09	0.1	0.2
Hardware protection A_5	R_5	0.1	0.29	0.12	0.21	0.13
Organizational and legal protection A_6	R_6	0.15	0.11	0.08	0.13	0.2
Network protection A_7	R_7	0.09	0.1	0.2	0.13	0.1

The probabilities of player A using one or another defense strategy in the course of the study were determined by the method of expert assessments [8].

In general, the system of equations for player A will look like

$$\begin{gathered}
a_{11} p1 + a_{21} p2 + a_{31} p3 + a_{41} p4 + a_{51} p5 + a_{61} p6 + a_{71} p7 <= V \\
a_{12} p1 + a_{22} p2 + a_{32} p3 + a_{42} p4 + a_{52} p5 + a_{62} p6 + a_{72} p7 <= V \\
a_{13} p1 + a_{23} p2 + a_{33} p3 + a_{43} p4 + a_{53} p5 + a_{63} p6 + a_{73} p7 <= V \\
a_{14} p1 + a_{24} p2 + a_{34} p3 + a_{44} p4 + a_{54} p5 + a_{64} p6 + a_{74} p7 <= V \quad (1) \\
a_{15} p1 + a_{25} p2 + a_{35} p3 + a_{45} p4 + a_{55} p5 + a_{65} p6 + a_{75} p7 <= V \\
a_{16} p1 + a_{26} p2 + a_{36} p3 + a_{46} p4 + a_{56} p5 + a_{66} p6 + a_{76} p7 <= V
\end{gathered}$$

Here V is the payoff of player A, which must be maximized. We introduce controlled variables $x_i = p_i / V$ and transform the matrix game into a system of linear equations, where (2) is the objective function; (3) - system of restrictions

$$\begin{gathered}
x_1 + x_2 + \ldots + x_m = 1/V \rightarrow \min \quad (2) \\
a_{11} x_1 + a_{21} x_2 + a_{31} x_3 + a_{41} x_4 + a_{51} x_5 + a_{61} x_6 + a_{71} x_7 \geq one \\
a_{12} x_1 + a_{22} x_2 + a_{32} x_3 + a_{42} x_4 + a_{52} x_5 + a_{62} x_6 + a_{72} x_7 \geq one \\
a_{13} x_1 + a_{23} x_2 + a_{33} x_3 + a_{43} x_4 + a_{53} x_5 + a_{63} x_6 + a_{73} x_7 \geq one \\
a_{14} x_1 + a_{24} x_2 + a_{34} x_3 + a_{44} x_4 + a_{54} x_5 + a_{64} x_6 + a_{74} x_7 \geq 13) \\
a_{15} x_1 + a_{25} x_2 + a_{35} x_3 + a_{45} x_4 + a_{55} x_5 + a_{65} x_6 + a_{75} x_7 \geq one \\
a_{16} x_1 + a_{26} x_2 + a_{36} x_3 + a_{46} x_4 + a_{56} x_5 + a_{66} x_6 + a_{76} x_7 \geq one
\end{gathered}$$

This approach allows solving large- scale problems, performing a structural and functional analysis of the optimal solution obtained, and the use of spreadsheets provides a graphical interpretation of the solution obtained.

A more thorough analysis of the nature and properties of the conflict between the protection of the object and possible threats shows that the uncertainty of player B's intentions makes it impossible to correctly determine the amount of possible damage V .

Statistical data on the size of possible damage can hardly be taken as a basis, since there is no confidence in their objectivity. Moreover, such a threat as a DDoS attack, being a poorly formalized factor, does not allow an effective prediction of possible damage in principle, since in addition to the actions of an attacker, the outcome is influenced by such factors as the qualifications of the system administrator, network configuration, composition and structure of software tools. hardware protection, etc.

Therefore, the expediency of using zero-sum antagonistic pair games as a strategy formation tool raises certain doubts when choosing methods and means of formalizing a conflict situation that arises at the design stage of an infocommunication object complex protection system.

Results and discussion. The lack of information about the behavior of the "enemy" when designing the object protection system serves as the main argument in favor of using the "one-player game" to develop a system for ensuring the object's security and choosing the optimal behavior strategy under uncertainty. Using the method of active sociological testing, analysis and control [9] identified five main "states of nature" p_1, p_2, p_3, p_4, p_5, each of which means different combinations of factors affecting the effectiveness of the object protection system.

The system administrator and design team have seven behavioral strategies; when choosing a set of measures, the expert commission must take into account five states of nature. Payoff matrix A (7.5), in which at the intersection of rows and columns is the amount of loss from the implementation of a particular strategy **i** with the corresponding state of nature **j** (Table 3), contains the initial data for solving the problem.

Table 3

Initial data for choosing a strategy in the "game with nature"

The strategies of player B (the attacker → Player A (Administrator) Strategies ↓)	Guessing passwords - B_1	Infection of the system with a virus - B_2	NSD - B_3	Spyware injection - B_4	DDoS attacks _ - B5 _ _	The maximum gain with the worst options max min aij _
Physical protection A_1	17	eleven	15	19	7	7
Technical protection A_2	13	nine	eleven	eighteen	8	8
Cryptographic protection A_3	12	4	6	13	nine	4
Software protection A_4	fourteen	6	five	eleven	10	five
Hardware protection A_5	15	eighteen	nine	16	eleven	nine
Organizational and legal protection A_6	6	10	3	five	6	3
Network protection A_7	eleven	eighteen	12	16	21	eleven

We will determine the optimal strategy in the game with nature using several criteria: the maximin (pessimistic) Wald criterion, the minimax (optimistic) Savage criterion, and the Hurwitz criterion, which takes into account the player's level of pessimism [10].

Wald's maximum criterion is a criterion that determines the size of the maximum payoff of player A in the worst conditions for him: $V = \max \min a_{ij}$.

Savage's minimum risk criterion recommends choosing a strategy that gives the minimum risk value in the most unfavorable situation: V = max min rij _

Hurwitz criterion $V = \max \{\lambda \min a_{ij} + (1 - \lambda) \max aij_{}\}$,

here λis a characteristic chosen empirically; the closer λto 1, the greater the share of the pessimistic approach.

In accordance with the Wald criterion, we determine the maximum gain that the implementation of the protection system will give in the worst conditions:

$$\max \min a_{ij} = \max \{7; 8; 4;5;9;3; 11\} = 11$$

It is obvious that, according to the Wald criterion, it is advisable to implement the strategy A_7 - network protection, as the main strategy for ensuring the security of the object.

To determine the optimal strategy according to the Savage criterion, we build a risk matrix (Table 4) according to the rule: $r_{ij} = \max a_{ij} - a_{ij}$

Table 4

Risk matrix for choosing a strategy in "playing with nature"

The strategies of player B (the attacker → / Player A (Administrator) Strategies ↓	Guessing passwords - B_1	Infection of the system with a virus - B_2	NSD - B_3	Spyware injection - B_4	DDoS attacks _ -B5 _ _
Physical protection A_1	2	8	4	0	12
Technical protection A_2	five	nine	7	0	10
Cryptographic protection A_3	one	nine	7	0	4
Software protection A_4	fourteen	6	five	eleven	10
Hardware protection A_5	15	eighteen	nine	16	eleven
Organizational and legal protection A_6	4	0	7	five	4
Network protection A_7	10	3	nine	five	0
max rij	15	eighteen	nine	16	12

The amount of the minimum risk is determined by the rule:

$$\min \max rij = {}_{\min}\{ 15; \text{eighteen}; 9;16; 12\}=9$$

According to Savage's criterion, it is expedient to adopt strategy $A_{5 \text{ for implementation}}$ - the use of hardware protection.

According to the Hurwitz criterion, which takes into account the pessimistic and optimistic assessment of the project implementation conditions for the initial matrix A with the expert pessimism coefficient $\lambda = 0.5$ assessment of the situation allows you to make a choice in favor of strategy A_7 - network protection

$\max \{0.5 * \min aij + 0.5 * \max a_{ij} \} = \max \{13; 13; 8.5; 9.5; 13.5; 7.5; 16\} = 16$

The mathematical expectation of the gain from the implementation of each strategy can be calculated, knowing the probabilities of implementing the strategies

M1 \u003d 17 * 0.25 + 11 * 0.13 + 15 * 0.16 + 19 * 0.22 + 7 * 0.07 \u003d 4.25 + 1.43 + 2.4 + + 4.18 + 0, 49 = **12.75**

M 2 \u003d 13 * 0.17 + 9 * 0.11 + 11 * 0.16 + 18 * 0.14 + 8 * 0.14 \u003d 2.21 + 0.99 + 1.76 + + 2.52 + 1 .12 = 8.6

M3 \u003d 12 * 0.08 + 4 * 0.19 + 6 * 0.17 + 13 * 0.06 + 9 * 0.15 \u003d 0.96 + 0.76 + 1.02 + + 0.78 + 1, 35 = 4.87

M4 = 14*0.21+ 6*0.06 +5*0.09+11*0.1 +10*0.2 = 2.94+0.36+0.45+1.1+2 = 6.85

M5 \u003d 15 * 0.1 + 18 * 0.29 + 9 * 0.12 + 16 * 0.21 + 11 * 0.13 \u003d 1.5 + 5.22 + 1.08 + + 3.36 + 1, 43 = **12.59**

M6 \u003d 6 * 0.15 + 10 * 0.11 + 3 * 0.08 + 5 * 0.13 + 6 * 0.2 \u003d 0.9 + 1.1 + 0.24 + 0.65 + 1, 2=4.09

M7 \u003d 11 * 0.09 + 18 * 0.1 + 12 * 0.2 + 16 * 0.13 + 21 * 0.1 \u003d 0.99 + 1.8 + 2.4 + 2.08 + 2, 1 = 9.37

The calculation of the mathematical expectation of the gain for each strategy shows that the system administrator can get the maximum gain using the strategies A_1 - physical protection of the infocommunication object and A_5 - hardware protection.

Thus, the analysis of the process of designing the complex protection of an infocommunication object as a conflict situation with a mismatch between the interests of a system administrator and a potential attacker, performed according to various criteria (optimistic, pessimistic, with a share of optimism) showed the feasibility of applying various behavior strategies. The "mismatch" of recommendations for choosing a strategy, compiled on the basis of different approaches, requires the designer to conduct additional research both in terms of checking the correctness of the initial data and in terms of choosing the optimality criteria.

Game modeling, as a rule, is carried out in several stages: problematization, goal setting, problem setting and mathematical model construction, algorithm development, solution method definition, solution itself, results analysis, model correction if necessary. The stage of building a model is one of the most significant and complex in this chain of actions, since when building a mathematical model, it is necessary to make a choice between alternative options: take a simple option as a basis with a small number of parameters / restrictions or bring the model closer to the real situation by introducing multiple restrictions and additional conditions. In a specific situation - a game as a choice of a defense strategy - an important role is played by weakly formalized factors, such as the attacker's profile, the corporate and executive discipline of the company, the information culture of team members, etc., which are difficult to take into account at the design stage.

These features, according to the author, can be taken into account if the simulation is performed repeatedly.

The transition from a simple model like a zero-sum pair game, solved in pure strategies to a model in mixed strategies, then to a more complex model like a one-player game, a game with nature, will make it possible to gradually introduce additional restrictions, comparing the results and evaluating the adequacy of the chosen algorithm.

Conclusions. Game theory, as a tool for mathematical modeling of the norms of behavior of opposing parties in a conflict situation, provides interested parties with the opportunity to make a reasoned choice of a behavior strategy. Despite the fact that the game-theoretic approach to modeling under uncertainty often gives conflicting results, it expands the players' understanding of the possibilities of maneuvering behavior strategies in order to achieve the optimal result.

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ЭКСЕРГЕТИЧЕСКИЙ АНАЛИЗ ТЕХНОЛОГИЧЕСКОЙ ЛИНИИ ПОДГОТОВКИ ЗЕРНА ТРИТИКАЛЕ К ПОМОЛУ

EXERGETIC ANALYSIS OF THE TECHNOLOGICAL LINE PREPARING OF TRITICALE GRAIN FOR GRINDING

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Аннотация

Для определения возможных направлений повышения энергетической эффективности технологических схем необходимо оценивать уровень использования энергетических ресурсов. Для этого применяют эксергетический метод термодинамического анализа для оценки термодинамического совершенства теплотехнологических систем. В работе рассмотрено влияние на технологическую систему подготовки зерна к помолу внутренних и внешних эксергетических потерь.

Матреиалы и методы, результаты и обсуждения *Эксергетический анализ технологической системы подготовки зерна к помолу выполнен по методике [1], в соответствии с которой классическая технологическая линия, а также вспомогательное оборудование (парокомпрессионная холодильная машина, оборудование для водоподготовки) рассматривались в виде теплотехнологической системы (рис. 1), условно отделенной от окружающей среды замкнутой контрольной поверхностью. Расчеты базировались на классической модели окружающей среды, предложенной Шаргутом [2]. В качестве абсолютного эксергетического параметра выбрана эксергетическая мощность, которая учитывает не только различие параметров потока и окружающей среды, но и массовый расход продукта.*

Заключение

Значительное повышение термодинамической эффективности предлагаемой технологии, с учётом получения продукции надлежащего качества, говорит о повышении термодинамической эффективности предлагаемой технологии при использовании парокомпрессионной холодильной машины, позволяющей применять теплоносители в режиме рециркуляции, без выброса в окружающую среду и, как следствие, степени ее энергосбережения.

Ключевые слова: зерно тритикале, эксергия, технологическая линия

Abstract

In order to determine possible directions for improving the energy efficiency of technological schemes, it is necessary to assess the level of use of energy resources. For this purpose,

the exergetic method of thermodynamic analysis is used to assess the thermodynamic perfection of heat-technological systems. The paper considers the influence of internal and external exergetic losses on the technological system of grain preparation for grinding.

Matreials and methods, results and discussions

The exergetic analysis of the technological system for preparing grain for grinding was carried out according to the method [1], according to which the classical technological line, as well as auxiliary equipment (steam compression refrigerating machine, water treatment equipment) were considered as a heat-technological system (Fig. 1), conditionally separated from the environment by a closed control surface. The calculations were based on the classical model of the environment proposed by Shargut [2]. As an absolute exergetic parameter, the exergetic power is chosen, which takes into account not only the difference in flow and environmental parameters, but also the mass flow rate of the product.

Conslusion

A significant increase in the thermodynamic efficiency of the proposed technology, taking into account the production of products of proper quality, indicates an increase in the thermodynamic efficiency of the proposed technology when using a steam compression refrigerating machine, which allows the use of heat carriers in the recirculation mode, without emission into the environment and, as a consequence, the degree of its energy saving.

Key words: triticale grain, exergy, technological line

Introduction. When preparing triticale grain for grinding, the fundamental points are: improvement of the main quality indicators of grain when removing moisture and its safety during storage in silos through the use of active ventilation; increasing the efficiency of using waste heat carriers in recirculation circuits; reduction in the amount of outdoor air used; reduction of specific energy consumption and use of secondary material resources; achievement of high environmental friendliness of production.

Goal and tasks.

The purpose of our work was to study the effect of internal and external exergy losses on the technological system of preparing triticale grain for grinding, as well as to perform the necessary calculations that allow a comparative analysis of the obtained exergy efficiency of the proposed technology, the most promising today, with the traditional one.

The task of the exergy analysis of the thermodynamic perfection of the grain preparation system for grinding, in general, was to determine the stages of the implemented processes in the technology, where the most significant exergy losses take place, allowing improve the efficiency of the system.

Objects and methods.

The calculation of the exergy loss of the proposed scheme was carried out according to the method [1], according to which the technological line operating according to the classical version of the construction of technological stages of production, as well as technological equipment (vapor-compression heat pump, equipment for hydrothermal preparation), which is auxiliary, were considered in the form of a heat technological system (Fig. 1). As a result, this system and the surrounding space were conditionally separated by a closed surface, in which, due to the existing heat exchange processes, control surfaces were determined:

I – heat treatment of grain;

II - preliminary preparation of grain;

III - hydrothermal processing of grain ;

IV - vapor compression refrigeration machine;

V - water regeneration.

In this case, all performed calculations were based on the well-known Shargut model [2].

In any presented surface of the developed circuit representing a set of irreversible processes, due to the dissipation of energy, exergy decreases with time.

Since the incoming wet grain is in thermodynamic equilibrium with the environment, its exergy is set equal to zero and is removed from the calculations.

During processing, the chemical exergy of the grain remains unchanged. The temperature of the main and auxiliary flows undergoes significant changes. Mechanical interactions are also taken into account due to the presence of a significant number of processes occurring with a large pressure transformation of non- main flows. Therefore, the calculations take into account both thermal and mechanical components of the calculated exergy.

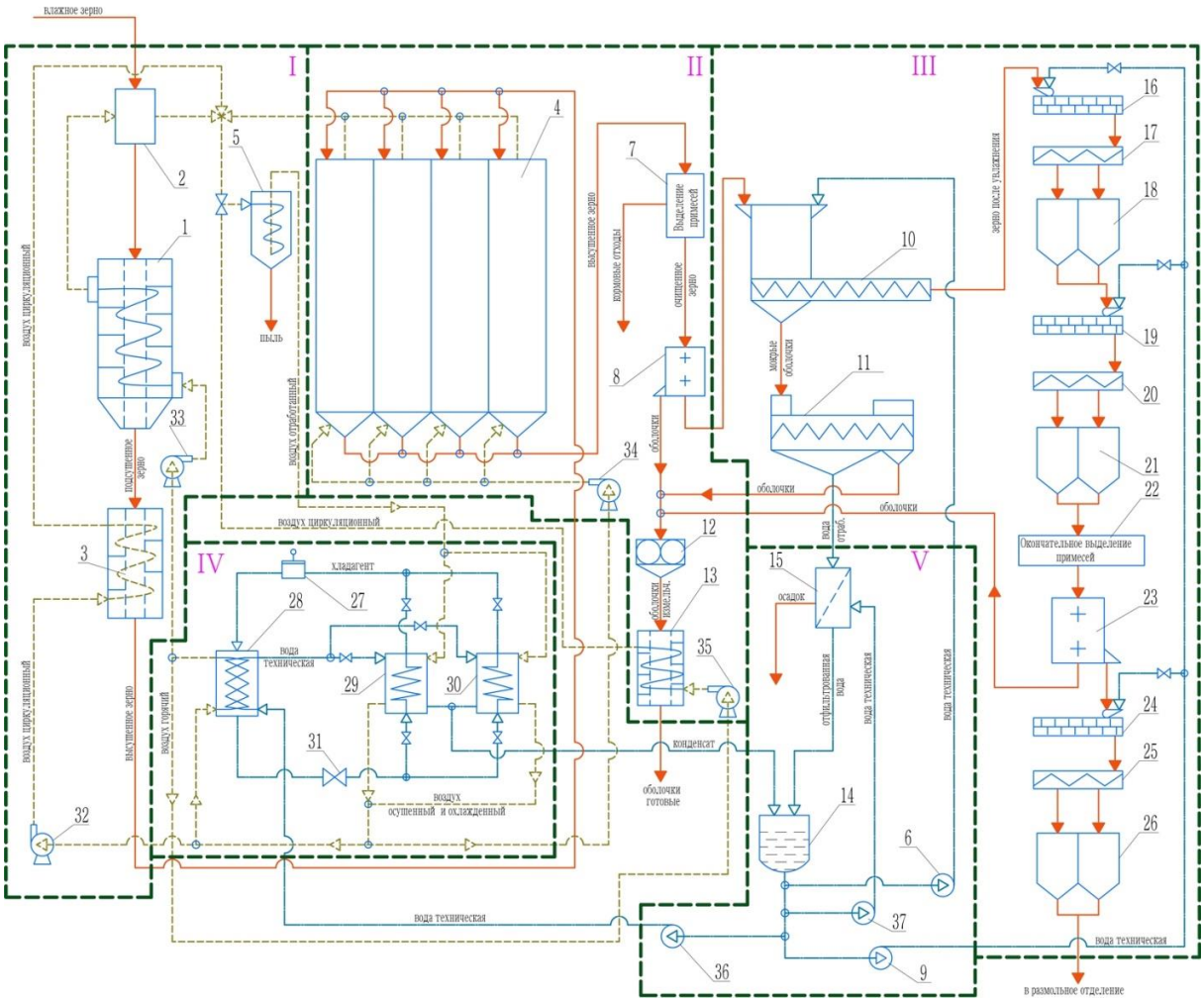

Fig. 1. Scheme of the technological line for preparing triticale grain for grinding: 1 - grain dryer; 2 – heating chamber; 3 - cooler; 4 - silos; 5 - cyclone; 6, 9, 36, 37 - pumps; 7 - a set of equipment for the primary separation of impurities; 8, 23 - scouring machines; 10 - wet peeling machine; 11 - screw press; 12 - shredder for shells; 13 – casing dryer; 14 - water collector; 15 - filters; 16, 19, 24 - intensive moisturizing machine; 17, 20, 25 - screw conveyor; 18, 21 – tempering bins; 22 - a set of equipment for the final separation of impurities; 27 - compressor; 28 - capacitor; 29, 30 - sections of the evaporator; 31 - TRV; 32-35 - fan; I – heat treatment of grain; II - preliminary preparation of grain ; III - hydrothermal processing of grain; IV - vapor compression refrigeration machine; V - water regeneration

The various fluxes that make up exergy were not the same. Air flows in the process of drying and cooling of the initial triticale grain were characterized by mechanical exergy, and thermal exergy during the preparation of grain for grinding is present in almost all flows of the considered thermodynamic system.

In the calculations, both reference data [3–5] of the thermophysical properties of air, water, and triticale grains, as well as those obtained in experimental studies [6–8], were used.

Electromechanical exergy losses [9] occur in every equipment for the mechanical processing of triticale grain and by-products of the technology (casings, feed waste) and correspond to the power of the corresponding drives.

The exergy of the flows under consideration and the exergy losses made it possible to obtain the calculated balance of the proposed system of the processes under study (Table 1).

To obtain the necessary diagrams according to the Grassmann-Shargut method (Fig. 2), the exergy power E, kJ/h, was chosen, which is the absolute parameter of the exergy. This value is quite simple to apply when considering thermodynamic systems, the clear priority of which is the production of high-quality finished products in the required quantity, and not the production of energy. The parameter E takes into account not only the mass flow of the product, but also how the values of the parameters of the flow and the environment differ. Table 2 shows the correspondence of flows to control surfaces.

The calculated exergy efficiency was 7.79%, exceeding by 2.32% the efficiency of the heat engineering system of the known method [10]. All this makes it possible to recommend the use of heat carriers in a closed mode, excluding pollution of the surrounding space due to the use of a refrigerating machine operating in the heat pump mode.

A sufficiently significant increase in the thermodynamic efficiency of the developed production line when compared with the prototype, as well as taking into account the production of the finished product of the required quality, indicates a high degree of its energy saving.

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Table 1

Exergy balance of the technological line for preparing wheat grain for grinding

No.	**Control surface name**	Absolute exergy power E , mJ/h	Relative exergy power, %
1	2	3	4
I	**THERMAL PROCESSING**		
income			
1	wet grain	0.00	0.00
2	Electricity for fan drives (I)	18.72	5.34
Total exergy supplied to the control surface		18.72	5.34
expense			
2	Internal exergy losses	12.39	3.54
3	External exergy losses	3.77	1.08
Total exergy removed from the control surface		16.16	4.61
II	**P R E P R E P A R A T I O N**		
income			
one	Electricity to drive the scalper, separator, stoner	9.00	2.57
2	Electricity to drive the casing grinder	36.00	10.28
3	Electricity for fan drives (II)	18.72	5.34
4	Electricity to drive the scourer (II)	19.80	5.65
Total exergy supplied to the control surface		83.52	23.84
expense			
1	Feed waste	4.33	1.24
2	Shells ready	2.55	0.73
3	Internal exergy losses	54.46	15.55
4	External exergy losses	21.24	6.06
Total exergy removed from the control surface		82.58	23.57
III	**HYDROTHERMAL PROCESSING OF GRAIN**		
income			
1	Electricity for screw press drive	5.40	1.54
2	Electricity for humidifier drives	43.20	12.33
3	Electricity to drive the wet peeling machine	39.60	11.31
4	Electricity for screw drives	23.76	6.78
5	Electricity to drive the scourer (III)	19.80	5.65

1	2	3	4
6	Electricity for separator and trier drives	12.60	3.60
Total exergy supplied to the control surface		144.36	41.21
expense			
1	Finished grain	18.70	5.34
2	Internal exergy losses	125.30	35.77
3	External exergy losses	23.79	6.79
Total exergy removed from the control surface		167.79	47.89
IV	**VAPOR COMPRESSION CHILLER**		
income			
1	Electricity to drive the compressor	72.00	20.55
Total exergy supplied to the control surface		72.00	20.55
expense			
3	Internal exergy losses	58.11	16.59
4	External exergy losses	10.36	2.96
Total exergy removed from the control surface		68.47	19.54
V	**WATER REGENERATION**		
income			
1	Electricity for pump drives	31.68	9.04
Total exergy supplied to the control surface		31.68	9.04
expense			
1	Sediment	1.7	0.5
2	Internal exergy losses	15.3	4.4
Total exergy removed from the control surface		15.3	4.4
GENERAL SUPPLY		**350.3**	100.0
GENERAL EXCEPTION		**350.3**	100.0

Table 2

Designations of flows on the Grassmann-Shargut diagram of the circuit under study

Position on the chart	Stream name	Reference surface	
		bestowing	host
1	Original product	-	I
2	Dry product	I	II
3	Purified product	II	III
4	finished product	III	-
5	Feed waste	I I	-
6	Shells primary	III	II
7	Shells ready	II	-
8	Sediment	V	-
9	Drying agent hot	IV	II
10	Drying agent dried and cooled	IV	II
11	Drying agent circulating	II	I
12	Drying agent spent (II)	II	I
13	Drying agent spent (I)	I	I V
14	Technical water (III)	V	III
15	Technical water (IV)	V	I V
16	Waste water	III	V
17	Condensate	IV	V
18	Electricity for fan drives (I)	-	I
19	Electricity to drive the scalper, separator, stoner	-	II
20	Electricity to drive the casing grinder	-	II
21	Electricity for fan drives (II)	-	II
22	Electricity to drive the scourer (II)	-	I I
23	Electricity for screw press drive	-	III
24	Electricity for humidifier drives	-	III
25	Electricity to drive the wet peeling machine	-	III
26	Electricity for screw drives	-	III
27	Electricity to drive the scourer (III)	-	III
28	Electricity for separator and trier drives	-	III
29	Electricity to drive the compressor	-	IV
30	Electricity for pump drives	-	V

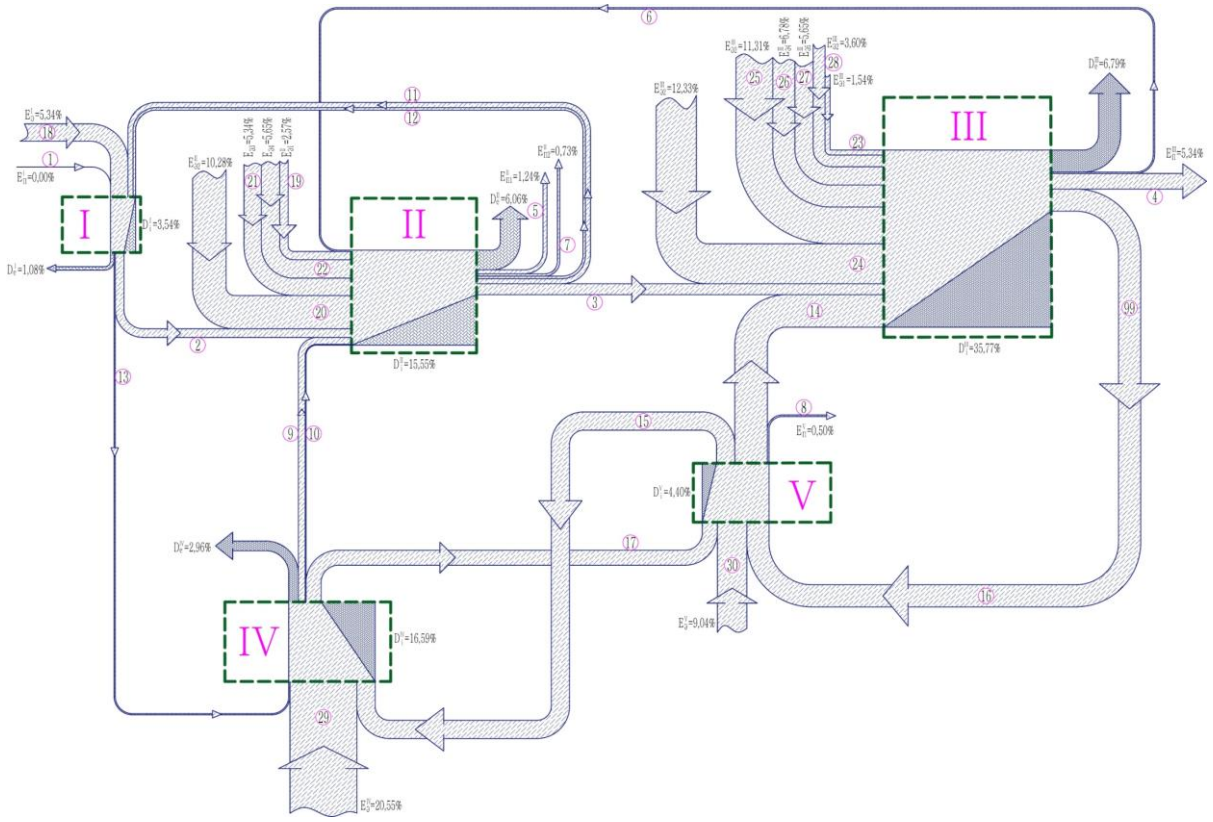

Fig. 2. Grassmann-Shargut diagram for the technology under study. I-V - numbers of control surfaces

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ТЕХНОЛОГИЧЕСКИЕ РЕШЕНИЯ, ОБЕСПЕЧИВАЮЩИЕ ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ СУШКИ ВЫСОКОВЛАЖНЫХ СЕМЯН РАПСА

TECHNOLOGICAL SOLUTIONS PROVIDING INCREASED EFFICIENCY OF DRYING OF HIGH MOISTURE RAPE SEEDS

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Аннотация

В 2020 году увеличился валовый сбор рапса в России и по данным Росстата составил 2,6 млн т. В 2021 года рекордный сбор составил около 2,9 млн тонн. Существенный интерес к рапсу обусловлен созданием безэруковых сортов семян данной культуры с малым содержанием глюкозинолатов (менее 3 мг/г сухого вещества). Данное обстоятельство позволило перевести продукты, получаемые из рапса, в разряд пищевых.

Материалы и методы, результаты и обсуждения

Проведен анализ перспектив выращивания и переработки семян рапса, а также существующих технологий сушки семян данной культуры и способов повышения их эффективности. Предложен способ сушки, позволяющий обеспечить снижение влажности семян рапса до критической за один цикл сушки. Проведена серия лабораторных опытов и производственных испытаний по исследованию кинетики сушки семян рапса при квазиизотермических режимах.

Заключение

По результатам проведенных лабораторных исследований и производственных испытаний можно сделать вывод о том, что представленный способ сушки позволяет снизить влажность семян рапса с начальной влажностью более 23% до 7% за один пропуск через сушилку при сохранении основных семенных и технологических достоинств высушиваемых семян, а также обеспечивает повышение производительность зерносушилки на 15%.

Ключевые слова: сушка зерна; зерносушилка; семена рапса; высоковлажные семена; квазиизотремический режим; рециркуляция.

Absrtact

In 2020, the gross harvest of rapeseed in Russia increased and, according to Rosstat, amounted to 2.6 million tons. In 2021, the record harvest was about 2.9 million tons. A significant interest in rapeseed is due to the creation of non-erucid seed varieties of this crop with a low content of glucosinolates (less than 3 mg/ g of dry matter). This circumstance made it possible to transfer the products obtained from rapeseed into the category of food

Matreials and methods, results and discussions

The analysis of the prospects for the cultivation and processing of rapeseed seeds, as well as existing technologies for drying seeds of this crop and ways to increase their efficiency. A drying method is proposed that allows reducing the moisture content of rapeseed seeds to critical in one drying cycle. A series of laboratory experiments and production tests were carried out to study the kinetics of drying rapeseed seeds under quasi-isothermal conditions.

Conclusion

Based on the results of laboratory studies and production tests, it can be concluded that the presented drying method reduces the moisture content of rapeseed seeds with an initial humidity of more than 23% to 7% in one pass through the dryer while maintaining the main seed and technological advantages of the dried seeds, and also provides an increase in the productivity of the grain dryer by 15%.

Key words: grain drying; grain dryer; rapeseed seeds; high-moisture seeds; quasi-isotremic regime; recycling.

Введение

В 2020 году валовый сбор рапса в России поставил новый рекорд и по данным Росстата составил 2,6 млн т. По итогам урожая 2021 года ожидается новый рекордный сбор в объёме около 2,9 млн тонн [1]. Цены на него в настоящее время также находятся на максимальных отметках и составляют 45-46 тыс. руб./тонну [2].

Урожайность и качественные характеристики семян рапса в значительной степени зависят от технологии возделывания, погодных условий и применяемых удобрений. Средняя урожайность рапса по России за последнее десятилетие выросла фактически на 30%, данный рост достигнут преимущественно за счёт применения передовых технологий и повышения качества семенного материала [3]. При этом содержание масла в семенах в большей степени зависит от погодных условий вегетации, с разницей в содержании липидов до 20% [4], и генетических особенностях применяемого сорта.

Существенный интерес к рапсу обусловлен созданием безэруковых сортов семян данной культуры с малым содержанием глюкозинолатов (менее 3 мг/г сухого вещества). Данное обстоятельство позволило перевести продукты, получаемые из рапса, в разряд пищевых. По липидному составу рапсовое масло богато ненасыщенными жирными кислотами: более 50% приходится на олеиновую кислоту, до 30% - на линолевую, до 13% - на альфа-линоленовую [5].

По суммарному содержанию протеинов и липидов рапс опережает сою и другие бобовые культуры. По концентрации обменной энергии семена рапса на 31% превосходят семена сои [6]. Высокой кормовой ценностью обладает и рапсовый жмых, содержащий 30-32% сырого протеина и 8-10% масла, способного на 80-100% заменить соевый шрот в рационах кормления сельскохозяйственных животных и птицы [7]. Проведенные исследования свидетельствуют о том, что включение в рационы кормления свиней и бройлеров продуктов переработки рапса увеличило живую массу, повысило перевариваемость протеина и сократило затраты на корма более чем на 16% [8].

Были проведены исследования по применению масла, полученного из семян рапса, в качестве фритюрного жира [9]. По результатам исследований установлено, что при использовании рапсового масла, в сравнении с пальмовым, содержание жиров в готовом продукте сократилось на 4,6%. Учитывая то, что на долю насыщенных жирных кислот в пальмовом масле приходится существенная доля липидов (на долю пальмитиновой кислоты – 45% от жирнокислотного состава), то переход их в изделие желательно минимизировать. Также необходимо отметить, что на долю наиболее ценных жирных кислот ω3 и ω6 в пальмовом масле приходится менее 0,3%, при том что в рапсовом масле их доля составляет около 2%.

В совокупности представленные качества рассматриваемой культуры определили её популярность у аграриев, производителей кормов и продуктов питания. Продукты переработки семян рапса нашли повсеместное применение в различных отраслях промышленности – от мыловарения и кормления сельскохозяйственных животных и птицы, до диетического питания.

Ежегодно до 75% валового сбора зерновых и зернобобовых культур, маслосемян и кукурузы в России нуждаются в сушке [10]. При валовом сборе семян рапса на уровне 2,6 млн т, в год в сушке нуждается около 1,9 млн т [2].

Уборка рапса, как правило, производится методом прямого комбайнирования, вследствие чего на хлебоприёмные предприятия семена рапса часто поступают с начальной влажностью до 30%. Сушка семян рапса усложняется тем, что ввиду высокого содержания гидрофобных липидов (около 42%), критическая влажность для семян рапса составляет 7% [25].

Используемые на большинстве элеваторов и хлебоприёмных предприятий России шахтные прямоточные сушилки не позволяют снизить влажность семян рапса за один пропуск через сушилку более чем на 5-7%. Данное обстоятельство вынуждает формировать партии зерна по влажности и осуществлять сушку зерна в несколько этапов, что существенно снижает коэффициент полезного действия хлебоприёмных мощностей и повышает себестоимость сушки.

В условиях ежегодного увеличения объёмов выращиваемого рапса, нехватки зерносушильных мощностей и сокращения уборочного периода, вопрос сушки высоковлажных семян рапса становится всё более актуальным.

В последнее время было опубликовано значительное количество работ, нацеленных на повышение эффективности сушки зерна и семян бобовых и масличных культур, в том числе семян рапса. Были проведены исследования по использованию СВЧ [11, 12, 13] и инфракрасного излучения [14, 15]. Данные способы сушки имеют значительный научно-практический потенциал, однако маловероятно, что в ближайшее время они получат широкое промышленное применение при достаточно высоком уровне производственных и инвестиционных затрат.

Были опубликованы работы по совершенствованию барабанных [16, 17, 18] и бункерных [19, 20,21] зерносушилок, а также по изучению возможности использования отработанного агента сушки и охлаждающего воздуха [22, 23, 24]. Они также заслуживают внимания, но предлагаемые технологические решения не позволяют решить проблему оперативной сушки семян высоковлажного рапса, поступающих на крупные заготовительные предприятия в зерноуборочный период.

Одним из возможных решений является использование технологии рециркуляционной сушки с применением квазиизотермических режимов, характеризующихся равенством температур высушиваемых семян в начале и конце процесса сушки. Данный эффект обусловлен промежуточным охлаждением семян за счёт интенсивного испарения влаги в течение процесса сушки.

Объекты и методы исследования

В качестве объекта исследования использовали семена ярового рапса сорта «Ратник». Экспериментальные исследования производили в два этапа. На первом этапе выполняли лабораторные исследования в лаборатории Московского государственного университета пищевых производств. На втором этапе осуществляли производственную апробацию на действующих модернизированных шахтных рециркуляционных зерносушилках Набережночелнинского элеватора.

Лабораторные исследования проводили на экспериментальной установке, физически моделирующей отдельные этапы процесса сушки семян на рециркуляционных сушилках. Экспериментальная установка состояла из вентилятора высокого давления, электрического калорифера, патрубка с задвижкой для регулировки количества подаваемого атмосферного воздуха, а также сушильной камеры и измерительных приборов.

С целью приведения условий лабораторных опытов к максимальному соответствию процессам сушки, протекающим в действующих рециркуляционных зерносушилках, опыты проводили на смеси семян рапса с различной начальной влажностью. Увлажнение семян осуществляли в соответствии с общепринятой методикой [26].

Кратность смешения семян с различной начальной влажностью определяли по формуле:

$$n = \frac{w_1 - w_{см}}{w_{см} - w_2},$$

где: w_1 – влажность первой пробы семян, %;

w_2 – влажность второй пробы семян, %;

$w_{см}$ – требуемая влажность смеси двух проб семян, %.

Продолжительность контактного тепловлагообмена при смешении семян с различной начальной влажностью установили соответствующей продолжительности данного процесса в действующих рециркуляционных зерносушилках – 20 ± 10 минут.

Расчетную скорость воздуха в экспериментальной установке также задали равной скорости воздуха в действующих шахтных зерносушилках типа ДСП - на уровне от 0,2 до 0,6 м/с. При этом смесь семян с различной начальной влажностью нагревали и выдерживали в термостате при температуре 60°С в герметичном стеклянном сосуде в течение заданного времени.

Максимальную температуру нагрева семян установили на уровне 60°С. По данным имеющейся нормативной документации [27] и на основании проведенных исследований [9], данное значение является максимальным, при котором активно протекают процессы сушки без значительных качественных потерь высушиваемых семян.

В качестве сушильного агента в экспериментальной установке использовали атмосферный воздух, нагретый до заданной температуры при помощи электрического калорифера. Температура агента сушки была задана по аналогии с действующими шахтными зерносушилками и варьировалась в диапазоне от 80 до 120°С. Продолжительность процесса сушки и начальную влажность семян рапса определили исходя из конструктивных и технологических особенностей действующих рециркуляционных зерносушилок.

За основные качественные показатели высушиваемых семян приняли всхожесть и энергию прорастания, так как увеличение данных показателей характеризует такие процессы, как денатурация белков и окисление липидов в составе семян. Для оценки влияния сушки на свойства семян товарного назначения определяли кислотное число и перекисное число масла, получаемого из высушенных семян. Также с целью подтверждения отсутствия канцерогенов в высушиваемых семенах определяли остаточное содержание бензапирена.

Производственные испытания осуществляли на модернизированной шахтной рециркуляционной зерносушилке типа «Целинная-36» с дополнительным подводом тепла в верхнюю зону сушки. Технологическая схема установки представлена на рисунке 1.

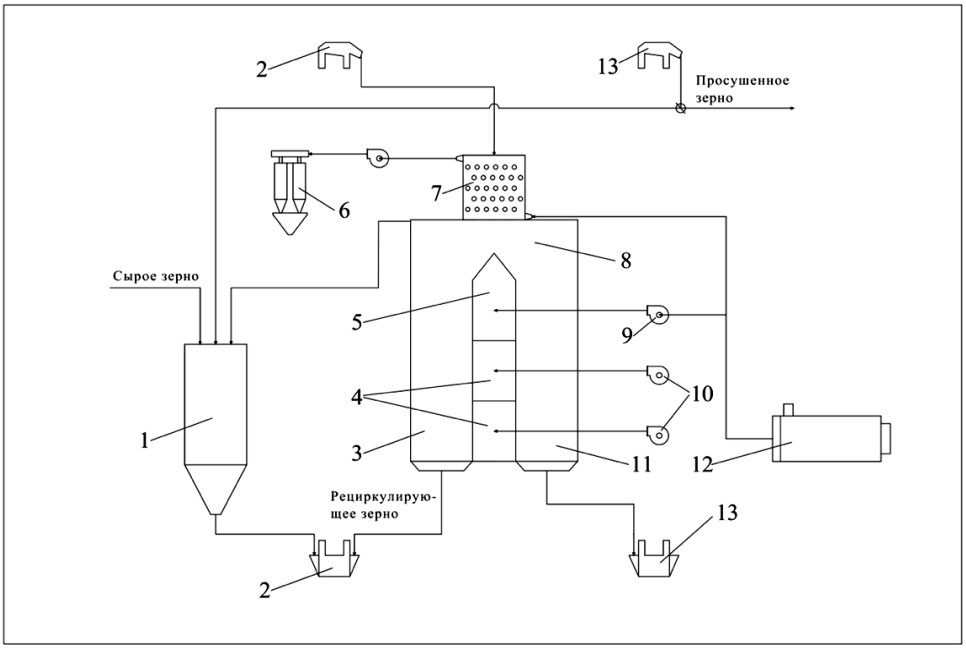

Рис. 1. Технологическая схема рециркуляционной зерносушилки, сушка в которой протекает при квазиизотермических режимах: 1 – оперативный бункер, 2 – рециркуляционная нория; 3 – рециркуляционная шахта, 4 – напорно-распределительные камеры зон охлаждения, 5 – напорно-распределительная камера зоны сушки, 6 – циклоны-пылеотделители для очистки отработавшего агента сушки, 7 – камера предварительного нагрева зерна, 8 – бункер-тепловлагообменник, 9 – вентилятор зоны сушки, 10 – вентиляторы зон охлаждения зерна, 11 – шахта охлаждения, 12 – топка, 13 – нория просушенного зерна.

Согласно представленной схеме, сырые семена рапса поступали в оперативный бункер (1), предназначенный для выравнивания производительности зерносушилки, далее в рециркуляционную норию (2) и в камеру предварительного нагрева зерна (7). Там они нагревались высокотемпературным агентом сушки в состоянии заторможенно-падающего слоя. После теплообмена и частичного влагообмена с рециркулирующими семенами в бункере-тепловлагообменнике (8) семена рапса распределялись на рециркуляционную шахту (3) и шахту охлаждения (11). В верхней зоне шахт осуществлялась сушка при квазиизотермических режимах. В нижних зонах осуществлялось охлаждение семян атмосферным воздухом. Далее семена из рециркуляционной шахты (3) поступали в рециркуляционную норию (2), где они смешивались с сырыми семенами, поступающими на сушку. Просушенные семена поступали на норию просушенного зерна (13) и направлялись далее на закладку для хранения. В случае невозможности просушить семена рапса до установленных значений за один пропуск через сушилку, имеется возможность направить их на повторную сушку из нории просушенного зерна (13) в оперативный бункер влажного зерна (1).

Режимы сушки при проведении производственных испытаний определили на основании данных лабораторных опытов. Температура сушильного агента в камере предварительного нагрева зерна в обоих опытах составляла 260°С, в зоне квазиизотермической сушки - 80°С. В случае сушки семян по «классической» технологии рециркуляционной сушки подача тепла в верхнюю зону напорно-охладительной камеры (5) приостанавливалась и сушка семян в данной зоне осуществлялась атмосферным воздухом.

Результаты и их обсуждение

Средневзвешенную влажность высушиваемых семян установили на уровне 25%. Пропорцию смешения в данном опыте определили в соотношении 1 к 2 семян влажностью 33% к семенам влажностью 9% соответственно. Результаты опытов представлены на рисунках 2 и 3.

Как видно из графика, представленного на рисунке 2, температура семян резко снижается в начале процесса на 13-20°С, а в дальнейшем начинает возрастать, что является характерным для данного процесса. Важно подчеркнуть, что температура семян на протяжении всего периода сушки не превышает предельно допустимую температуру нагрева семян.

Снижение температуры семян вызывается интенсивным испарением влаги, на что расходуется часть тепла, аккумулированного семенами в процессе предварительного нагрева. Идентичная тенденция снижения температуры семян при различных температурах сушильного агента объясняется непропорциональным изменением долей тепла, расходуемого сушильным агентом и семенами на испарение влаги.

По данным, представленным на рисунке 3, снижение влажности в рассматриваемых опытах составило от 6,3 до 11%. Данные значения свидетельствуют об эффективности применения квазиизотермических режимов при сушке семян рапса с высокой начальной влажностью.

Скорость сушки семян в течение проведения опыта также меняется – максимальных значений она достигает в начале эксперимента, в дальнейшем интенсивность выделения влаги снижается, температура семян при этом начинает возрастать, что объясняется углублением зоны испарения внутрь семян.

На рисунках 4 и 5 отражены результаты исследования влияния скорости сушильного агента на процесс сушки смеси семян рапса. Как видно на рисунке 4, температура семян в начальный период сушки падает с 60° до 44,5-39°С. Исследования показали, что увеличение скорости сушильного агента с 0,2 м/с до 0,6 м/с в значительной мере интенсифицирует процесс сушки семян рапса. При этом температура семян остаётся ниже предельно допустимой, а снижение их влажности составляет 5% и более, в зависимости от выбранного режима.

Интересную закономерность представляет тот факт, что большее снижение температуры семян достигается при меньшей скорости сушильного агента. Данная особенность

позволяет обеспечить необходимое охлаждение семян за установленную продолжительность времени.

По данным рисунка 5 снижение влажности в данных опытах составило от 4,8 до 9,8%.

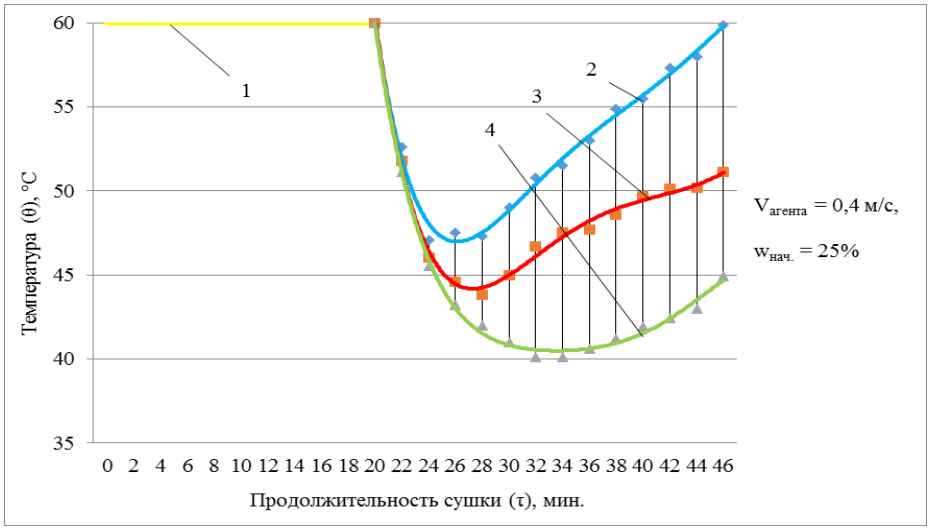

Рис. 2. Кривые температуры смеси семян рапса: 1 – период теплообмена, 2 - при сушке агентом температурой 120°С, 3 - при сушке агентом температурой 100°С, 4 - при сушке агентом температурой 80°С.

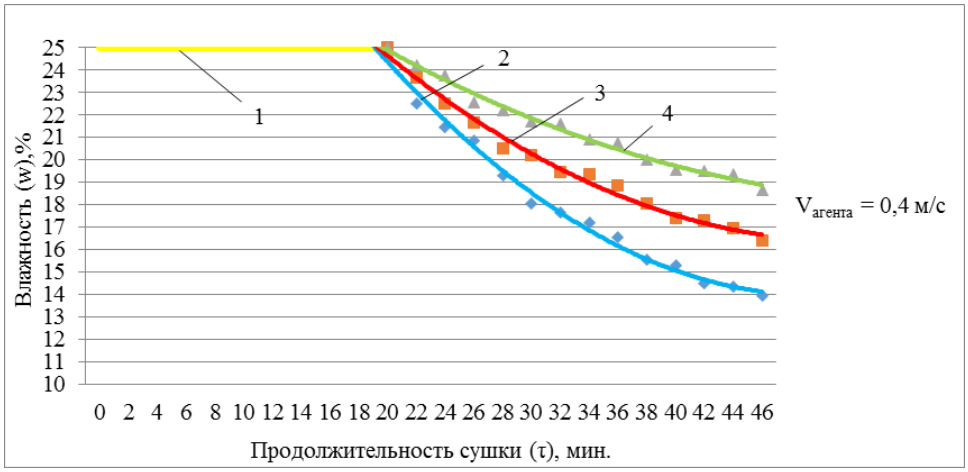

Рис. 3. Кривые сушки смеси семян рапса: 1 – период теплообмена, 2 - при сушке агентом температурой 120°С, 3 - при сушке агентом температурой 100°С, 4 - при сушке агентом температурой 80°С.

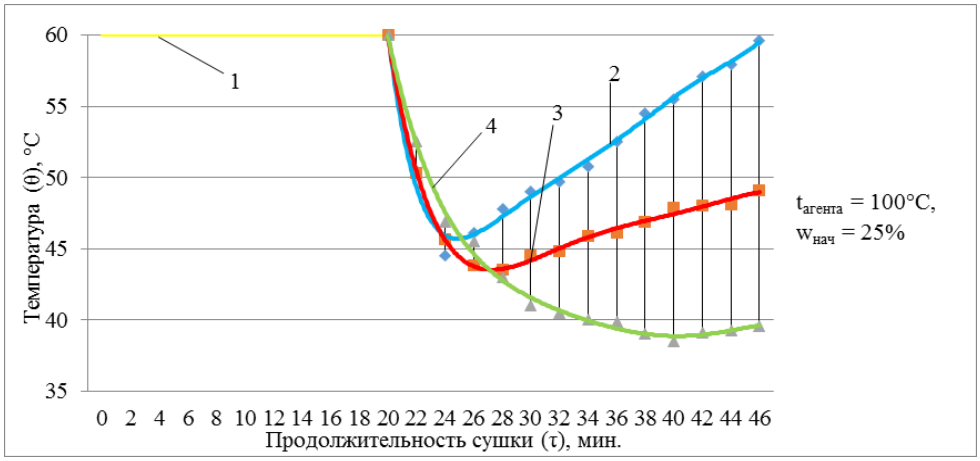

Рис. 4. Кривые температуры смеси семян рапса: 1 – период теплообмена, 2 – при скорости сушильного агента 0,6 м/с, 3 – при скорости сушильного агента 0,4 м/с, 4 – при скорости сушильного агента 0,2 м/с.

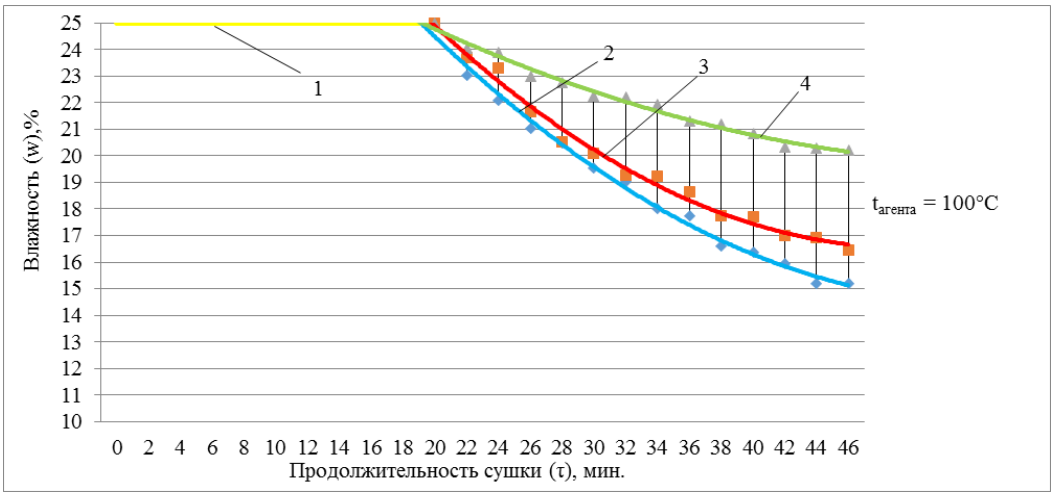

Рис. 5. Кривые сушки смеси семян рапса: 1 – период теплообмена, 2 – при скорости сушильного агента 0,6 м/с, 3 – при скорости сушильного агента 0,4 м/с, 4 – при скорости сушильного агента 0,2 м/с.

Результаты производственных испытаний сушки семян рапса на зерносушилке с частичной рециркуляцией зерна и с применением квазиизотермических режимов представлены на рисунках 6 и 7 соответственно.

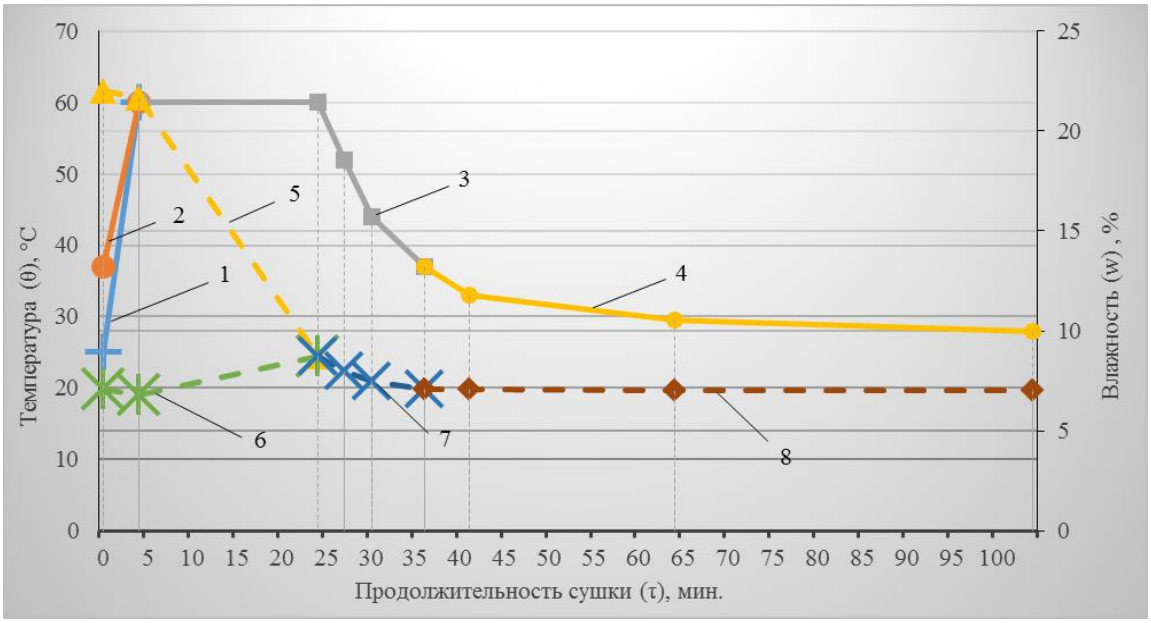

Рис. 6. Кривые изменения температуры и влажности рапса при сушке семян с частичной рециркуляцией: 1 – температура сырых семян, 2 - температура реуиркулирующих семян, 3 – температура смеси сырых и рециркулирующих семян, 4 – температура просушенных семян, 5 – влажность сырых семян, 6 – влажность рециркулирующих семян, 7 – влажность смеси сырых и рециркулирующих семян, 8 – влажность просушенных семян.

Снижение влажности в опыте по сушке семян на рециркуляционной зерносушилке, результаты которого представлены на рисунке 6, составило около 2% и происходило в зоне предварительного нагрева (0,3%) и охлаждения (1,7%) зерна. Кратность смешения сырых и рециркулирующих семян при этом составила 6,8.

На рисунке 7 отражены результаты опыта по сушке семян рапса с применением квазиизотермических режимов. В данном случае общее снижение влажности семян составило почти 6% и состояло из следующих величин: зона предварительного нагрева – около 0,3%, зона изотермической сушки – 3,9%, зона охлаждения – 1,6%. Кратность смешения сырых и рециркулирующих семян сократилась до 3. Общее снижение влажности за цикл в итоге увеличилось в 3 раза в сравнении с рециркуляцинной сушкой семян. Данный эффект дости-

гается за счёт активного испарения влаги в зоне квазиизотермической сушки, он обусловлен совпадением потоков термо- и влагопроводности в семени, особенно в период снижения температуры семян в начале сушки.

Также необходимо отметить, что в обоих случаях на сушку поступали семена рапса начальной влажностью 22% и более. Снизить их влажность до значений, обеспечивающих возможность размещения на хранение за один цикл сушки, удалось, в том числе, за счёт их тепловлагообмена с рециркулирующими семенами.

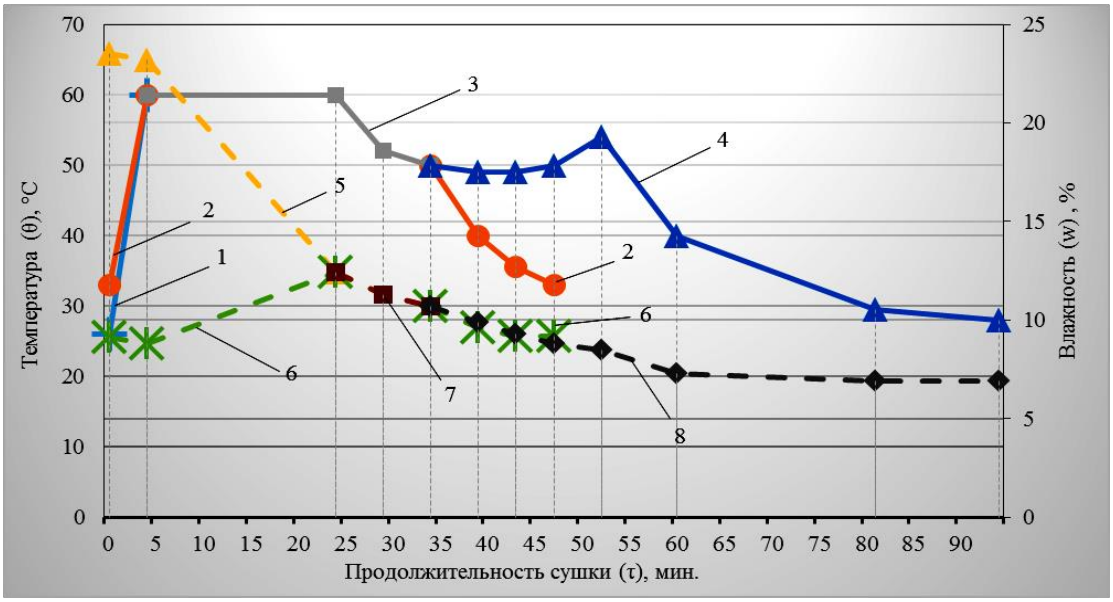

Рис. 7. Кривые изменения температуры и влажности семян рапса в рециркуляционной зерносушилке при квазиизотермических режимах: 1 – температура сырых семян, 2 - температура реуиркулирующих семян, 3 – температура смеси сырых и рециркулирующих семян, 4 – температура просушенных семян, 5 – влажность сырых семян, 6 – влажность рециркулирующих семян, 7 – влажность смеси сырых и рециркулирующих семян, 8 – влажность просушенных семян.

Поддержание температуры в процессе проводимых опытов ниже предельно допустимой обуславливало минимальное снижение качественных показателей высушиваемых семян. Качественные характеристики семян, которые измеряли до и после проведения опытов, представлены в таблице.

Таблица

Качественные характеристики семян рапса

Наименование опыта		Кислотное число масла, мг КОН/1 г на АСВ	Перекисное число масла, ммоль/кг 1/2О	Всхожесть, %	Энергия прорастания, %
Сушка с частичной рециркуляцией просушенных семян	До сушки	3,31	6,61	56	44
	После сушки	2,9	8,02	38	29
Сушка при квазиизотермических режимах	До сушки	3,32	6,53	53	41
	После сушки	2,82	7,48	42	31

Из представленных данных следует, что сушка семян рапса при квазиизотермических режимах обеспечивает лучшую сохранность качественных показателей высушиваемых

семян. Данный эффект, судя по всему, обусловлен существенным снижением кратности рециркуляции сырых и рециркулирующих семян, а следовательно и снижением дополнительного термического воздействия на высушиваемые семена.

Содержание бензапирена в высушиваемых семенах ни в одном из проведенных опытов не обнаружено.

Производительность сушилки, в случае сушки семян при квазиизотермических режимах, составила 11,2 тонн в час, при сушке с частичной рециркуляцией семян – 12,9 тонн в час. Следовательно, дополнительная подача сушильного агента в верхнюю зону сушки помимо повышенной сохранности качественных показателей и большего снижения влажности высушиваемых семян, позволила увеличить общую производительность зерносушильной установки на 15%.

Также необходимо отметить, что во избежание перегрева семян и, как следствие, снижения их качественных показателей, необходимо обеспечить максимальный контроль заданных режимов сушки на всех этапах процесса, в том числе за счёт средств автоматизации – датчики контроля температуры и влажности семян должны быть предусмотрены на ключевых этапах технологического процесса: на входе в рециркуляционную шахту, в бункере-тепловлагообменнике, в зоне сушки рециркуляционной и охладительной шахт, а также на выходе из них.

Заключение

По результатам проведенных лабораторных исследований и производственных испытаний можно сделать вывод о том, что представленный способ сушки позволяет снизить влажность семян рапса с начальной влажностью более 23% до 7% за один пропуск через сушилку при сохранении основных семенных и технологических достоинств высушиваемых семян, а также обеспечивает повышение производительность зерносушилки на 15%.

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СОВРЕМЕННЫЕ МЕТОДЫ ОБОГАЩЕНИЯ СЫРОВ СОЛЯМИ КАЛЬЦИЯ

CURRENT METHODS OF CHEESE ENRICHMENT WITH CALCIUM SALTS

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Аннотация

Рассмотрены проблемы роста заболеваемости населения Российской Федерации остеопорозом и поиска эффективного варианта ее решения. Обоснована актуальность применения молочных продуктов для профилактики осетопороза.

Материалы и методы, результаты и обсуждения

Целью научного исследования является сопоставление реализованных отечественных и зарубежных научно-технических разработок и технологических приемов обогащения сыров солями кальция. Представлено научно обоснованное описание каждого из изученных способов.

На основе анализа источников информации подтверждена целесообразность производства данной группы молочных продуктов функционального назначения. Сделан прогноз производства молочных продуктов, обогащенных витаминами и минеральными веществами.

Заключение

Обоснована актуальность применения молочных продуктов для профилактики осетопороза. Рассмотрены отечественные и зарубежные научно-технические разработки и технологические приемы обогащения сыров солями кальция. Подтверждена целесообразность производства данной группы молочных продуктов функционального назначения.

Ключевые слова: сыроделие, обогащение, соли кальция, молочные функциональные продукты.

Abstract*. The problems of the increase in the incidence of osteoporosis among the population of the Russian Federation and the search for an effective solution to it are considered. The relevance of the use of dairy products for the prevention of osteoporosis is substantiated.*

Materials and methods, results and discussions

The purpose of the research is to compare the implemented domestic and foreign scientific and technical developments and technological methods of cheeses enrichment with calcium salts. A scientifically based description of each of the studied methods is presented.

Based on the analysis of information sources, the expediency of this functional dairy products group manufacturing has been confirmed. The forecast of the production of dairy products enriched with vitamins and minerals is made.

Conclusion

The relevance of dairy products application for osteoporosis prophylaxis is grounded. Domestic and foreign scientific and technical developments and technological methods of cheese enrichment with calcium salts are considered. The expediency of this functional dairy products group production is proved.

Key words: cheese making, fortification, calcium salts, functional dairy products.

Introduction . According to the Research Institute of Rheumatology, in 2015, over 30% of the adult population suffers from osteoporosis [2]. According to the latest literature data, 14 million people (10% of the country's population) suffer from osteoporosis in Russia, and 20 million people have osteopenia. Osteoporosis is a multifactorial disease of the skeleton, the main cause of which is an insufficient amount of calcium that enters the body with food. 34 million people in Russia are at risk of osteoporotic fractures. Every year there are 9 million osteoporotic fractures of the peripheral skeleton and 3.8 million cases of vertebral fractures. Every minute there are 7 fractures of the vertebrae and 17 extravertebral fractures in people over 50 years old, every 5 minutes - a fracture of the femoral neck. It should be noted that 90% of all hip and vertebral fractures are associated with osteoporosis. At the same time, fractures of the humerus, ribs, pelvis, ankle and collarbone in 50-70% of cases are osteoporotic fractures [19]. The 2020 audit of osteoporosis in the Russian Federation estimated that between 2010 and 2018, the number of people at high risk of fracture increased by 18% to 40 million, and by 2050 it will increase by another 25% and amount to 50 million people.

Today, osteoporosis is an urgent public health problem and its prevention is possible only with the start of preventive measures from childhood. Basic prevention measures include ensuring a nutritious diet with sufficient calcium intake and, if necessary, calcium supplements.

Developed in addition to [8], the Strategy for Improving the Quality of Food Products in the Russian Federation until 2030 [27] provides for a number of measures to create conditions for the production of new generation food products with specified characteristics. Dairy products are the most suitable market segment for this, as they are one of the most consumed food products in our country. Therefore, the expected result is an increase in the share of production of dairy products enriched with vitamins and minerals, up to 40-50% of the total production [18]. Including due to the production of various types of cheeses enriched with calcium.

Materials and methods.

The purpose of this article is to consider domestic and foreign scientific and technical developments, and technological methods for enriching cheeses with calcium salts and substantiating the feasibility of producing this group of functional dairy products.

The introduction of additional calcium ions into raw milk is a difficult task. The weak solubility of inorganic calcium salts and the interaction of calcium with a protein sensitive to it can lead to coagulation of protein fractions during heat treatment, and a decrease in the nutritional value of milk proteins. Therefore, special attention is paid to the optimal balance of ingredients, the selection of the most acceptable form of calcium, which will increase its absorption by the body. Articles [3, 20] analyzed the evidence base on the bioavailability of organic and inorganic calcium salts, which confirms the possibility of creating a range of cheeses enriched with them.

In our country, scientific developments in the direction of milk enrichment with calcium phosphates in order to partially or completely replace calcium chloride began in the 1960s. In the work of M.A. Bayramkulov, experiments were carried out on the introduction of calcium phosphates into milk and their effect on the quality of rennet clots [1]. As a result, it was concluded that by adding calcium phosphate (single-substituted) to rennet milk, it is possible to increase its gelatinizing properties. At the same time, it thickens the clot, enhances the release of whey, less fat is released with whey, reduces the duration of curdling and processing of the cheese mass by 55-60 minutes. The addition of disubstituted calcium phosphate to milk also helps to increase the gelatinizing ability of milk, improves the quality of rennet clots, reduces the transfer of fat into whey, but to a much lesser extent than with monosubstituted calcium phosphate. The processed cheeses with the addition of calcium phosphate were rated higher than the cheeses with the introduction of calcium chloride.

These findings are supported by more recent studies. During a series of experiments, L.A. Popova, it was found that the introduction of monosubstituted calcium phosphate into milk instead of calcium chloride in an equivalent dose gives the following positive results: a reduction in the duration of milk coagulation by rennet by 15 minutes; the formation of a denser elastic clot; accel-

eration of the grain processing process by 10 minutes; decrease in dry matter content in serum by 4%; an increase in the yield of cheese by 69 kg during the production of 1 ton of cheese [17].

With the development of nanotechnologies in the Russian Federation and the widespread use of nanomaterials in the dairy industry, it became necessary to carry out active work to develop food technologies and prevent the risks of using nanomaterials. In particular, at the All-Russian Scientific Research Institute of Butter and Cheese Making (VNIIMS), studies were carried out on the effect of calcium phosphate nanoparticles in the structure of hydroxyapatite (HAP) on gelation in milk. As a result, the results of earlier studies were confirmed and supplemented by new ones. In the course of experimental studies, it was found that HAP nanoparticles significantly accelerate the process of gel syneresis; partially block the action of the enzyme on kappa-casein; physicochemical processes of enzymatic gelation in milk with the participation of HAP nanoparticles proceed differently than with the participation of calcium chloride; at significant concentrations of HAP, gelation in milk receives an additional, unexplored stage; HAP nanoparticles contribute to the binding of whey proteins; presumably, HA nanoparticles contribute to lactose binding and increased proteolysis [22].

Calcium-containing additives have gained particular popularity in the production of processed cheeses and cheese products. In his scientific work, S.O. Sokhryakov studied the effect of calcium-containing additives on the mineral composition of a processed cheese product [25]. For comparison, “food calcium phosphate (E 341)” (TU 100205847.031-2006), “food calcium citrate (E 333)” (TU 9199-001-0101447096) and a new calcium-containing additive were also added to the samples of the processed cheese product as a mineral fortifier "Calcium-MACG". This ingredient (MACG) is a nanodispersed amorphous modified form of calcium gluconate. The conducted studies have shown that the addition of the mineral enricher Calcium-MACH in the amount of 1.5±0.5% of the total mass of the melting mixture contributes to an increase in the amount of ionized calcium up to 75% with a total amount of 160±5 mg%. When using other mineral enrichers, "Food calcium phosphate (E 341)" and "Food calcium citrate (E 333)", only values of the mass fraction of ionized calcium up to 60% can be achieved. The best efficiency of Calcium-MACG is due to its use in nanoform. Based on the results of the study by S.O. Sokhryakov wrote and successfully defended his Ph.D. thesis in 2012, as a result of which the technology of processed cheese enriched with calcium was developed for feeding schoolchildren and regulatory documentation (STO No. 71063300-001-2012) [26].

A variety of choice of melting salts, both foreign and domestic production, allows you to form a wide range of processed cheeses. The right combination of melting salts largely determines the organoleptic characteristics, nutritional value, safety of the product, as well as its stability in storage.

For the production of processed cheeses, mixtures of phosphates under the trademarks Fonacon and Polifan, which are produced by OJSC REATEX, are widely used. CJSC PKF Slavyanka (Nizhny Novgorod), a relatively young and successfully developing enterprise, has been producing food additives under the brand name PHOSPHO-MIX since 2005 [23]. Also in [21] , popular types of melting salts of domestic production and their most important indicators characterizing safety and efficiency are considered. The authors concluded that the safest melting salts of domestic production are citrates, followed by polyphosphates, the most dangerous are sodium orthophosphates, in particular disubstituted sodium phosphate, since the dose of its introduction is 2–2.5 times higher than the dose of other melting salts.

Sodium citrate salts give processed cheese a clean, pronounced cheesy taste, as well as a pleasant taste of freshness. At the same time, there is no alkaline taste [5]. Special melting salts "Solva" and "Yokha" make it possible to obtain thermostable types of cheese, thereby expanding the circle of consumers [29]. The conducted studies have established that by introducing calcium compounds into the composition of melting salts, which form additional bonds between casein subunits during melting, it is possible to achieve a stronger structure of the finished product, as well as to ensure its thermal stability upon reheating. Food phosphate additive "Fonacon-K-M" in quality and efficiency is not inferior to the salt melter "Solva S 230" [21].

Complex mixtures of melting salts " Cremosal " by " Thermphos " (Great Britain) have good emulsifying properties, perfectly stabilize the protein and increase the shelf life of the finished product due to its antioxidant properties. Their use allows, using various raw materials and, without changing the technological process adopted in the production, to produce a wide range of processed cheeses.

The chemical group "Budenheim" is a well-known name in the dairy world. Phosphates "Budenheim" are used to improve the quality of dairy products and improve the technological process. The choice is quite wide: SELF melting salts make it possible to produce processed cheese with a low sodium content, Budal stabilizers and acidity regulators neutralize the problem of an aggressive increase in acidity and improve the quality of dairy raw materials. "Budals" help to raise the pH - the level of milk, while effectively neutralizing calcium released during the maturation of milk, which can lead to clotting, bacteriostatic salts protect against mold and other troubles, mineral enrichment with preparations of the Levall trademark will contribute to the nutritional the composition of products, especially those in which the natural content of calcium, magnesium, iron, potassium, etc. is insignificant [6].

In recent years, VNIIMS specialists have completed a large cycle of research work on the creation of environmentally friendly structure formers, the main component of which is of an organic nature. Structure formers of two grades have been developed and are being produced: SO-1 and SO-3. They can be used both in the creation of new original products and in the production of traditional processed cheeses. CO-1 is intended for processed cheeses as the main raw material in which rennet cheeses are used, structure formers CO-3 are used for cheeses produced on the basis of cottage cheese. A distinctive feature of the use of structure formers is the achievement of the required physiological ratio of calcium and phosphorus (1, 3:1, 0) by reducing phosphorus in the finished product by 2.0...2.5 times [7].

A group of Canadian scientists conducted studies on calcium enrichment of Cheddar cheese [32]. The aim of the study was to establish a link between the calcium concentration in cheese and the effect on digestion. Enrichment was carried out with $CaCl_2$ at the stage of curd curd salting. The samples were represented by one control and two experimental ones with high and very high calcium content. The study showed that the addition of $CaCl_2$ produced significant organoleptic and physico-chemical changes. The ionic strength and pH increased, the moisture content of the cheese decreased during the pressing stage. The hardness of the cheese increased with the increase in calcium concentration, which resulted in the cheese breaking down more slowly during digestion, however, the lipolysis process became faster, possibly due to increased lipase activity. In the control sample, despite the faster breakdown rates, the lipolysis process was the slowest. Thus, the results showed that lipolysis depends on the content of calcium and the matrix that models the access of enzymes to their substrates. This means that the microstructure and matrix of the food can control the release of lipid nutrients from the cheese. In general, these studies can be adapted in the food industry, in particular, to control the release of nutrients, the extraction of bioactive molecules and as evidence of a positive effect on human health.

It is believed that the high sodium content of cheese causes an acid load on the body, which negatively affects human health. There is a method for reducing the sodium content by partially replacing sodium chloride with alkalizing organic calcium salts [31]. Experiments were carried out using blue-veined cheeses. These cheeses, obtained by replacing 75% NaCl with calcium lactate, contained 33% less sodium. Replacing NaCl with calcium citrate improved the citrate content by 410%. This study revealed a significant effect of salt granulometry on sodium content. When using coarse salt, the decrease in the Na content was 21%. The produced cheese did not differ much in bitter and salty perception compared to the control and can be considered similar in organoleptic characteristics.

Cottage cheese or as it is also commonly called "village cheese" is very popular in Europe and the USA. Due to its high protein content and low fat content, it has a positive effect on human health. However, not every consumer is aware of the low calcium content in Cottage cheese. Therefore, studies were carried out on its enrichment with various calcium salts with taste control

[30]. The cheese to which the hydrocolloid mixtures were added was tested and compared with cheese with an equivalent amount of calcium without hydrocolloid and with cheese without additives. The aim of the study was to increase the calcium content of Cottage cheese without adversely affecting the organoleptic properties. Various hydrocolloids have been used to study their ability to mask the bitter taste of calcium salts.

Preliminary tests showed no difference in the taste of the calcium phosphate-supplemented cheese compared to the control at 28mg per 100g. At a dose of 117mg calcium per 100g, the cheese was rated as sour, slightly chalky, and slightly bitter. Cheese with added calcium lactate was rated the same as the control at 28 mg per 100 g. Taste was slightly sour and chalky at 117 mg per 100 g. addition of 28 mg per 100 g. Calcium lactate was chosen as the source of calcium for subsequent experiments due to its least bitter taste among the salts tested.

Studies also showed that guar gum and locust bean gum can mask the bitter taste of added calcium, but the organoleptic rating of these cheeses was lower than that of the control sample. This is mainly due to the earthy taste of guar gum. The use of purified or more neutral tasting guar may result in a more acceptable product.

Yaroslavl State Medical Academy (YaGMA), together with VNIIMS, developed a cheese paste based on whey, which included calcium in the form of carbonate and citrate salts in a daily dose of 1000 mg in terms of calcium element and vitamin D_3 in a dose of 400 IU / day The use of such a product, enriched with calcium and vitamin D_3 for 12 months, according to studies, led to an increase in BMD in the spine. It is an effective, safe and well tolerated product that can serve as an additional tool for the prevention and treatment of osteoporosis [4].

Most preferably, from a technological point of view, the process of cheese enrichment with calcium is carried out at the stage of milk preparation. Therefore, the following series of patents may be applicable in the production of calcium fortified cheese. Thus, patent RU2202213 C2 [12] describes a complex formed by a calcium salt and alkali metal citrate, which makes it possible to enrich milk drinks and other dairy products without coagulation and precipitation and with improved taste properties. The soluble calcium salt component may be, for example, calcium gluconate or calcium chloride, but calcium lactate is preferred. The alkali metal citrate may be sodium citrate or other food acceptable alkali metal citrate, but potassium citrate is preferred. The components of the complex can be added to a liquid food product such as milk or milk drink, either simultaneously or one after the other, and then they interact to form the complex.

Known patent RU 2541760 C1 "Method of preparing milk for making cheese" [15], according to which, in order to increase cheese suitability, monosubstituted sodium phosphate is added to milk in the form of a solution with a concentration of 35 ± 5% after the addition of calcium chloride in an amount of 0.025 ± 0.015% in the form of a solution concentration 35±5%. The amount of monosubstituted sodium phosphate varies depending on the purpose of use: to increase the cheese suitability of milk with its low titratable acidity - from 0.01 to 0.03%; to accelerate the ripening of cheese and increase the plasticity of the cheese mass - from 0.03 to 0.05% of the feedstock.

The description of the invention to the patent RU 2218800 C 2 [11] refers to a calcium complex obtained as a result of the interaction of a calcium source and a negatively charged emulsifier in the presence or absence of an organic or inorganic acid, or their salts. The calcium source can be calcium hydroxide, calcium carbonate, calcium chloride, calcium phosphate, etc. The negatively charged emulsifier may be an ester of citric acid or monoglycerides, stearoyl lactylate as a sodium, calcium or acid salt, etc. It can also be hydrated. The calcium complex may be dried.

In patent RU 2254033 C2 [13], the authors developed a lactate-citrate calcium complex with a low calcium content, which is formed by reacting a suspension of an alkaline source of calcium, such as calcium hydroxide, calcium oxide or calcium carbonate, with a solution of lactic or citric acids. The complex can be used to fortify milk, milk drinks, dairy products, nutritional drinks and baby food without protein coagulation or salt precipitation and with improved taste due to the absence or slight taste resulting from the presence of potassium ions.

Patent RU 2265338 C2 [10] speaks of an enriching amount of a non-ionic source of calcium and a food grade polyphosphate having at least six phosphate groups. The non-ionic source of calcium includes: calcium, hydrolyzed pectin, calcium citrem, lactate-citrate calcium complex, or a balanced mixture of calcium lactate and calcium carbonate. EFFECT: invention makes it possible to prevent coagulation of milk proteins, gelation during storage of milk for two months and precipitation of calcium when it is added to the product.

Patent RU 2428057 C2 [14] describes a stable calcium composition. It includes at least one calcium source, at least one citrate source, and at least one metal source selected from an alkaline earth metal other than calcium and an alkali metal.

Patented RU 2673134 C2 [16] is a method for the production of soft cheese, during the production of which, before adding a milk-clotting preparation, a suspension of calcium phosphate nanoparticles in the form of hydroxyapatite is introduced into the milk mixture. Hydroxyapatite nanoparticles in suspension have sizes from 2 to 20 nm, and their amount relative to the mass of the milk mixture is 0.02-0.08%. EFFECT: invention allows to reduce the gelation time, increase the elastic modulus of the gel, reduce the mass fraction of moisture, and also increase the mass fraction of lactose and calcium in the resulting cheese.

US2003/0021873 A1 describes an invention aimed at improving the disadvantages associated with cellulosic anti-caking agents while further fortifying the cheese product, thereby increasing nutritional value in the form of calcium fortification. It has been observed that fortification over time reduces the drying out of the product. In the present invention, powdered calcium such as calcium carbonate or calcium sulfate is added to the cheese after it has been ground. The addition of calcium reduces product clumping in the package while adding nutritional value to the product [37].

Another invention is protected by patent RU 2235482 C 2 [9] a mixture of balanced calcium lactate and calcium carbonate stabilized by a source of glucuronic acid. The mass ratio of calcium lactate and calcium carbonate may be from 1:2 to 3:1. The food product may be milk or a milk-based product. The source of glucuronic acid can be gum arabic.

Using the calcium enrichment system according to the invention protected by the Austrian patent AU 20011031323 [33], it is possible to obtain calcium-enriched cheese and dairy products without a significant impact on organoleptic properties. The invention provides a method for preparing aromatic, organoleptically pleasing cheeses and dairy products, including natural cheeses, which contain significant amounts of calcium supplements. More specifically, the calcium supplement of the present invention is a mixture of calcium sulfate and tricalcium phosphate. Using a mixture of calcium sulfate and tricalcium phosphate surprisingly and substantially eliminates the bitterness normally associated with tricalcium phosphate.

This method of enriching cheeses with calcium is protected by patents from different countries. Canadian patent CA 2342043 dated 2004.11.23 [34], Mexican patent MX PA0100348 A [36], EU patent EP 1 138 207 A3 dated 2002.09.25 [35], US patent US 6,326,038 B1 dated 2001.12.04 [38].

There is a domestic version of a mixture of calcium salts of biogenic origin, produced by the Stavropolsky dairy plant under the brand name LaktoMin. It should be noted that this product can surpass foreign analogues in nutritional status, since, being essentially a sedimentary part of milk molasses, it contains not only phosphates, citrates and calcium lactates, but also substances characteristic of molasses with an intermediate molecular weight (vitamins , hormones, polypeptides, amino acids, etc.) [28]. Positive results of its complex impact on the organism of animals have already been obtained. The study of the influence of the mineral supplement "LaktoMin" on the human body is a promising direction in the search for ways to use it. The results of the research will be the subject of future publications.

Conclusion

An analysis of existing domestic and foreign methods for enriching cheeses with calcium salts confirms the need for further improvement and development of such technologies. The pro-

spects for their use are due to the attention on the part of the state to the problems of the increase in the incidence of osteoporosis in the population of the Russian Federation associated with low consumption of dairy products. The cheese market is the most dynamically developing cluster of the food industry. Cheese consumption in Russia is growing steadily. In this regard, it is important to note the choice of cheese for the development of a functional product. However, despite the demand for the product, the market is still far from saturation in terms of quality and quantity. Therefore, in order to achieve the goals and objectives of the "Strategy for the Development of the Food and Processing Industry of the Russian Federation for the period up to 2030" [27], it seems possible to expand the range of cheeses through the introduction of modern bionanotechnologies that increase not only the nutritional value of cheeses, but also the biological value. Mass production of functional types of cheese is the immediate prospect for the development of the dairy industry.

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ТЕПЛОФИЗИЧЕСКИЕ ХАРАКТЕРИСТИКИ И ПЛОТНОСТЬ ГЕКСАНОВОГО РАСТВОРА ПАРАФИНА, КАК ОБЪЕКТА КОНВЕКТИВНОГО КОНЦЕНТРИРОВАНИЯ И ПОЛУЧЕНИЯ ПИЩЕВОГО ПАРАФИНА

THERMAL CHARACTERISTICS AND DENSITY OF HEXANE PARAFFIN SOLUTION AS AN OBJECT OF CONVECTIVE CONCENTRATION AND OBTAINING FOOD PARAFFIN

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Аннотация. *Для пленочных структур, идущих на производство биоразлагаемых упаковочных материалов и являющимися по своей природе гидрофильными, снизить влияние внешних факторов, в первую очередь влаги, позволит их парафинизация, т.е. нанесение на поверхность пленки тонкого слоя расплавленного пищевого парафина для последующей защиты упакованных пищевых продуктов от воздействия влаги и солнечных лучей. При производстве влагоотталкивающих композиций большое внимание уделяется качеству исходного базового для получения пищевого парафина, где одним из важных его показателей безопасности является отсутствие в нем канцерогенных ароматических углеводородов. Одними из основных характеристик исследуемого материала с учетом поставленной цели являются его плотность* ρ *и теплофизические характеристики (ТФХ).*

Материалы и методы, результаты и обсуждения

Целью исследования послужило выявление закономерностей варьирования ТФХ и ρ *в диапазонах изменения температуры и концентрации гексанового раствора парафина, соответствующих конвективному концентрированию при выработке пищевого парафина. Объектами исследования являлись гексанопарафиновая смесь и очищенный от канцерогенных ароматических углеводородов парафин. Плотность определялась пикнометрическим способом, а ТФХ методом комплексного их определения для сыпучих, жидких и пастообразных образцов, базирующимся на инерционности термического датчика температур. Что касается гексанового раствора, то экспериментальные исследования показали, что наиболее рациональными условиями его получения являются: температура растворителя 40°С, с учетом температуры плавления образца и интенсификации испарения растворителя; соотношение технического парафина и растворителя 1:10, что обусловлено практически полной растворимостью парафина. Для осуществления тепловых расчетных процедур при проектировании аппаратов аналитически и опытным путем найдены ТФХ и* ρ *гексанопарафиновой композиции в определенных границах варьирования количества растворителя в ней и ее* T*, которые обусловливают способ конвективного концентрирования исследуемого материала.*

Заключение

Приведенные данные не входят в конфликт с известными результатами других исследователей, подтверждены экспериментально и следственно могут быть использованы в инженерной практике.

Ключевые слова:

гексанопарафиновая смесь, водоотталкивающее покрытие, парафинизация, пищевой парафин, канцерогенные ароматические углеводороды, конвективное концентрирование, теплофизические характеристики, плотность объекта исследования.

Abstract

For film structures that are used for the production of biodegradable packaging materials and are hydrophilic in nature, the influence of external factors, primarily moisture, will be reduced by their paraffinization, i.e. applying a thin layer of molten food paraffin to the surface of the film for subsequent protection of packaged food products from moisture and sunlight. In the production of moisture-repellent compositions, much attention is paid to the quality of the initial base for the production of food paraffin, where one of its important safety indicators is the absence of carcinogenic aromatic hydrocarbons in it. One of the main characteristics of the material under study, taking into account the set goal, are its density and thermophysical characteristics (TPC).

Matrials and methods, results and discussions

The aim of the study was to identify the regularities in the variation of TPH and in the ranges of temperature and concentration of a hexane paraffin solution corresponding to convective concentration during the production of food paraffin. The objects of study were a hexane-paraffin mixture and paraffin purified from carcinogenic aromatic hydrocarbons. The density was determined by the pycnometric method, and the TPC was determined by the method of their complex determination for bulk, liquid and pasty samples, based on the inertia of a thermal temperature sensor. As for the hexane solution, experimental studies have shown that the most rational conditions for its preparation are: the temperature of the solvent is 40 ° C, taking into account the melting point of the sample and the intensification of solvent evaporation; the ratio of technical paraffin and solvent 1:10, which is due to the almost complete solubility of paraffin. For the implementation of thermal calculation procedures in the design of apparatuses, TPH and a ρ hexanoparaffin composition were found analytically and experimentally within certain limits of varying the amount of solvent in it and T , which determine the method of convective concentration of the test material.

Conclusion

The given data do not conflict with the known results of other researchers; they have been confirmed experimentally and, consequently, can be used in engineering practice.

Key words: hexane-paraffin mixture, water-repellent coating, paraffinization, food paraffin, carcinogenic aromatic hydrocarbons, convective concentration, thermophysical characteristics, density of the object of study.

Введение

Для пектиносодержащих пленочных структур, идущих на производство биоразлагаемых упаковочных материалов и являющимися по своей природе гидрофильными, снизить влияние внешних факторов, в первую очередь влаги, позволит их парафинизация, т.е. нанесение на поверхность пленки тонкого слоя расплавленного пищевого парафина для последующей защиты упакованных пищевых продуктов от воздействия влаги и солнечных лучей. При производстве влагоотталкивающих композиций большое внимание уделяется качеству исходного базового для получения пищевого парафина, где одним из важных его показателей безопасности является отсутствие в нем канцерогенных ароматических углеводородов [1].

Одними из основных характеристик исследуемого материала с учетом поставленной цели являются его плотность ρ и теплофизические характеристики (ТФХ).

Цель исследования

Выявление закономерностей варьирования ТФХ и ρ в диапазонах изменения температуры и концентрации гексанового раствора парафина, соответствующих конвективному концентрированию при выработке пищевого парафина.

Объекты и методы исследования

Плотность для гексанового раствора парафинового продукта (ПП) и очищенного парафина после удаления из него растворителя вместе с растворенными в нем токсичными летучими компонентами, в частности бенз-α-пиреном, в границах варьирования температуры (T) от 273 °К до 318 °К для ПП и н-гексана меняется малозаметно и по этой причине в этих пределах T можно осуществить единичный опыт пикнометрическим способом [2, 3, 4].

В процессе конвективного концентрирования из гексанового раствора парафина получается пищевой ПП, причем величина ρ изначального и итогового образца отличается по причине варьирования доли н-гексана в них. В данном варианте можно эмпирически найти для них ρ, а ρ с приемлемой погрешностью определить путем линейной аппроксимации в пределах ее варьирования от исходной гексано парафиновой композиции до очищенного ПП.

В работах [5, 6] предложен метод комплексного определения ТФХ сыпучих, жидких и пастообразных образцов, базирующийся на инерционности термического датчика T. Посредством такого подхода возможно оперативно найти теплоемкости c_M, тепло-λ и температуропроводность a образца в течение технологической операции. Ни один из известных других зондовых способов нахождения ТФХ не дает такой возможности [7].

С целью осуществления опытной серии по определению ТФХ гексанопарафиновой композиции использовался электронный термометр «ЛТ-300», где чувствительной частью служит пленочное платиновое покрытие керамической поверхности, которое обладает высокой воспроизводимостью T и длительной устойчивостью. Ниже на рисунке 1 представлена схема экспериментальной установки.

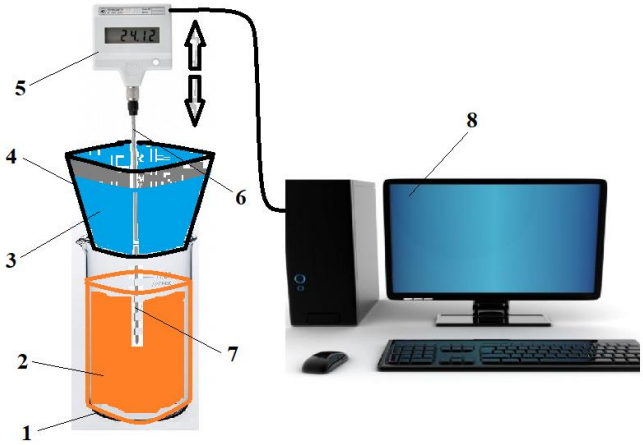

Рисунок 1. Схема экспериментальной установки:
1 – стакан для исследуемого материала; 2 – материал, имеющий температуру внешней среды; 3 – вода со льдом для поддержания низкой температуры, близкой к 0°С;
4 – бумажный стакан; 5 – ЛТ-300; 6 – щуп измерительный в начальном положении;
7 – щуп измерительный в конечном положении; 8 – ЭВМ с программой ThermoChart

Порядок проведения эксперимента следующий. T водоледяной композиции в емкости из бумаги достигает 1…4°С, после чего активизируется программное обеспечение ThermoChart, которое с помощью «ЛТ-300» фиксирует T на компьютерном мониторе.

Далее образец с T окружающей его среды, погружается в резервуар для изучения, над которым находится емкость из бумаги с зондом и водоледяной композицией. Далее датчик соединяется с компьютером, на мониторе которого фиксируется варьирование T, и оперативно протыкается дно емкости из бумаги и зонд проникает в образец.

Последующее нахождение ТФХ гексанового раствора предопределяет нахождение их зависимостей от величины $C_Г$ в диапазоне $0,00 \le C_Г \le 0,91$ кг/кг. Изменение теплоемкости при варьировании концентрации растворителя в исследуемом растворе можно с допустимой точностью принять линейным, поэтому информация о величине этого параметра в нескольких, как минимум в двух точках, дает возможность получить аппроксимирующую зависимость c_M от $C_Г$ в заданном диапазоне, используя методы экстра- или интерполяции. Что касается коэффициента теплопроводности, то его изменение в зависимости от величины $C_Г$ в заданном диапазоне может быть определено методом линейной аппроксимации между крайними точками диапазона $C_Г$, где точкой отсчета служит известное значение λ для пищевого парафина. A служит комплексным расчетным параметром с учетом 3-х выше обозначенных, поэтому получить искомую зависимость для этой характеристики целесообразно расчетным путем [7, 8].

Информация о величине коэффициента теплоемкости исследуемого раствора при фиксированных значениях его $C_Г$ была получена экспериментальным путем на опытной установке, представленной на фотографии (рис. 2). Следует отметить, что данная установка обладает рядом преимуществ по сравнению, например, с адиабатическим калориметром, а именно: конструктивной простотой, оперативностью замены изучаемых проб и низкой погрешностью измерений.

Применяемый способ опирается на точное нахождение калориметрической константы K, обусловленной теплопотерями, посредством высокочувствительной схемы измерения даже малозначительных (порядка 2°К) варьирований T пробы и всего лишь за несколько минут провести замер.

Опытный стенд (рис. 2) скомпонован из термического и измерительного отсеков, первый из которых является термосом, в который загружаются изучаемые пробы, а 2-ой скомпонован из схем питания, замера разности электрических потенциалов и силы тока в нагревательном узле и регистрации T во времени.

Принципиальная схема опытной установки приведена на рисунке 3.

Рисунок 2. Опытный стенд для определения теплоемкости жидких материалов

K находится из табулированных водной c_M и зависит от T, что целесообразно установить в опытной серии при варьировании T в термостате.

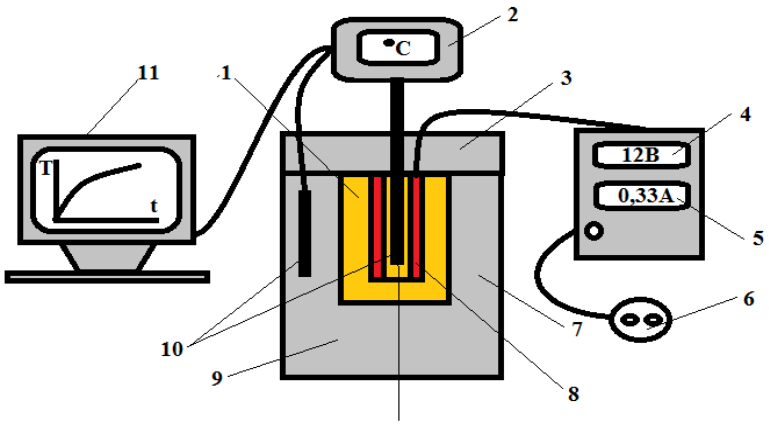

Рисунок 3. Принципиальная схема опытной установки для определения теплоемкости жидких материалов: 1 – исследуемый жидкий материал; 2 – дисплей термодатчика; 3 – крышка калориметра; 4 – вольтметр; 5 – амперметр; 6 – источник питания; 7 – калориметр (термос); 8 – электронагреватель; 9 – теплоизоляционный материал; 10 – термопары; 11 – ЭВМ.

Данные при варьировании T в пределах 25…40 °С приведены в публикации [9], а вследствие малозаметного изменения в данных пределах варьирования T приемлемо считать ее равной 15,3 Дж. Итоговое соотношение для нахождения c_M жидкого материала на установке, представленной на рисунке 2 имеет следующий вид:

$$c_M = \frac{U \cdot I \cdot \Delta\tau - K}{M_{обр} \cdot \Delta T}, \quad (1)$$

где U – подаваемое напряжение на нагреватель, В; I – сила подаваемого тока, А; $\Delta\tau$ – время за которое образец изменил свою температуру ΔT, с; K – константа калориметра, Дж; $M_{обр}$ – масса образца, кг.

Опыт дублируется как минимум трижды и полученные данные табулируются [5] и вычисляются ТФХ.

Результаты исследования и их обсуждение

Что касается самого гексанового раствора, то экспериментальные исследования показали (табл. 1), что наиболее рациональными условиями его получения являются: температура растворителя 40°С, с учетом температуры плавления образца и интенсификации испарения растворителя; соотношение технического парафина и растворителя 1:10, что обусловлено практически полной растворимостью парафина.

На рисунке 4 представлены фотографии полученного гексанового раствора, имеющего концентрацию сухих веществ 9,1% и полученного очищенного парафина из него, в котором практически отсутствуют н-гексан и токсичные вещества, удаленные вместе с ним.

Опытные данные по ρ полученного гексанового раствора и конечного ПП сведены в таблице 2.

Таблица 1

Результаты экспериментальных исследований по растворению технического парафина в н-гексане при его различных температурах

Температура растворителя t, °С	**Масса тех. парафина $m_п$, г.**	**Масса растворителя $m_р$, г.**	**Модуль, $m_п/m_р$**	**Продолжительность процесса τ, мин**	**Нерастворимый остаток $m_{ос}$, г**
30	25	150	1:6	120	≈8,5
30	25	200	1:8	120	≈4,7
30	25	250	1:10	120	≈2,9
40	25	150	1:6	120	≈7,2
40	25	200	1:8	120	≈3,4

40	25	250	1:10	120	≈0,4
50	25	150	1:6	120	≈6,5
50	25	200	1:8	120	≈2,8
50	25	250	1:10	120	≈0,3

а *б*

Рисунок 4. Фотографии по результатам исследования растворения технического парафина в н-гексане: *а* – полученный раствор при рациональных условиях проведения процесса; *б* – полученный пищевой парафин, взвешенный в этиловом спирте

Таблица 2

Плотность гексанового раствора и пищевого парафина

Наименование	**Плотность ρ , кг/м^3**
Гексановый раствор парафина, концентрация сухих веществ 9,1%	649±3
Пищевой парафин, полученный методом конвективного концентрирования исходного раствора, в котором практически отсутствуют н-гексан и токсичные вещества, удаленные вместе с ним	898±3

На рисунке 5 представлен график зависимости физической плотности ρ при 273…318 °К и концентрации растворителя от 0,91 до 0 кг/кг. В основном плотность образца зависит от его химсостава и преимущественно от соотношения растворителя и растворенных веществ в нем.

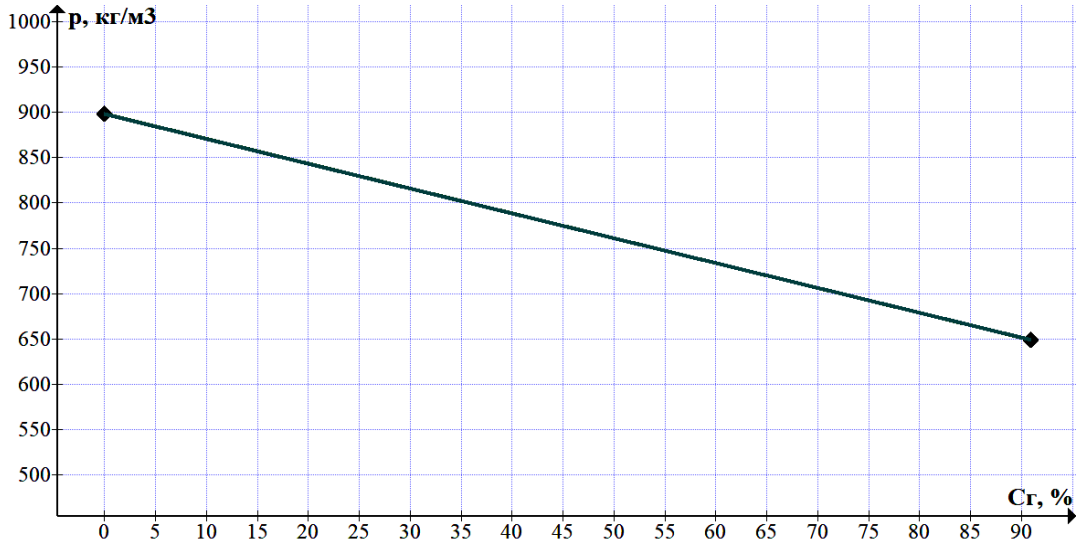

Рисунок 5. График зависимости плотности исследуемого раствора от концентрации растворителя в нем, в интервале температур 273…318°К

График, представленный на рисунке 5, линейно аппроксимирован для диапазона концентрации растворителя в исследуемом гексановом растворе: $0,00 \le C_Г \le 0,91$ кг/кг при T от 273 до 318°К:

$$\rho = 898 - 2,7392 C_Г, \quad (2)$$

где $C_Г$ – относительное содержание н-гексана с растворенными в нем токсичными веществами в объекте исследования, %.

В итоге для растворенного технического парафина в н-гексане, при его концентрации в растворе 91%, были получены следующие средние значения искомых величин, представленные в таблице 3.

Опытные данные по $C_М$ для объекта исследования представлены в таблице 4. Дальнейшее изменение теплоемкости раствора было получено, используя методы экстра- или интерполяции.

Таблица 3

Результаты по экспериментальному определению ТФХ объекта исследования

Концентрация $C_Г$,%	**Удельная теплоемкость $C_М$, Дж/(кг·К)**	**Температуропроводность $a \cdot 10^8$, м²/с**	**Коэффициент теплопроводности, λ, Вт/(м·К)**
≈91	≈2321	≈22,59	≈0,34

Таблица 4

Значения коэффициента теплоемкости исследуемого раствора при разных концентрациях растворителя

Концентрация образца $C_Г$, %	**Удельная теплоемкость образца $C_М$, Дж/(кг·К)**
91	2321
80	2413
70	2421
60	2477
50	2576

На рисунке 6 показана зависимость $C_М$ при 273…318°К и концентрации растворителя от 0,91 до 0 кг/кг.

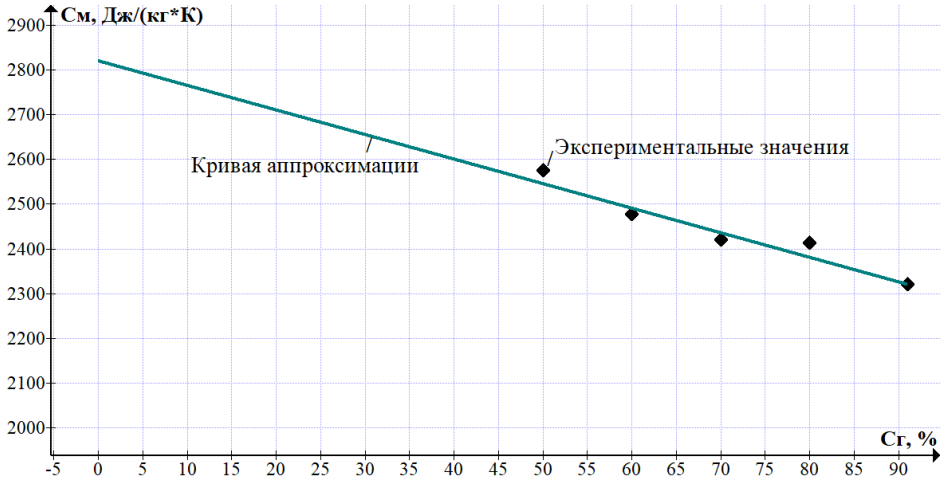

Рисунок 6 – График зависимости теплоемкости исследуемого раствора от концентрации растворителя в нем, в интервале температур 273…318°К

Построение графика 6 осуществляли по аппроксимированному соотношению для $0,00 \le C_Г \le 0,91$ кг/кг и T 273 до 318°К:

$$C_М = 2820 - 5,4835 C_Г. \quad (3)$$

λ не подчиняется правилу аддитивности, поэтому необходим иной подход к выявлению его зависимости от $C_Г$. Практически полная растворимость технического парафина в н-гексане наблюдается ориентировочно при их соотношении 1 к 10, при котором был экспериментально определен коэффициент теплопроводности данного раствора (табл. 3). Следует отметить, что при увеличении содержания технического парафина в растворителе выше данного порога общая смесь представляет собой уже не раствор, а неоднородную систему, вследствие его частичной растворимости, поэтому с целью получения зависимости коэффициента теплопроводности от величины $C_Г$, нужной для моделирования процесса конвективного концентрирования, необходимо определиться с его значениями в двух точках, одна из которых соответствует чистому пищевому парафину ($\lambda = 0,26$ Вт/(м·°К) [10]), а вторая – раствору с граничным относительным содержанием растворителя ($\lambda = 0,34$ Вт/(м·°К)).

Ввиду невозможности экспериментального определения промежуточных значений коэффициента теплопроводности между этими точками достаточно будет провести между ними приблизительную линейную аппроксимацию (рис. 7).

Обоснованность такого допущения можно будет определить путем сравнения результатов решения математической модели конвективного концентрирования гексанового раствора с эмпирическими данными по температурным режимам и кинетике этого процесса. Ниже представлена аппроксимированная линейная зависимость коэффициента теплопроводности от $C_Г$ в диапазоне: $0,00 \le C_Г \le 0,91$ кг/кг и T от 273 до 318°К:

$$\lambda = 0,00088 C_Г + 0,26, \qquad (4)$$

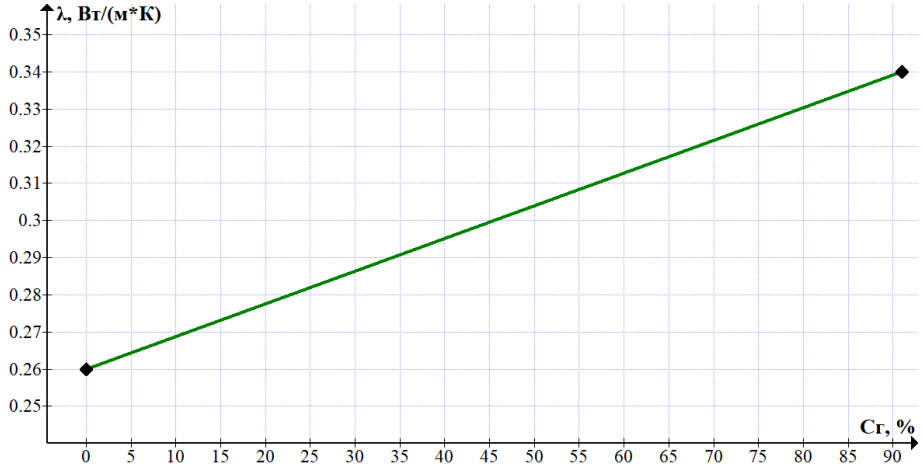

Рисунок 7. График зависимости коэффициента теплопроводности исследуемого раствора от концентрации растворителя в нем, в интервале температур 273…318°К

где $C_Г$ – относительное содержание н-гексана с растворенными в нем токсичными веществами в объекте исследования, %.

a для $C_Г$ исследуемого раствора от 0,0 до 0,91 кг/кг определяется известным соотношением: $a(C_Г) = \dfrac{\lambda(C_Г)}{c(C_Г)\rho(C_Г)}$, для которого математические зависимости величин $\lambda = f(C_Г)$, $c = f(C_Г)$ и $\rho = f(C_Г)$ уже известны.

Ниже, на рисунке 8, представлен график этой зависимости для исследуемого раствора в заданных интервалах температур и относительного содержания н-гексана в нем.

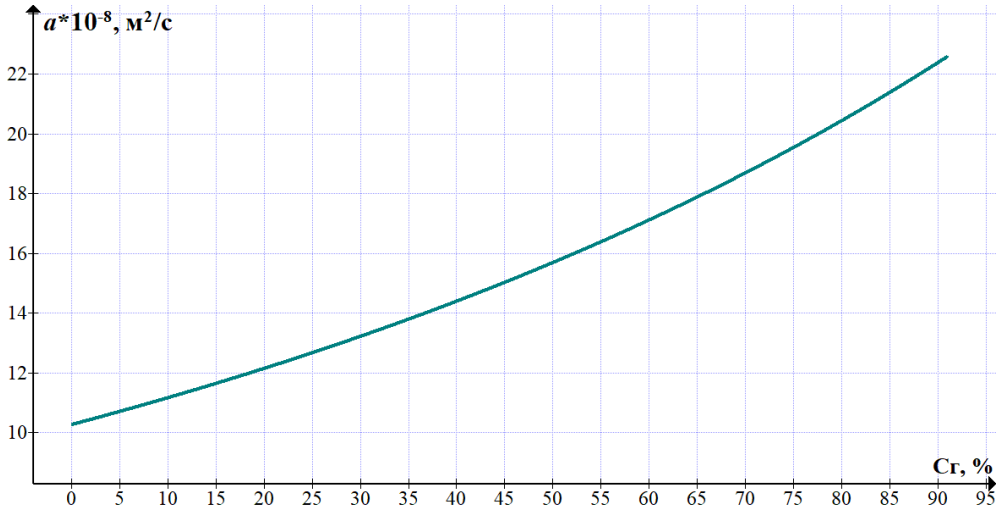

Рисунок 8. График зависимости коэффициента температуропроводности исследуемого раствора от концентрации растворителя в нем, в интервале температур 273…318°К

Вывод

Для осуществления тепловых расчетных процедур при проектировании аппаратов аналитически и опытным путем найдены ТФХ и ρ гексанопарафиновой композиции в определенных границах варьирования количества растворителя в ней и ее T, которые обусловливают способ конвективного концентрирования исследуемого материала.

Приведенные данные не входят в конфликт с известными результатами других исследователей, подтверждены экспериментально и следственно могут быть использованы в инженерной практике.

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МАТЕМАТИЧЕСКОЕ ОБОСНОВАНИЕ РАБОТЫ ЭЛЕМЕНТОВ ЭКСТРАКЦИОННОЙ УСТАНОВКИ

THE MATHEMATICAL JUSTIFICATION OF THE EXTRACTION PLANT ELEMENTS OPERATION

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Аннотация

Описан принцип работы экстракционной установки с CO_2-экстрактором, испарителем, конденсатором и пульсатором. Особенностью установки является возможность использования мисцеллы в качестве растворителя. В условиях объёмного кипения растворителя проведён расчёт испарителя для разделения мисцеллы.

Матриалы, методы, результаты и обсуждения

Цель исследований – оптимизация параметров работы экстракционной установки для получения CO_2-экстрактов. Описан принцип работы экстракционной установки с CO_2-экстрактором, испарителем, конденсатором и пульсатором. Представлена структурная схема производства CO_2-экстрактов. Особенностью установки является возможность использования мисцеллы в качестве растворителя. Теплофизические характеристики процессов теплообмена рассчитываются без учёта влияния локальных скоростей жидкого и газообразного CO_2 на характеристики кипения и конденсации, учитывая только объёмный характер кипения и поверхностной конденсации в условиях взаимодействия с трубными теплообменными элементами. В условиях объёмного кипения растворителя проведён расчёт испарителя для разделения мисцеллы.

Заключение

Полученная информация может быть использована при проектировании газожидкостных установок.

Ключевые слова: CO_2-экстрактор, испаритель, конденсатор, пульсатор, теплофизические характеристики.

Abstract

The aim of the research is to optimize the parameters of the extraction plant for the production of CO_2 extracts. The principle of operation of the extraction unit with a CO_2 extractor, evaporator, condenser and pulsator is described. A block diagram of the production of CO_2 extracts is presented.

Matrials, methods, results and discussions

A special feature of the installation is the possibility of using miscella as a solvent. The thermophysical characteristics of heat exchange processes are calculated without taking into account the influence of local velocities of liquid and gaseous CO_2 on the boiling and condensation characteristics, taking into account only the volumetric nature of boiling and surface condensation in the conditions of interaction with pipe heat exchange elements. Under the conditions of volu-

metric boiling of the solvent, the calculation of the evaporator for the separation of the miscella is carried out.

The information obtained can be used in the design of gas-liquid installations

The principle of operation of the extraction unit with a CO_2 extractor, evaporator, condenser and pulsator is described. A special feature of the installation is the possibility of using miscella as a solvent.

Conclusion

Under the conditions of volumetric boiling of the solvent, the calculation of the evaporator for the separation of the miscella is carried out.

Key words: CO_2 extractor, evaporator, condenser, pulsator, thermophysical characteristicsю

Introduction . The use of liquefied gases as solvents for valuable components of plant raw materials is one of the promising areas of work for extraction enterprises. Significant progress in this direction has been achieved by scientists and specialists of the scientific and pedagogical school "Scientific foundations and practical implementation of the processing of agricultural raw materials with liquefied and compressed gases" created at KubGTU under the scientific guidance of Professor Kasyanov G.I. In order to optimize the production processes for the production of CO_2 -extracts, mathematical modeling methods were used [1]. Gas-liquid technologies for extracting valuable components from raw materials have their own specific features [2]. The resulting food additives in the form $_{of\ CO2}$ extracts have an antibacterial effect on a number of pathogenic microorganisms [3]. In addition to the target products in the form of CO_2 -extracts, an additional product is obtained - CO_2 -meal, which is a carbohydrate-protein-lipid additive [4].

Participants of the scientific and pedagogical school, on the eve of the 100th anniversary of KubGTU in 2018, published materials about their achievements [5, 9, 10]. Information about the features of obtaining and using extracts from the standpoint of system analysis is presented [6, 7]. Thus, carbon dioxide, known for its properties as a refrigerant, is confidently gaining the position of an extractant [8].

Materials and methods.

Figure 1 shows a block diagram of the production of CO_2 -extracts, developed with the participation of the authors, which differs from the known system of using GZh-miscella as a solvent.

Let us present the thermophysical characteristics of carbon dioxide used in the system as a solvent. CO_2 pressure in the flow path of the plant Pn = 6.4 MPa. This corresponds to the saturation temperature t_n = 24.7 ° C. Liquid density ρ ” = 718 kg / m ^{3} , vapor density ρ ' = 240 kg / m ^{3} . Specific heat of vaporization r = 123.5 kJ/kg. Dynamic viscosity for steam η ' = 2·10 $^{-5}$ Pa· c , for liquid η ” = 6·10 $^{-5}$ Pa·s. Steam kinetic viscosity ν ' = 8.3 · 10 $^{-8}$ m ^{2} /s, for liquid ν ” = 8.3 · 10 $^{-8}$ m ^{2} / s . Steam thermal conductivity λ ” = 35 · 10 $^{-3}$ W/(m·K). Prandtl number Pr = $\frac{Cp \cdot \mu}{\lambda}$; couple pr ' = 6.0, liquid Pr ” = 5.0 Heat capacity with $_p$ = 3.3 · 10 ^{3} J/(kg·K). Critical parameters of CO_2 Pcr =7.3 MPa ; Tkr =304 K. Characteristics of heating water and cooling liquid : density ρ = 965 kg / m ^{3} , heat capacity C_{in} = 4.2·10 ^{3} J/(kg·K). Thermal conductivity of water λ_{in} = 0.65 W/(m·K) coolant λ_{oh} = 0.55 W/(s m·K). Kinematic viscosity of water ν_{in} = 4.43·10 $^{-7}$ m ^{2} / s , coolant ν_{oh} \u003d 1.5 · 10 $^{-6}$ m ^{2} / s. Prandtl number of water Pr = 3, Coolant Pr = 11.4.

The thermophysical characteristics of heat transfer processes are calculated without taking into account the influence of local velocities of liquid and gaseous CO_2 on the characteristics of boiling and condensation, taking into account only the volumetric nature of boiling and surface condensation under conditions of interaction with pipe heat exchange elements.

Results and discussion.

When calculating the characteristics of the evaporator, which is part of the extraction unit, the following data were used. The temperature of the heating water t_{in} \u003d 65 ° C. Water consumption *G* in = 0.28 kg/ s (1 m ^{3} /g), heat exchange surface *F* = 0.62 m ^{2}. Let us determine the

coefficient of heat transfer from water inside the pipes. Number of pipes n = 7, water speed inside the pipe:

$$V = \frac{G_B/2}{n\frac{\pi d^2}{4}S} = \frac{2G_B}{n\pi d^2 S} \quad (1)$$

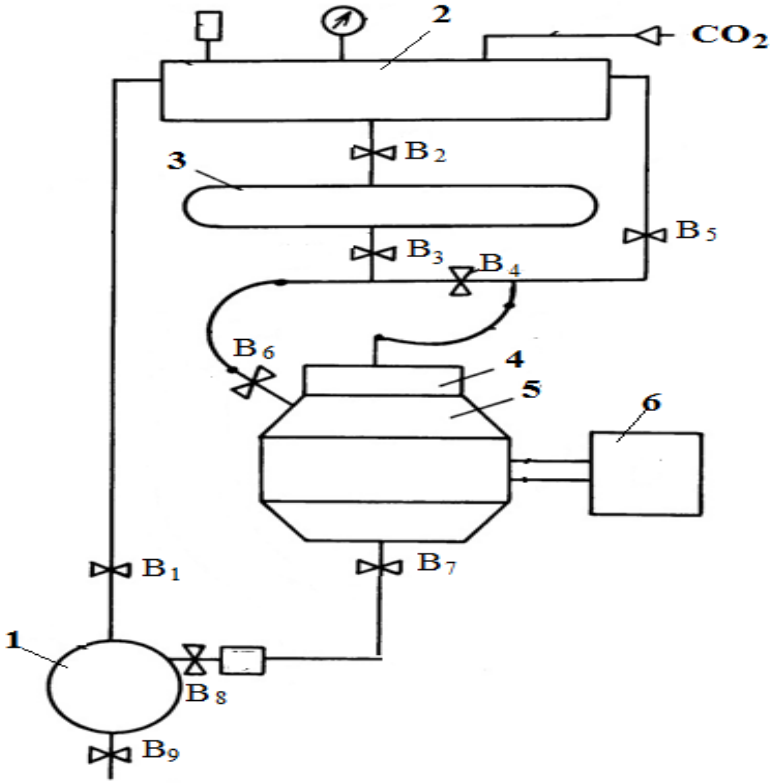

Fig. 1. Structural scheme for the production of CO 2 -extracts: 1 - evaporator, 2 - condenser, 3 - collector, 4 - hatch, 5 - extractor, 6 - pulsator

Here, half the flow rate G B /2 is taken for each of the symmetrical water inlets. Substituting the inner diameter *d* = 20 mm \u003d 2 · 10 -2 m , we get the water speed:

$$V = \frac{2 \cdot 0,28}{7 \cdot 3,14 \cdot \left(2 \cdot 10^{-2}\right)^2 \cdot 965} = 0,066 \text{ m/s} \quad (2)$$

The Reynolds number is used in the case of a change from the laminar regime of the flow of heating water in the apparatus to turbulent

$$\mathrm{Re} = \frac{Vd}{\nu_B} = \frac{0,066 \cdot 2 \cdot 10^{-2}}{4,43 \cdot 10^{-7}} = 2980 \quad (3)$$

Since 2.1 · 10 3 < Re < 10 4 , then the flow regime: transitional from laminar to turbulent. In this case, the Nusselt number for the heat transfer of water in the pipe is determined using the extrapolation formula:

$$N_u = N_{ul}\left(\frac{\mathrm{Re}}{2100}\right)^{0,64\ln\left(N_{um}/N_{ul}\right)} \quad (4)$$

where the number $N_{u\,l}$ *is* the Nusselt number in the laminar flow regime, $N_{u\,m}$ is the Nusselt number in the turbulent regime with the Reynolds term Re = 10 4 . For laminar flow in a pipe and at a constant target heat flux $N_{u\,l}$ = 4.36. For turbulent flow in a pipe:

$$N_{u\,t} = 0.023\ \mathrm{Re}^{0.8}\ \mathrm{Pr}^{0.4} = 0.023 \cdot (104)^{0.8} \cdot 3^{0.4} = 56.6 \quad (5)$$

The resulting Nusselt number for the heat transfer of water in a pipe

$$N_u = 4,36 \cdot \left(\frac{2980}{2100}\right)^{0,64\ln\left(56,6/4,36\right)} = 7.74 \quad (6)$$

From the definition of the Nusselt number $N_u = \frac{\alpha_{mp} \cdot d}{\lambda}$, where α_{tr} is the heat transfer coefficient from water to the pipe, d - pipe diameter, λ - thermal conductivity of water, we get the heat transfer coefficient from water to the pipe

$$\alpha_{mp} = N_u \cdot \frac{\lambda}{d} = 7,74 \cdot \frac{0,65}{2 \cdot 10^{-2}} = 252 \; Bm/\left(м^2 \cdot K\right) \quad (7)$$

The thermal resistance of the pipe wall is calculated using b_{st} - wall thickness, λ_{st} is the coefficient of thermal conductivity of the wall material

$$R_{cm} = \frac{b_{cm}}{\lambda_{cm}} = \frac{2 \cdot 10^{-3}}{60} = 3,3 \cdot 10^{-5} \; м^2 \cdot K/Bm \quad (8)$$

As the upper limit of the heat flux, we take the value

$$q_{\max} = \frac{t_{B_1} - t_n}{\frac{1}{\alpha_{mp}} + R_{cm}} = \frac{65 - 24,7}{\frac{1}{252} + 3,3 \cdot 10^{-5}} = 10071 \; Bm/м^2 \quad (9)$$

where tn _ = 24.7 about C is the saturation temperature of CO_2 -miscelles at operating pressure P = 6.4 MPa; t_{B1} = 65° C is the temperature of the heating water.

In the first approximation, the thermal power of the evaporator is determined by the maximum heat flux $W_{max} = F \cdot q_{max} = 0.62 \cdot 10071 = 6.24 \cdot 10^3$ W.

water temperature at the outlet of the evaporator t_{B2} from the heat balance equation $G_B \cdot C_B \cdot (t_{B1} - t_{B2}) = W$:

$$t_{B_2} = t_{B_1} - \frac{W}{G_B \cdot C_B} = 65 - \frac{6,24 \cdot 10^3}{0,28 \cdot 4,2 \cdot 10^3} = 59,7°C \quad (10)$$

In the second approximation, the evaporator power is determined from the power W_1 required to evaporate a given solvent flow rate – liquid CO_2, G_{CO2} = 45 kg/hour = 0.0125 kg / s, and power $W_{2\,for}$ heating vapors CO_2 to operating temperature t_2 = 30° C

$$W_1 = G_{CO2} \cdot r = 0.0125 \cdot 123.5 \cdot 10^3 = 1544 \text{ W},$$

$$W2 \_ \backslash u003d \; G_{CO2} \cdot C_p (t_2 - t_n) \backslash u003d \; 0.0125 \cdot 3.3 \cdot 10^3 \cdot (30 - 24.7) = 219 \text{ W}$$

$$W = W_1 + W_2 \backslash u003d \; 1544 + 219 \backslash u003d \; 1763 \text{ watts.}$$

The average logarithmic temperature difference in this case is equal to

$$Q = \frac{\left(t_{B_1} - t_n\right) - \left(t_{B_2} - t_2\right)}{\ln \frac{t_{B_1} - t_n}{t_{B_2} - t_2}} = \frac{\left(65 - 24,7\right) - \left(59,7 - 30\right)}{\ln \frac{65 - 24,7}{59,7 - 30}} = 34,7°C \quad (11)$$

The boiling heat transfer coefficient is determined by a formula based on thermodynamic similarity

$$\alpha_{кип} = 1015 \cdot \left(P_{кр}\right)^{1/4} \cdot \left(T_{кр}\right)^{-7/8} \cdot \left(M\right)^{-1/8} \cdot q^{3/4} \cdot \left(0,14 + 2,2 \cdot \frac{P}{P_{кр}}\right) \quad (12)$$

Here q is the heat flux density, which is calculated taking into account the power determined in the second approximation and the given heat transfer area F

$$q = \frac{W}{F} = \frac{1763}{0,62} = 2844 \; Bm/м^2 \quad (13)$$

we get

$$\alpha_{кип} = 1015 \cdot (7{,}14)^{1/4} \cdot (304)^{-7/8} \cdot 44^{-1/8} \cdot 2844^{3/4} \cdot \left(0{,}14 + 2{,}2 \cdot \frac{64}{74}\right) =$$

$$= 1015 \cdot 1{,}6 \cdot 6{,}72 \cdot 10^{-3} \cdot 0{,}623 \cdot 389 \cdot 2{,}04 = 5395 \; Bm \Big/ \left(м^2 \cdot K\right) \tag{14}$$

Heat transfer coefficient

$$K = \frac{1}{\frac{1}{\alpha_{кип}} \cdot \frac{d_н}{d_в} + R_{ст} + \frac{1}{\alpha_{кип}}} = \frac{1}{\frac{1}{252} \cdot \frac{2{,}4 \cdot 10^{-2}}{2{,}0 \cdot 10^{-2}} + 3{,}3 \cdot 10^{-5} + \frac{1}{5395}} = 201 \; Bm \Big/ \left(м^2 \cdot K\right) \tag{15}$$

$$F_2 = \frac{W_2}{\alpha_{мт} \cdot \left(t_{B_2} - t_2\right)} = \frac{219}{7{,}5 \cdot (60 - 30)} = 0{,}97 \; м^2 \tag{16}$$

This area is the sum of the area of the parts of the tubular elements (0.62 - 0.22) = 0.4 $м^2$ and shirt surface area $\pi D\alpha = 0{,}56 м^2$. When calculating the capacitor, the following information was used. Vapor temperature CO_2 $t_1 = 30°C$. Coolant $t_{B_1} = 6°C$ temperature . Coolant flow rate $G_B = 2 м^3 / час$. heat transfer surface $F = 4{,}1 м^2$. Let us determine the power consumed for cooling CO_2 to saturation temperature $t_н = 24°C$:

$$W' = G_{CO_2} \cdot C_p \cdot \left(t_1 - t_н\right) = 0{,}0125 \cdot 3{,}6 \cdot 10^3 \cdot (30 - 24) = 270 \; Bm \tag{17}$$

To calculate heat transfer in the annular space, we use the formula for the transverse flow around a staggered tube bundle

$$N_u = 0{,}195 \cdot \mathrm{Re}^{0{,}6} \cdot \mathrm{Pr}^{0{,}33} \tag{18}$$

The speed is determined by the average section:

$$v_{CO_2} = \frac{G_{CO_2}}{\rho'} \cdot \frac{1}{l \cdot \left(D - 8d_н\right)} = \frac{0{,}0125}{240} \cdot \frac{1}{1{,}49 \cdot 0{,}151} = 2{,}31 \cdot 10^{-4} \quad \text{m/s} \tag{19}$$

where l = 1,490 is the length of the capacitor. Reynolds number

$$\mathrm{Re}_{CO_2} = \frac{v_{CO_2} \cdot d}{\vartheta'} = \frac{2{,}31 \cdot 10^{-4} \cdot 2{,}1 \cdot 10^{-2}}{8{,}3 \cdot 10^{-8}} = 58{,}6 \tag{20}$$

Nusselt number for annulus

$$N_{u\,MT} = 0{,}195 \cdot (58{,}6)^{0{,}6} \cdot 6^{0{,}33} = 4{,}1 \tag{21}$$

Heat transfer coefficient in the annulus during steam cooling

$$\alpha_{MT} = N_u \cdot \frac{\lambda'}{d} = 4{,}1 \cdot \frac{3{,}5 \cdot 10^{-2}}{2{,}1 \cdot 10^{-2}} = 6{,}8 \; Bm \Big/ \left(м^2 \cdot K\right) \tag{22}$$

The speed of the cooler in the pipe $v_B = \frac{G_B}{n \cdot \pi d^2 / 4}$, where n = 22 - the number of pipes conducting the flow in one direction, 2.0 10^{-2} - inner diameter of pipes; from here

$$v_B = \frac{4 \cdot 2 / 3600}{22 \cdot 3{,}14 \cdot \left(2 \cdot 10^{-2}\right)^2} = 0{,}08 \quad \text{m/s} \tag{23}$$

Reynolds number as a criterion for the similarity of the miscella flow

$$\mathrm{Re} = \frac{v_B \cdot d}{\vartheta_B} = \frac{0{,}08 \cdot 2 \cdot 10^{-2}}{1{,}5 \cdot 10^{-6}} = 1{,}07 \cdot 10^3 \tag{24}$$

In this case, the laminar flow regime and the Nusselt number for the tube space $N_{UT} = 3.6$. As a result, the heat transfer coefficient in the pipe α_T and the total heat transfer coefficient during cooling K ' are equal to:

$$\alpha_T = N_{uT} \cdot \frac{\lambda_B}{\alpha} = 3,6 \cdot \frac{0,55}{2 \cdot 10^{-2}} = 99 \ {}^{Bm}\!/\!_{\left(м^2 \cdot K\right)} \tag{25}$$

$$K' = \frac{1}{\frac{1}{\alpha_{MT}} + \frac{\delta_{CT}}{\lambda_{CT}} + \frac{1}{\alpha_{CT}}} = \frac{1}{\frac{1}{6,8} + \frac{10^{-3}}{60} + \frac{1}{99}} = 6,39 \ {}^{Bm}\!/\!_{\left(м^2 \cdot K\right)} \tag{26}$$

Heat exchange area required to cool $CO_{2\ vapor}$ to the condensation temperature

$$F' = \frac{W'}{K' \cdot \left(\frac{1}{2}\left(t_1 - t_н\right) - t_{B_1}\right)} = \frac{270}{6,2 \cdot \left(27 - 6\right)} = 2,07 \ м^2 \tag{27}$$

Thus, most of the heat exchanger serves to cool $CO_{2\ vapor}$. The area left directly for condensation

$$F'' \backslash u003d F - F' \backslash u003d 4.1 - 2.07 \backslash u003d 2.03 \ H^2 \tag{28}$$

To calculate the condensation process on horizontal pipes, we determine the Reynolds number of the condensate film

$$\mathrm{Re} = \frac{\overline{q} \cdot \pi \cdot d_н}{r' \cdot r''} \tag{29}$$

where $\overline{q}$ is the average heat flux

$$\overline{q} = \frac{W''}{F''} = \frac{r \cdot G_{CO_2}}{F''} = \frac{123,5 \cdot 10^3 \cdot 0,0125}{2,03} = 760 \ {}^{Bm}\!/\!_{м^2} \tag{30}$$

Wherein

$$\mathrm{Re} = \frac{760 \cdot 3,14 \cdot 21 \cdot 10^{-3}}{123,5 \cdot 10^3 \cdot 6 \cdot 10^{-5}} = 6,8 \tag{31}$$

This number is less than the critical value $\mathrm{Re}_{cr} = 50$ corresponding to the transition to the turbulent regime. The heat transfer coefficient from the side of the condensing CO2 is determined for these conditions by the Nusselt formula

$$\alpha_K = 0,726 \cdot \left(\frac{\delta''^3 \cdot \rho'' \cdot \left(\rho'' - \rho'\right) \cdot g \cdot r}{\eta'' \cdot d_н \cdot \left(t_н - t_{CT}\right)} \right)^{0,25} \tag{32}$$

where t_{st} is the unknown pipe wall temperature. Substituting the values of quantities, we obtain

$$\alpha_K = 0,726 \cdot \left(\frac{\left(85 \cdot 10^{-3}\right)^3 \cdot 718 \cdot \left(718 - 240\right) \cdot 9,8 \cdot 123,5 \cdot 10^3}{6 \cdot 10^{-5} \cdot 21 \cdot 10^{-3} \cdot \left(24,7 - t_{CT}\right)} \right)^{0,25} = \frac{2738}{\left(24,7 - t_{CT}\right)^{0,25}} \tag{33}$$

The wall temperature is determined from the condition of equality of heat fluxes from the coolant and condensing steam:

$$\frac{t_{CT} - t_{B_1}}{\frac{1}{\alpha_T} + \frac{\delta_{CT}}{\lambda_{CT}}} = \alpha_K \cdot \left(t_н - t_{CT}\right) \tag{34}$$

As a result, we obtain the equation $99 \cdot \left(t_{CT} - 6\right) = 2738 \cdot \left(24,7 - t_{CT}\right)^{3/4}$

Solving it, we obtain the value $t_{CT} = 24.08°$ C and heat flux $q = 99 \left(t_{CT} - t_{B\ 1} \right) = 1797$ W / m ^{2}. This heat flux turns out to be greater than necessary $\overline{q} = 760 \ {}^{Bm}\!/\!_{м^2}$. Thus, on the remaining area $P' = 2.03$ m ^{2} condensation occurs completely.

Conclusion

The calculation of the evaporator is reduced to the conditions for approaching the bulk boiling temperature. At a flow rate of liquid CO_2 45 kg/h, the required amount of hot water is 1 m^3 / h. 0.022 is used directly for evaporation m^2 heat exchange surface. The rest of the surface of the tubular elements and the surface of the heating jacket are sufficient to heat $CO_{2\ vapor}$ to 30°C.

When calculating the condenser, the processes of $CO_{2\ vapor\ cooling}$ and film condensation are taken into account. To cool vapors to a condensation temperature of 24.7°C, 2.07 $m^{2\ of}$ heat exchange surface is required. Directly for condensation, 0.82 $m^{2\ of}$ surface is required.

The information obtained can be used in the design of gas-liquid installations.

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ИССЛЕДОВАНИЕ БЕЗОПАСНОСТИ ЖИРОВОГО КОМПОНЕНТА КАПСУЛИРОВАННЫХ ФОРМ СПЕЦИАЛИЗИРОВАННОЙ ПРОДУКЦИИ

RESEARCH OF THE SAFETY OF THE FAT COMPONENT OF CAPSULATED FORMS OF SPECIALIZED PRODUCTS

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Аннотация. *В спорте высоких достижений и фитнесе применение широко применяются полиненасыщенные жирные кислоты (ПНЖК). Стоит отметить их способность снижать мышечное повреждение и воспалительный ответ после силовых нагрузок, улучшать функцию внешнего дыхания и нормализовать состав тела спортсмена.*

Материалы, методы, результаты и обсуждения

Тем не менее, прямое использование ПНЖК в продуктах питания и напитках ограничено их низкой растворимостью в воде и высокой чувствительностью к окислению, в связи с чем в их состав вводят различные антиоксиданты, ярким представителем которых является астаксантин, который, по полученным различными учеными данным, демонстрирует эффективность применения в качестве нутритивной поддержки, обеспечивая организм необходимыми элементами для его построения и обновления, снабжая необходимым количеством энергии и веществами, участвующими в регуляции физиологических процессов, а также ослабляя ремоделирование сосудов, подавляя пролиферацию гладкомышечных клеток сосудов, улучшая функцию митохондрий. Однако, работ, посвящённых исследованию различных безопасности форм ПНЖК в процессе хранения, практически нет. Тем не менее они могут являться потенциальным источником опасности для организма, в связи с тем, что в процессе окисления, образуются продукты окисления, как эфиры глицидола, эпокиды, вторичные продукты окисления, нерастворимые в петролейном эфире, которые обладают тератогенным, мутагенным и канцерогенным действием. В связи с этим ***цель нашего исследования*** *состоит в сравнении биологической эффективности и безопасности инкапсулированных форм ПНЖК с содержанием антиоксиданта и без такового.* ***В работе используется общепринятые методы****, которые нормируют безопасность и качество жиров, регламентированные Всероссийским научно-исследовательским институтом жиров. Были исследованы следующие показатели: определение концентрации эпоксидов; определения кислотного числа по реакции с концентрированной фосфорной кислотой; перекисного числа по реакции с тиосульфатом натрия; определение суммарного содержания продуктов окисления, нерастворимых в петролейном эфире.* ***В результате исследования*** *жирового компонента исследуемых образцов кислотное число составляет 5,8 мг КОН / г, что превышает максимально*

допустимое значение в два раза. Это не стабильные компоненты, они реагируют друг с другом или с другими продуктами окисления и их содержание варьируется. Количество эпоксидов исследуемых капсул составляет 48,4 ммоль/кг, что примерно в два раза превышает допустимый уровень, что не может не вызывать беспокойства учёных всего мира. Число эпоксидов не нормируется ни в одном из нормативно-техническом документов, но в научных исследованиях доказано, что данные продукты токсичны.

Заключение

Показатели безопасности жирового компонента, регламентированные техническим регламентом Таможенного союза не отражают в полной мере требования безопасности к жировому компоненту биологически активных добавок, так как отсутствуют нормативы важнейших показателей безопасности жиров – содержания вторичных продуктов окисления.

Ключевые слова: специализированная продукция, астаксантин, качество, безопасность, жировой компонент

Abstract

Polyunsaturated fatty acids (PUFA) are widely used in high performance sports and fitness. It is worth noting their ability to reduce muscle damage and the inflammatory response after strength loads, improve the function of external respiration and normalize the athlete's body composition.

Materials, methods, results and discussions

Nevertheless, the direct use of PUFAs in food and beverages is limited by their low solubility in water and high sensitivity to oxidation, and therefore various antioxidants are introduced into their composition, a striking representative of which is astaxanthin, which, according to various scientific data, demonstrates effective use as a nutritional support, providing the body with the necessary elements for its construction and renewal, supplying the necessary amount of energy and substances involved in the regulation of physiological processes, as well as weakening vascular remodeling, suppressing the proliferation of vascular smooth muscle cells, improving the function of mitochondria. However, there are practically no works devoted to the study of various safety forms of PUFAs during storage. Nevertheless, they can be a potential source of danger to the body, due to the fact that during the oxidation process, oxidation products are formed, such as glycidol ethers, epoxides, secondary oxidation products, insoluble in petroleum ether, which have teratogenic, mutagenic and carcinogenic effects. In this regard, the aim of our study is to compare the biological effectiveness and safety of encapsulated forms of PUFAs with and without an antioxidant. The work uses generally accepted methods that normalize the safety and quality of fats, regulated by the All-Russian Research Institute of Fats. The following indicators were investigated: determination of the concentration of epoxides; determining the acid number by reaction with concentrated phosphoric acid; peroxide number by reaction with sodium thiosulfate; determination of the total content of oxidation products insoluble in petroleum ether. As a result of the study of the fat component of the test samples, the acid number is 5.8 mg KOH / g, which is twice the maximum allowable value. These are not stable components, they react with each other or with other oxidation products and their content varies. The amount of epoxides in the studied capsules is 48.4 mmol / kg, which is approximately twice the permissible level, which cannot but cause concern for scientists around the world. The number of epoxides is not standardized in any of the regulatory and technical documents, but scientific studies have proven that these products are toxic.

Conclusion

The safety indicators of the fat component regulated by the technical regulations of the Customs Union do not fully reflect the safety requirements for the fat component of biologically active additives, since there are no standards for the most important safety indicators of fats - the content of secondary oxidation products.

Key words: specialized products, astaxanthin, quality, safety, fatty component

Introduction. The constant pursuit of athlete excellence is achieved through regular and planned training and quality nutrition. The use of specialized sports nutrition products is designed to contribute to the performance of an athlete, maintaining his health, preventing the development of diseases and rapid recovery [1].

Encapsulated forms of polyunsaturated fatty acids (PUFAs) are currently the most popular. The advantages of such forms include easier selection of dosage and masking of strong odors or tastes of oils. However, it should be noted that the exclusion of the possibility of gustatory sensation of the product and the perception of the consumption of biologically active substances only as the use of a "pill", without the possibility of assessing taste and smell, excludes the "organoleptic control" of the consumed products [2].

However, direct use of PUFAs in foods and beverages is limited by their low water solubility and high sensitivity to oxidation. Oxidation reactions are involved in various pathologies of the body, including cerebral and cardiac ischemia, reperfusion injury [3]. For these reasons, these biologically active substances must be encapsulated. A number of innovative technologies are suitable for this. For example, coacervation, spray drying, freeze drying, spray cooling and fluid bed coating [4]. Lipid oxidation can be prevented to a certain extent by the addition of antioxidants [5].

In numerous studies, scientists have found that the use of antioxidants is most effective in relation to terrestrial animal fats and vegetable oils. Due to the presence of a number of unique physical and chemical properties , astaxanthin is widely used as an antioxidant. The pigment is able to be included in the composition of biomembranes and protect them from the action of free radicals and other destructive agents. In particular, it can help reduce the risk of atherosclerosis [6]. This is associated, first of all, with the inhibition of lipid peroxidation in the composition of low-density lipoproteins [7]. The pigment also has a beneficial effect in diabetes. It is an anti-inflammatory agent [8–11], protects the skin from damage by UV rays, prevents deterioration of vision [11, 12], memory impairment, and a number of other disorders of higher nervous activity [13–15]. Astaxanthin has a beneficial effect on the circulatory system [15-17] and metabolism in general [18-20], muscle function [21,22], male fertility [23,24]. The pigment also has an anticancer effect [25-27]. It was concluded that " astaxanthin promotes blood thinning in arterial hypertension and restoration of vascular tone" [28]. It is important to note that astaxanthin can have a preventive and curative effect through the suppression of neoangiogenesis in ophthalmology [29], as well as attenuate vascular remodeling by suppressing the proliferation of vascular smooth muscle cells, improving mitochondrial function [30].

It should be noted that sports nutrition products with astaxanthin as an antioxidant is acquired during a pandemic, when after suffering COVID -19 (Covid-19) - an infection-mediated disease caused by the SARS - CoV -2 coronavirus , occurring in various variants (from asymptomatic carriage of the virus to terminal conditions), characterized by the development of a clinical picture Not only acute respiratory infection, but also lung injury, nervous system, including brain structures, gastrointestinal tract, liver, kidneys, endocrine organs, organs of the reproductive system, skin, intoxication, disseminated intravascular coagulation syndrome (DIC) of a subacute course and multiple organ failure, it is much more difficult to maintain the health of an athlete. The pathogenetic mechanisms of DIC in COVID -19 are represented by three interconnected processes that form a vicious pathological circle:

- cytopathic damaging effect of the virus on vascular endothelial cells, which carry ACE 2 and CD 147 molecules, with which the virus gets the opportunity to interact with the destruction of the air-blood barrier and developing viremia .

- " cytokine storm", which has a damaging effect on the vascular endothelium and provides an inflammatory response with recruitment of leukocytes, macrophages, lymphoid elements to the site of damage and activation of blood coagulation ("inflammatory- coagulation (thrombotic) tornado"). Generalized endotheliopathy is accompanied by the release of high molecular weight von Willebrand factor , which stimulates the activation of both the plasma and platelet pathways of blood coagulation. A hyperergic immune response to SARS - CoV -2 in some patients causes a rapid development of an immune inflammatory response, a pronounced systemic inflammatory response syndrome, DIC, with severe alteration of lung tissue in the form of diffuse alveolar damage, damage to other organs and tissues, with the development of a picture of septic shock.

systemic vasculitis with lesions of small and medium-sized vessels. The appearance of antiphospholipid antibodies may modify the developing DIC. The role of virus-induced autoimmune reactions is also not excluded.

Additional pathogenetic syndromes that develop during DIC are bacterial complications, including sepsis, hemodynamic disorders (hypotension, hemodynamic shock), decreased barrier functions of the vascular wall and mucous membranes, and impaired tissue repair.

In May 2020, edited by prof. Zayratyantsa O.V. a detailed Atlas "Pathological Anatomy of COVID -19" was released. The authors note that morphologically, with this infection, microangiopathy is determined in the form of a destructive-productive thrombovasculitis and hypercoagulable syndrome. Persistent inflammatory status in patients with severe and critical severity of COVID -19 acts as a trigger for activation of the blood coagulation cascade. [31].

Based on the foregoing, the correct selection of safe and high-quality nutritional supplements for athletes is a hot topic. At the moment, there are a significant number of studies confirming the beneficial effect of the consumption of various dietary supplements [32-35]. However, there are practically no works devoted to the study of their safety during storage [1]. Nevertheless, they can be a potential source of danger to the body, due to the fact that during the oxidation process, oxidation products are formed, such as glycidol esters [36-38], epoxides [39-40.], secondary oxidation products that are insoluble in petroleum ether, which have teratogenic, mutagenic and carcinogenic effects [41].

Due to this **the purpose of our study** is to compare the biological efficacy and safety encapsulated forms of PUFAs with and without antioxidant content.

The objects of the study were capsule forms of dietary supplements " Astaxanthin + Omega-3 + Omega-6 + Iodine" (Russia), which include Artemia crustacean extract. Capsules contain: astaxanthin 50 mg/100 g; PUFA (omega-3) 28 g/100 heicosapentaenoic acid 26.80 g/100 gulf-linolenic acid 1.18 g/100 g, PUFA (omega-6) 8 g/100 g, iodine 1.2 mg/100.

The shelf life of prototypes is 12 months. Studies of the fat component were carried out on the 10th month of product storage.

Research methods

The work uses generally accepted methods that normalize the safety and quality of fats, regulated by the All-Russian Research Institute of Fats.

Were explored the following indicators :

- definition concentration epoxides [42, 43]
- definitions acidic numbers on reactions with concentrated phosphoric acid ;

- peroxide numbers on reactions with thiosulfate sodium ;
- determination of the total content of oxidation products insoluble in petroleum ether (TPPE) according to the method described in the manual of the All-Russian Research Institute of Fats with the following additions. A mixture of oxidation products insoluble in petroleum ether was dissolved in hot ethyl alcohol, concentrated on a water bath to a small volume, quantitatively transferred into a 50 cm3 volumetric flask ، made up to the mark with ethyl alcohol, and mixed well. The resulting solution containing TPES from 5 g of the fat fraction was divided into 2 equal parts. One part was dried to constant weight and then calcined to determine the ash, as described in the main method. Based on the data obtained, the content of CHPE in oxidized fat was calculated in % of the mass of fat, given that the treated solution contains CHPE from 2.5 g of fat. In the second part of the solution, the content of fatty acids was determined by titration with a 0.1 mol/dm3 alkali solution. Based on the results obtained, the content of SPE in oxidized fat was calculated in mmol /kg of fat [44];
- fatty acid composition determined method gas-liquid chromatography methyl ethers fatty acids according to GOST R 51483-99 " Oils vegetable and fats animals . Definition method gas chromatography mass shares methyl ethers individual fatty acids to their sum ". Methyl ethers fatty acids prepared on GOST R 51486-99 " Oils vegetable and fats animals . Receipt methyl ethers fatty acids ."

Statistical processing was carried out in accordance with GOST R ISO 5725-2-2002. The measurement result is taken as the arithmetic mean of the results of two parallel determinations performed under conditions of repeatability (convergence) if the acceptance condition is met.

The results of the fatty acid composition of the capsule form of dietary supplements Astaxanthin (Russia) composition are presented in table 1.

Table 1

Fatty- acid composition of the capsule form of the dietary supplement " Astaxanthin + Omega-3 + Omega-6 + Iodine"

Name acids	Myristic C14:0	Palmitic C16:0	Palmitoleic C16:1	Stearic C18:0	Oleic C18:1	Linoleic C18:2	Linolenic C18:3	Begenova C22:0
Content , %	0.6	7.9	1.3	3.3	29.9	55.4	1.0	0.6

From the data presented in Table 1 it follows that the fatty acid composition (FAC) of the studied oil corresponds to the FAC of liquid vegetable oil, as evidenced by the low content of saturated acids - palmitic acid (C16:0) and stearic acid (C18:0) and high the content of unsaturated acids - linoleic acid (C18:2) and oleic acid (C18:1). According to the data of [45], it can be concluded that the FA of the sample corresponds to the FA of sunflower oil.

The results of the study of some safety indicators of the capsule form of the dietary supplement " Astaxanthin + Omega-3 + Omega-6 + Iodine" (Russia) are presented in Table 2.

Table 2

The results of the study of some safety indicators of the capsule form of the dietary supplement " Astaxanthin + Omega-3 + Omega-6 + Iodine" (Russia)

Name sample	Acid number, mg KOH/g	Peroxide value, Mmol½O/kg	Mass fraction of oxidation products insoluble in petroleum ether ,%	Content epoxides , mmol / kg
" Astaxanthin + Omega-3 + Omega-6 + Iodine" (Russia)	5.8	1.0	0.6	48.4

In the study of the fatty component, the content of free fatty acids was determined. This indicator in the Russian Federation is controlled by technical regulations in fatty products. The content of peroxide value, mg KOH / g: permissible level - 0.6 - 4.0 (according to the regulatory documentation of the Russian Federation). Thus, in the test sample, this indicator exceeds the maximum allowable value by one and a half times.

The peroxide number shows the presence of peroxides in the product - the primary products of oxidation. Peroxides are toxic to the body and therefore are regulated by TR / TS 021/2011 on safety. Peroxides, when ingested in large quantities, cause necrosis of the cells of the gastrointestinal tract, the development of cancer cells. Content of peroxides, meq . / kg: permissible level - no more than 10.0 (according to the regulatory documentation of the Russian Federation) . This indicator for the tested sample is within the normal range.

The content of copolymers insoluble in petroleum ether (TPPE, %): the permissible level is no more than 1.0 [46]. This indicator does not exceed the norm, but these values correspond to frying fats subjected to repeated thermal exposure; for native fats, this indicator is not normalized.

Content of epoxides , mmol /kg: recommended level - no more than 17-24 mmol /kg. The amount of epoxides in the prototype is 48.4 mmol/kg, which is about twice the recommended level.

At the 11th international conference Biosystems Engineering-2020 [1], we raised the problem of the quality and safety of encapsulated forms of sports nutrition products of Russian and foreign production. The data are presented in table 3.

Table 3

The results of the study of the fatty component of capsules ω -3-6-9 for sports nutrition

Name sample	Acid number, mg KOH/g	Peroxide number , meq / kg	Mass fraction of oxidation products insoluble in petroleum ether,%	Content epoxides , mmol / kg
Capsules ω–3, ω–6, ω–9 Sportline (Russia)	0.4	4.1	1.1	8.5
Capsules ω-3, ω-6, ω-9 Maxler (USA)	1.7	4.0	1.0	9.6
Capsules Multipower (Germany)	1.9	4.8	0.7	9.8

Normalized safety indicators of the fatty component of capsules ω -3, ω -6, ω -9 for sports nutrition have indicators that do not exceed the regulated norm.

The mass fraction of oxidation products in Maxler products reached the level of the maximum allowable value, while Sportline products exceeded the values by 0.1%. In Multipower capsules, all the studied indicators, except for the mass fraction of oxidation products, are normal. Thus, despite the encapsulated form, the fat component is subject to oxidation.

From the data of both studies , it is clear that antioxidants significantly stabilize such an indicator as peroxide value, in contrast to the content of epoxides . Given that athletes of many sports [47, 48.] use sports nutrition products daily, there is a need for further clarifying studies on the safety of the fat component.

Discussion

When studying the fat component, we determined the content of free fatty acids, which, although they do not affect the safety of the product, indicate one or another degree of oxidation - if their content is too high, then saponification of fats occurs, respectively, a change in the

organoleptic characteristics of the product. These data correlate with the data obtained by scientists conducting research on the fatty component of vegetable oils from various raw materials [49]. In the studied samples, the acid number is 5.8 mg KOH / g, which is twice the maximum allowable value . These are not stable components, they react with each other or with other oxidation products and their content varies. Excessive intake and limited excretion of free radicals, as a rule, leads to oxidative stress, triggers a chain reaction that disrupts the integrity of cells, leads to their damage or death, initiates oncological processes [50, 51], the development of arthritis and neurodegenerative diseases [52].

The amount of epoxides in the studied capsules is 48.4 mmol /kg, which is approximately twice the permissible level, which cannot but cause concern for scientists around the world. The number of epoxides is not standardized in any of the normative and technical documents, but scientific studies have shown that these products are toxic. Researchers from different countries have confirmed the toxic effect of epoxides on various body systems. For many of them, toxicological studies have shown cyto- and genotoxicity , carcinogenicity and mutagenicity, and can also be a precursor of leukotoxins that can cause degeneration and necrosis of leukocytes, disrupt the endocrine system, block the estrous cycle in rats, stimulate the proliferation of human breast cancer cells [53, 54]. Epoxidation serves to activate many known chemical carcinogens; Chemical carcinogenesis is a multi-stage process that includes initiation, promotion and progression. Epoxides trigger initiation, the first critical and irreversible step in carcinogenesis, requiring covalent binding of the carcinogen to DNA [55]. They integrate into the nucleotide and change the genome of the organism, i.e., they are mutagenic products [56].

One of the secondary products formed during the oxidation of oils and fats are polyhydroxy acids . The quantitative content of these compounds is determined as the total content of oxidation products insoluble in petroleum ether. From the literature data, a close correlation is known between the content of fat breakdown products that are insoluble in petroleum ether and the effect of oxidized fats on the body [57]. Negative effects on the blood and biochemical parameters of fat metabolism were recorded in experiments on animals [58]. Oxidation products, insoluble in petroleum ether, have a proven toxic effect and have carcinogenic and cocarcinogenic effects [59].

The experimental data obtained by us in the study of some safety indicators of the capsule forms of the dietary supplement " Astaxanthin + Omega-3 + Omega-6 + Iodine" (Russia) have a significant correlation with the experimental data on the study of the safety of fats described in the literature.

Conclusion. The safety indicators of the fat component, regulated by the technical regulations of the Customs Union, do not fully reflect the safety requirements for the fat component of biologically active additives, since there are no standards for the most important safety indicators of fats - the content of secondary oxidation products - TPES and epoxides . In our opinion, the conducted studies necessitate further study of the safety indicators of the fat component of sports nutrition products during storage in order to additionally control the safety of the fat component .

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КРАТКИЕ СООБЩЕНИЯ|
SHORT REPORTS

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РАЗРАБОТКА ОБОГАЩЁННОГО ХЛЕБОБУЛОЧНОГО ИЗДЕЛИЯ С ИСПОЛЬЗОВАНИЕМ ПРОБИОТИКА

DEVELOPMENT OF AN ENRICHED BAKERY PRODUCT USING A PROBIOTIC COMPOSITE

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Аннотация

Функциональное питание одном из приоритетных направлений развития питания в 21 веке, востребованное и актуальное, быстро развивающееся. Актуальность Здорового образа жизни, рационального питания, особенно персонализированного, с учетом индивидуальных особенностей организма человека, не только актуально, но и востребовано в России и странах Евразийского сообщества.

Материалы и методо, результаты и обсуждения

В статье представлены результаты исследования: изменение органолептических показателей хлеба белого пшеничного из муки высшего сорта, путем замена части муки смесью муки из зёрен кукурузы и нута в экспериментальных пропорциях, и обогащения хлеба инакулятом чайного гриба с целью получения инновационного продукта питания для лечебно-профилактического питания людей, страдающих сахарным диабетом I и.IIтипа

Заключение

В результате проведенных исследований:

1. Изучен оптимальный объем введения дополнительных растительных ингредиентов в изделие для получения оптимальных органолептических показателей и витаминизации продукта;

2. Изучено изменение органолептических показателей изделия при введении в изделие растительных добавок функционального назначения

3. Изучен химический состав и пищевая ценность мяса индейки, описаны её основные преимущества и показатели, указывающие на необходимость применения данного вида изделия в питании.

4. Изучен химический состав корня сельдерея, описаны его основные преимущества и показатели, указывающие на необходимость применения данного вида изделия в питании.

5. Изучен химический состав дайкона, свёклы, пекинской капусты, описаны их основные преимущества и показатели, указывающие на необходимость применения данного вида изделия в питании.

6. Проведён анализ химического состава и пищевой ценности продуктов и изделия.

Следующие этапы исследования связаны с определением:

Ключевые слова: обогащение, инакулят, нут, кукуруза, медуизин, инновационный продукт.

Abstract

Functional nutrition is one of the priority directions of nutrition development in the 21st century, in demand and relevant, rapidly developing. The relevance of a healthy lifestyle, rational nutrition, especially personalized, taking into account the individual characteristics of the human body, is not only relevant, but also in demand in Russia and the countries of the Eurasian Community.

Materials and methods, results and discussions

The article presents the results of the study: changing the organoleptic parameters of white wheat bread from premium flour, by replacing part of the flour with a mixture of flour from corn and chickpeas in experimental proportions, and enriching bread with kombucha noculate in order to obtain an innovative food product for therapeutic and preventive nutrition of people suffering from diabetes mellitus I and I.Type I.

Conclusion

As a result of the conducted research: 1. The optimal volume of the introduction of additional herbal ingredients into the product has been studied to obtain optimal organoleptic parameters and fortification of the product;

2. The change in the organoleptic parameters of the product was studied when plant additives of functional purpose were introduced into the product

3. The chemical composition and nutritional value of turkey meat have been studied, its main advantages and indicators indicating the need to use this type of product in nutrition have been described.

4. The chemical composition of celery root has been studied, its main advantages and indicators indicating the need to use this type of product in nutrition have been described.

5. The chemical composition of daikon, beetroot, Peking cabbage has been studied, their main advantages and indicators indicating the need to use this type of product in nutrition are described. 6. The analysis of the chemical composition and nutritional value of products and products was carried out. The following stages of the study are related to the definition

Key words: enrichment, noculate, chickpeas, corn, meduizin, innovative product.

Introduction

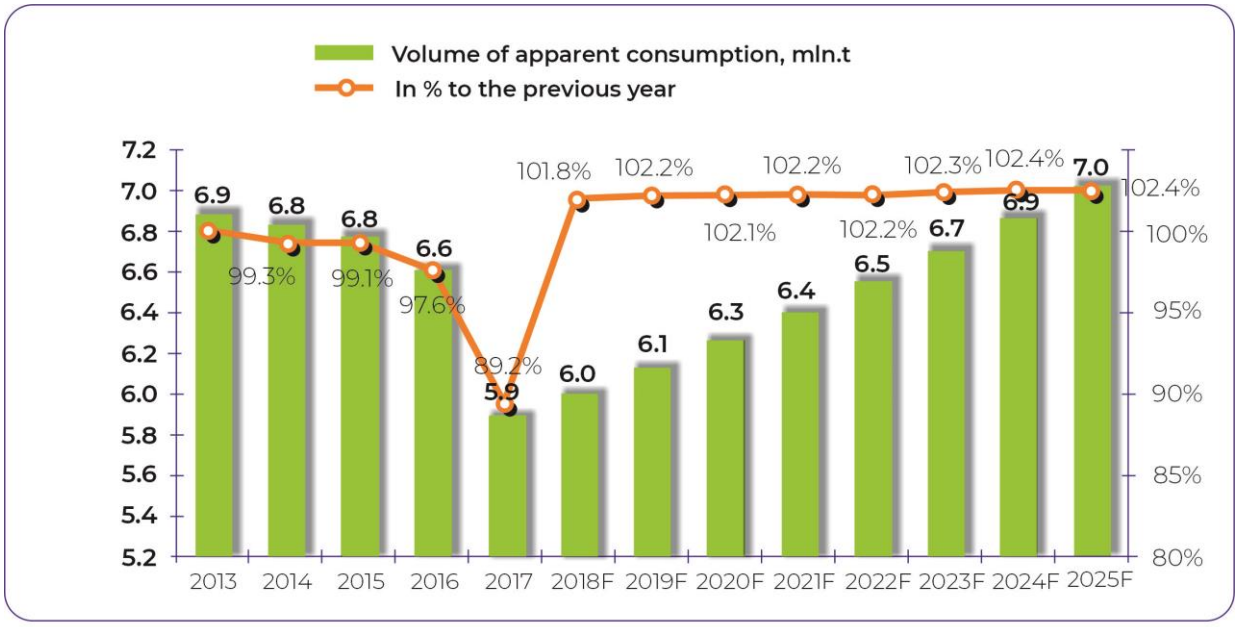
The development of the market for innovative products is reactionary, based on constantly emerging incentives in the economic, political, social and cultural environments of human existence. At the same time, the formation of an innovative product is facilitated by many external factors, as well as internal factors occurring in society and the state as a whole.

Therapeutic, preventive and functional nutrition in the context of coronavirus disease (COVID -19), associated with severe acute respiratory syndrome-coronavirus-2 (SARS - CoV - 2), leads to multiple respiratory disorders, failure of several systems and organs, followed by death, which ultimately represents a global health problem both in states with a highly developed economic component and in developing countries [1-6].

Improving immunity with the help of biologically active compounds that are part of functional and therapeutic and prophylactic foods, as noted by foreign and domestic scientists and this position is supported by the World Health Organization (WHO), is considered as a first-line treatment and is one of the main components involved in the complex treatment of patients with COVID -19 who are on medical treatment. In the future, it is understood that the development of one of the priority areas of gerontological nutrition, since proper nutrition not only increases the body's immunity to diseases, including COVID -19, but also reduces the recovery period [9]

Immunomodulation and stimulation is an actual direction for the treatment of patients with COVID -19, both in the food and pharmaceutical industries [7,8,10-14].

The relevance of the development of enrichment of bakery products with functional selective biologically active compounds of products from flour of various types is due to the fact that this product is one of the most popular products among various population groups (Fig. 1).



Source: Rosstat data, Federal Customs Service, IndexBox analytics

Fig. 1. The level of consumption of bread, bakery products

Materials and methods of research

The widespread use of wheat bread, from high-grade flour in large quantities, is one of the factors in the occurrence of diabetes, which is associated with the following:

- The almost complete absence of coarse fiber in wheat flour. The technology for making wheat bread is based on the use of premium flour, in which there is practically no bran part of the grain, which contains an increased amount of easily digestible carbohydrates.
- High glycemic index of bakery products made from premium flour.

Scientific development is a technology for obtaining bread enriched by replacing part of the flour with a mixture of corn and chickpea flour in experimental proportions using kombucha inoculum, in order to obtain an innovative food product for the nutrition of people suffering from type I , II diabetes mellitus .

A technology, a recipe have been developed, rheological studies of the finished product have been carried out, differing in the following:

1. Received a bakery product with an average glycemic index
2. Additionally enriched with biologically active compounds of selective action.
3. Containing an antimicrobial compound - meduizin, due to the use of kombucha inoculum, a bakery product with a longer shelf life was obtained.
4. With high rheological parameters.

As enriching composites, we used: chickpea and corn flour, inoculum of Kombucha.

Chickpea flour **,** enriches the developed bakery product with vitamins and minerals compounds: vitamin B_1 - 32.4%, vitamin B_5 - 12.1%, vitamin B_6 - 24.6%, vitamin B_9 - 109.3%, potassium - 33.8%, magnesium - 41.5%, phosphorus - 39.8%, iron - 27%, manganese - 80%, copper - 91.2%, selenium - 15.1%, zinc - 23.4% [one]

Corn flour enriches the bakery product not only with vitamins B 1 - 23.3%, vitamin PP - 15%, but also with mineral compounds involved in the construction of organs and systems of the human body: phosphorus - 13.6%, iron - 15%, selenium - 19, eleven]

- Kombucha inoculum is rich in such vitamins and minerals as: vitamin B_2 - 11.1%, iron - 11.1%, manganese - 15% [1]

Research results

The purpose of the study was to study the organoleptic and chemical characteristics of the innovative product "Wheat bread enriched with composites containing biologically active compounds of selective action: corn and chickpea flour, kombucha inoculum".

To achieve this goal, the proportions of wheat, corn and chickpea flour were experimentally selected (the ratio of flour of different types - 1:1:1 was chosen as a control sample), water, as an ingredient, was replaced by inoculum. In order to determine the optimal rheological properties, a different ratio of flour in % was selected. (Table 1.)

Table 1

Experimental ratio of different types of flour for obtaining bakery products

Indicators	%					
Wheat flour	33	40	46	fifty	55	60
Corn flour	33	thirty	27	25	22.5	twenty
chickpea flour	33	thirty	27	25	22.5	twenty
The resulting consistency of the semi-finished product (dough)	liquid	liquid	mediu m density	Thick, available for kneading	Thick, available for kneading	The optimal ratio, the consistency corresponds to the indicators for semi-finished bakery products (dough)

In terms of the total mass, it turns out: 300 g of wheat flour, 100 g of corn flour and 100 g of chickpea flour and 250 ml. inoculum.

According to the classic recipe, 7 g of edible salt is introduced. Yeast was added to the recipe in the amount of 10 g, since the lifting force of tea inagulate from kombucha was not enough to raise the dough. Yeast was preheated to room temperature and added in loose form directly to the dough. This was done for the following reason: kombucha inagulate has an acidic pH , which means that the yeast will passivate in this environment [15-20, 24-30] and as a result, carbon dioxide will not form, which provides the dough with lift [21-23]. To confirm this thesis, we will perform a microscopic study of yeast activity by the following method: Let's prepare two samples of yeast. One using distilled water, the other with kombucha inoculum. Spent coloring that does not cause damage to the structural cells of yeast cells. For differentiation, Buri-Gins or Buri-Leffler staining was used. In this case, all dead cells will be stained black.

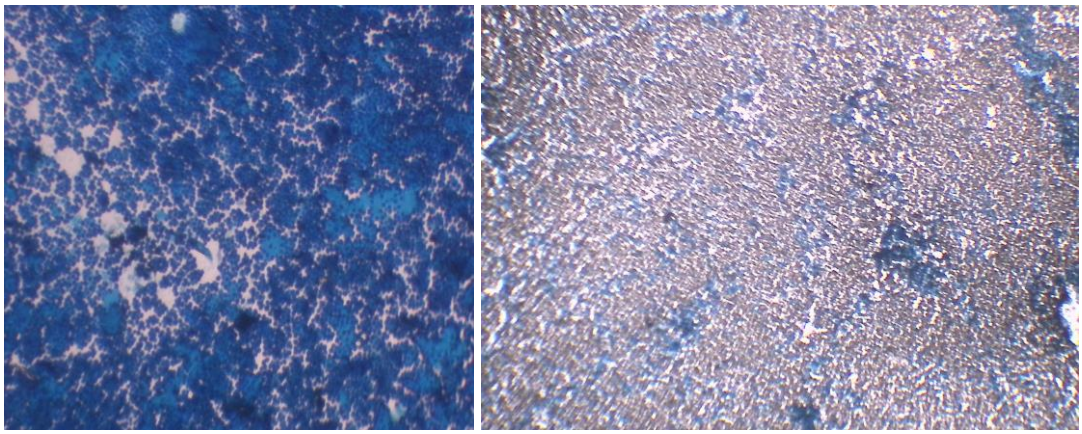
As a result of yeast studies, about 50-60 percent of yeasts were inactivated or died when kombucha inoculum was introduced (Fig. 2).

A slight increase in acidity in bread does not prevent damage to the internal structures of yeast fungi and ensures their activity.

At the next technological stage of bread production, the dough is sent for proofing. Proofing is carried out with two punches. A recipe with sponge was used as a control sample [30-36].

The product was baked at 160 degrees for 30-40 minutes, after which it was placed in a combi oven for 20-30 minutes.

According to the requirements for bread and bakery products, acidity is an identification indicator of the safety of a bakery product [20-27]. The study of acidity was carried out by the titrimetric method with the product of 3 measurements. Determination of the change in acidity, titrimetric analysis was carried out as it cooled. The overall result was entered in table 2.



a) b)

a) Yeast staining according to Buri-Leffler prior to the introduction of Kombucha inoculum
b) yeast taken immediately after mixing with the inoculum. Void and dead cells are highlighted in black color. Buri-Leffler staining

Fig. 2. Study of yeast activity in the medium of kombucha inoculum

Table 2

Results of a titrimetric study of the acidity of bread.

measurements	1 sample	2 sample	3 sample
pH values	5.5±0.25	6.0±0.25	6.0±0.25

Based on the data in the table, it can be noted that over time (in the process of cooling), the acidity of the bread decreases, which is associated with a decrease in the moisture content of the bread and the decay of third-party acids when the native biobackground of the bread changes.

Table 3

Organoleptic, rheological and physico-chemical and some microbiological indicators of the innovative product.

The name of indicators	Bread with optimal flour mixing ratio.
Organoleptic indicators.	
Consistency	Soft, homogeneous, with small inclusions of coarser cornmeal
Appearance	The bread is gray-brown, in the form of a loaf, the surface is smooth, dense
Color	The surface is gray, the base is gray-orange with darker spots
The form	Semicircular flattened
Elasticity	Elasticity is high, bread quickly restores its shape
Smell	Pleasant bread smell, the smell of corn, a faint smell of chickpeas.
Humidity	The crumb has a medium moisture content, the crust has a low moisture content
Uniformity	Homogeneous, porous, with small inclusions of coarser flours
Density and depth of crust	The crust is light, not deep (1-2 mm), soft.
Taste	Pleasant, tender, soft, sour. The taste of bread and grains. A bit rough on the mouth feel.
Rheological indicators	
Elasticity	Elasticity is high, bread quickly restores its shape and does not change it. When lining up after baking, the height did not change (there is no fall)
Viscosity	The crumb is not viscous.
stickiness	The crumb is not sticky.
Surface adhesion	Adhesion of surfaces is high, easily absorbs moisture.

pH and general microbiological parameters	
pH	5.8
General microbiological background	Yeast found
Yeast activity	Missing

Conclusion

As a result of the research, the issues of the relevance of the use of selective bakery products in diabetes mellitus with non-insulin-dependent diabetes mellitus were considered. As a result of the experiment, the rheological and organoleptic characteristics of the finished product were identified and evaluated, and the chemical and microbiological indicators were studied.

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НАУЧНО-ТЕХНИЧЕСКОЕ ТВОРЧЕСТВО И ЕГО РОЛЬ В ФОРМИРОВАНИИ СПЕЦИАЛИСТА ДЛЯ ИНДУСТРИИ ПИТАНИЯ

THE SCIENTIFIC AND TECHNICAL CREATIVITY AND ITS ROLE IN THE FORMATION OF A SPECIALIST FOR THE FOOD INDUSTRY

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Аннотация

Инновационное развитие отраслей зависит от специалистов, способных к инновационной деятельности, подготовленных в современных университетах. В основе научно-инновационной деятельности лежит научно-техническое творчество.

Материалыи методы, результаты и обсуждения

Понятие и сущность творчества формировались и трансформировались веками с учетом особенностей этапов развития общества. Отличительной особенностью современного общества является техновеществественность, предполагающая проектирование и конструирование новшеств с заданными свойствами с применением информационных технологий. Приоритетным научных направлением развития индустрии питания является конструирование продуктов специализированного назначения, представляющих собой многокомпонентные системы как результат инженерного творчества. Показана многоаспектность творческой деятельности специалиста нового поколения, представляющая собой интеграцию наук и специальных дисциплин в научно-образовательном процессе университета.

Заключение

Показана актуальность проектирования новых продуктов специального назначения в системе «наука, образование - производство – рынок», при котором на каждом этапе процесса создания новшества рекомендуется применять методы научно-технического творчества.

Ключевые слова: творчество, научно-техническое творчество, проектирование новшества, разработка СПП, специалист, индустрия питания

Abstract

The innovative development of industries depends on specialists capable of innovative activities, trained in modern universities. Scientific and innovative activity is based on scientific and technical creativity. The concept and essence of creativity have been formed and transformed over the centuries, taking into account the characteristics of the stages of development of society.

Materials and methods, results and discussions

A distinctive feature of modern society is techno-materiality, which implies the design and construction of innovations with given properties using information technologies. The priority scientific direction in the development of the food industry is the design of specialized products, which are multicomponent systems as a result of engineering creativity. The multidimensionality

of the creative activity of a new generation specialist is shown, which is the integration of sciences and special disciplines in the scientific and educational process of the university.

Conclusion

The relevance of designing new products for special purposes in the system "science, education - production - market" is shown, in which at each stage of the process of creating an innovation it is recommended to apply methods of scientific and technical creativity.

Key words: creativity, scientific and technical creativity, innovation design, development of SFP, specialist, food industry

Introduction. A distinctive feature of a modern university lies in the sequence of processes that form a specialist: training - research - creation of innovations - commercialization of innovations. Innovation as a result of scientific and innovative activity is based on creativity aimed at generating ideas and their implementation.

Results and discussions. The level of formation of creativity in a person largely determines the dynamics of the formation of social relations. It was of interest to trace the formation of the concept of creativity at different stages of the development of society. The analysis of scientific and technical literature was carried out and a selection of the concepts of the term "creativity" was made in chronological order (table 1).

Table 1

Definitions of the concept of "creativity" in chronology

Source	Definition
Pre-industrial period	
F. Bacon	Creativity as a successful - but largely random - combination of already existing elements
Industrial period	
Berdyaev N.A. The meaning of creativity, 1916.	The process of cultural human activity, as a result of which *qualitatively new material* and spiritual values are created. The ability of a person from the material delivered by reality to create a new reality that satisfies the diverse needs of a person.
Post-industrial period	
Philosophy of science and technology, Dictionary, 2016	The activities of people aimed at creating a new, earlier not famous; human capacity from known to create in the process of labor *a new reality* that meets the diverse social needs. Scientific creativity - creation of *new* theories, new scientific disciplines, discovery of *new* phenomena, introduction new concepts and terms.
Novoselov S.V. Theoretical Innovation , 2017	Creativity and philosophical aspects of scientific and technical creativity, together with the main scientific and technical features of modernity, are the basis for scientific and innovative activities and *innovative development of the* life of society

A comparative description of the term shows that the industrial period already characterizes creativity as a productive ability of the human imagination. At the present stage of the development of society, scientific and technological progress based on the scientific and technical creativity of specialists is based only on the integration of science and production as an element of innovative development aimed at consumer satisfaction.

The result of generalizing the concepts of "creativity" from different points of view of authors and periods is the understanding that:

- creativity is an activity or a component of an activity;
- the source of creativity - a person endowed with certain creative abilities, possessing the necessary skills and abilities;
- the result of creativity - something new, as a result of fundamental and / or applied research, aimed at satisfying human needs.

The concept of "creativity" is multifaceted and is studied within different disciplines and sciences, such as philosophy, psychology, sociology, aesthetics, pedagogy, science of science , cybernetics and others. Interest in creativity as a process and its results contributed to the formation of a special science that specifically studies creative activity - eurylogy . The concept of "creativity" in different fields of knowledge is given in Table 2.

Table 2

The concept of "creativity" from the point of view of different sciences

Science	Definition creativity
Philosophy	An activity that generates something qualitatively *new* and is distinguished by originality, originality and socio-historical uniqueness; the creator can be both natural intelligence (human), and its continuation - artificial (computer)
Sociology	Socially significant activity to create *new* material and spiritual values in the interests of society in a specific local socio-cultural environment. It is a means of self-expression, self-realization of the individual to achieve success in socially significant activities, in winning leadership positions in a particular area.
Pedagogy	The ability of a teacher / person to learn through the prism of individuality and effectively apply traditional methods and techniques of pedagogical activity in *new* conditions, to create new socially valuable pedagogical technologies, methods and techniques.
Psychology	A type of human activity aimed at solving *a new* problem, creating something that has never been created by anyone else. The products of human creative activity are objects of material and spiritual culture, as well as the transformation of nature and society.
Aesthetics	Creation *new* aesthetic values .
Cybernetics	Increasing the efficiency of scientific work of the information symbiosis of a machine and a person, i.e. direct interaction between a person and an information-logical machine in the process of creativity in solving *scientific* problems.

The unifying element in the interpretation of the term "creativity" by different sciences is "novelty". The basis for the innovative development of industries (regions) is also the novelty of technical/technological solutions. The term innovative product: a new, competitive product demanded by the market and confirmed by intellectual property [2].

One of the types of creativity is technical creativity, since it is associated with technological transformations, relies on the mechanisms of creative thinking based on visual-figurative and visual-effective components, and its result is an invention [1].

Technical creativity is a cyclical process that includes the stages that are presented in Scheme 1.

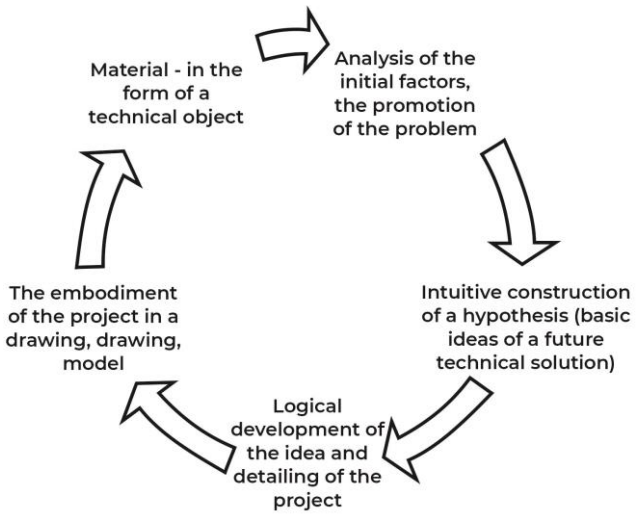

Fig 1. The process of technical creativity

The last stage of the cycle of technical creativity is aimed at creating technical objects and systems. A technical object (TO) is a man-made and really existing device, method, material designed to meet certain human needs. All technical objects consist of elements that are indivisible parts of the whole. If the functioning of one element of TO affects the functioning of another element, then such TO is commonly called technical systems (TS) [3].

A promising direction in solving the problem of healthy nutrition of the Russian population is the development of specialized food products (SPS), which are multicomponent systems. This indicates that scientific and technical creativity is a component of the process of designing such

products as technical systems. NGN design, including search design, is based on the principle of interdisciplinarity . Table 3 contains a list of sciences (disciplines) that form and activate the creative activity of a specialist.

Table 3

Characteristics of disciplines that form creative activity based on the principle of interdisciplinarity

Discipline	Characteristic
neuroscience	An interdisciplinary field of knowledge covering a wide range of brain and neural processes: from molecular structures to the operation of neural networks and brain in in general, the connection of nervous processes with general physiology and human behavior.
Eurylogy	A theory covering all phenomena of creativity: scientific discovery, technical invention, artistic creation, as well as practical activities aimed at creation.
Cognitive science (theoretical)	Science _ about thinking. A field of activity related to the analysis of knowledge (concrete theories) and the provision of knowledge for further development. Cognitive modeling is the vision of specialists in organizing the process of cognition in the "subject-object" system. The subject is a specialist (creative team), the object is an innovation being developed with specified properties
Logic (the science of thought)	It is aimed at developing the ability for logical thinking, analysis, systematization, generalization, critical understanding of information, setting research problems and choosing ways to solve them, publicly present research results, and conduct discussions taking into account the characteristics of professional activity.
Psychology	Studies the human psyche, patterns in the behavior of individuals and their groups, as well as the features of their interaction with each other; mental processes, both conscious and unconscious. The purpose of science is the accumulation of knowledge of practical value for various spheres of life and professional activity.
Combinatorics	Branch of mathematics that studies discrete objects, sets (combinations, permutations, arrangements and enumerations of elements) and relations on them (for example, partial order). food combinatorics - the scientific and technological process of creating new forms food products, including SPP.
Engineering pedagogy	A component of professional pedagogy aimed at training specialists implementing engineering activities. The object of engineering pedagogy is the pedagogical system for training engineering personnel, and the subject is the design and implementation of the content of vocational education, methods and teaching aids. Engineering pedagogy considers two aspects: engineering and pedagogy; includes the theory and practice of design, construction, management of objects and systems, etc. From the point of view of pedagogy: the theory and methodology of teaching technical, technological knowledge, skills and abilities, the formation of methods of engineering activity
Marketing	An organizational function and set of processes for creating, promoting, delivering a product or service to customers and managing customer relationships for the benefit of the organization. Marketing is a management system aimed at motivating a potential consumer to buy a product. Important when saturating the NGN market and bringing them to the consumer

It is of interest to consider the presented sciences (disciplines) in the system "science, education - production - market", which is the main "formula" of innovative development. The analysis shows that the main task for innovative development is to train a specialist who is able to generate an idea (innovation) and then gradually designs (develops) the SPP, taking into account the capabilities (potential) of the enterprise and the demand for a new product on the market. In the absence of demand, the task of a specialist is to create demand.

An important role in solving the issues of development, production and bringing a new product to the market is played by the search for new methods for solving problems. Problem solving is a complex and multifaceted thought process in which important components are: understanding the problem and psychological readiness to solve it [4].

There are numerous classifications of task types. G. Bedny and W. Karwowski offer the following criteria for classifying such a classification [5]:

- the degree of uncertainty of the initial data;
- uncertainty of the main goal of solving the problem;
- information redundancy in the representation of the problem;

- contradictions in the conditions of the problem;
- time constraints in the formulation of the problem;
- specificity of instructions, as well as their descriptive power;
- compliance of the subject's past experience with the requirements of the task.

Research tasks are divided into formalized and non -formalized :

- a formalized task is a task in which all its elements and the relationships between them are known. The content of such a problem can be shown in the form of a mathematical model that has an exact solution algorithm. To solve such problems, automation is applicable, and the role of a person is minimized;

- non-formalized task - a task in which it is difficult or impossible to single out elements and determine relationships between them. The solution of such problems often defies mathematical description; the development of the algorithm is associated with great difficulties, there is a need for cognitive thinking.

Non-formalized tasks, in turn, are divided into tasks that require mnemonic data reproduction; tasks that require simple mental operations with data; tasks that require complex mental operations with data; tasks requiring data reporting; tasks that require creative thinking.

In Table 4, non-formalized tasks are ranked in order of increasing cognitive complexity and operational value. The analysis of non-formalized tasks with the description of their essence is carried out and methods of the scientific and technical decision for concrete groups of tasks are offered.

Table 4

Types of problems and possible methods of solution based on NTT

Type tasks	**Essence tasks**	**NTT methods in solving research problems**
Tasks requiring mnemonic data reproduction	cognitive general education actions	- questioning - sevenfold search method - cognitive models of V.M. Sergeeva - V.L. Tsimbursky, P. Zhane
Tasks that require simple mental operations with data	cognitive general educational , logical actions	- drawing up a formula - method of control questions - Model of P. Janet
Tasks that require complex mental operations with data	cognitive general educational , logical actions	- method of control questions - brainstorm - method of morphological analysis - Algorithm for solving inventive problems (ARIZ)
Tasks requiring messages data	Regulatory, cognitive, communicative actions	- brainstorm - "round table" synectics method - cognitive model of K. Levin
Tasks requiring creative thinking	Regulatory, cognitive, communicative, personal actions	- heuristic methods (random search strategy) - Model of B. Spinoza - Algorithm for solving inventive problems (ARIZ)

The analysis of tasks and solution methods testifies to the expediency of their application at the stage of designing new SSS in the system "science, education - production - market". When preparing a specialist for the food industry, it is important to form, along with professional skills, superprofessional ones . For this, scientific and technical creativity of students in the scientific and educational process is relevant at the university. Disciplines with elements of the sciences presented in Table 3 are expedient. These can be disciplines: Fundamentals of scientific research, Student research work (SRW), Design (modeling) and development of specialized food products, Fundamentals of scientific creativity, Engineering pedagogy, etc.

Conclusion. Thus, the innovative development of the food industry is directly related to the renewal of the education paradigm, an important component of which should be scientific and technical creativity. One of the trends in education is practice-oriented training of a specialist. In

this regard, the developed projects of new products/technologies should include elements of the "science, education - production - market" system. Designing an innovation is a non-formalized task, therefore, it is important to apply the methods of scientific and technical creativity in solving it. Analysis and comparison of scientific developments in the field of NGN shows a preponderance towards the availability of developments and a lack of their finished products on the market. This confirms the expediency of development in the system "from idea to consumer" and shows the potential for economic efficiency and social effect of projects.

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ПРОБЛЕМЫ ОРГАНИЗАЦИИ ОБЩЕСТВЕННОГО ПИТАНИЯ В ТУРИСТИЧЕСКОЙ ОТРАСЛИ ПОЛУОСТРОВА КРЫМ

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THE PROBLEMS OF ORGANIZATION OF PUBLIC FOOD IN THE TOURIST INDUSTRY OF THE CRIMEA PENINSULA

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Аннотация

В данной статье рассмотрены основные виды туристического отдыха на полуострове Крым. Выявлены проблемы в сфере организации культурного туристического отдыха, а именно в организации предприятий общественного питания, находящихся вблизи музейно-выставочных комплексов.

Ключевые слова: внутренний туризм, виды туристического отдыха, предприятия общественного питания, музейно-выставочный комплекс, полуостров Крым.

Abstract

This article examines the main types of tourist recreation on the Crimean peninsula. The problems in the field of organizing cultural tourism recreation, namely in the organization of catering establishments located near the museum and exhibition complexes, have been identified.

Key words: domestic tourism, types of tourist recreation, catering establishments, museum and exhibition complex, region, Crimea Peninsula

In 2020, the temporary suspension of foreign holiday destinations, due to restrictive measures related to the pandemic, forced us to reorient ourselves towards the development of domestic Russian tourism destinations. [one]. As a result, the demand for domestic tourism has increased. "For 9 months since the beginning of the year, the flow of tourists to Crimea amounted to 8.3 million tourists. This is 25% higher than the level of the same period in 2019, "the head of the Crimea Sergey Aksenov said on October 1, 2021 on his page on the VKontakte social network [2].

Crimea attracts tourists with various types of recreation. The most common type of recreation in the summer is the beach. The Crimean peninsula is washed by the Black and Azov seas, so there are beaches for every taste: sandy and pebbly, "wild" and well-maintained.

Active types of recreation on the peninsula include: hiking in the mountains, visiting cave cities, caves, waterfalls. Horse riding and cycling are in demand.

A large number of museums and exhibition complexes on the peninsula contribute to the development of cultural recreation. Unlike beach and active recreation, cultural recreation in Crimea is year-round, so it is so important that the development of this type of recreation is aimed at improving the conditions for tourists.

"Bread and circuses" is a well-known expression, reminding that no matter what type of vacation a tourist chooses, catering will be one of the important indicators in assessing the quality of a vacation.

Considering various types of tourist recreation in the Crimea in terms of catering, problems were identified that tourists face when visiting most museum and exhibition complexes.

To date, a tourist who has visited the museum and exhibition complex, after the tour, is forced to look for catering establishments (cafe, restaurant, canteen) that are within walking distance to eat. At best, he will find an institution that offers either fast food or purchased products, and then only in season. In other cases, catering establishments may not be within walking distance.

In our opinion, the solution to this problem can be the organization of public catering establishments within walking distance from the museum and exhibition complex. It is desirable that the concept of the institution coincide with the concept of the museum and exhibition complex and be its continuation.

A vivid example of such a symbiosis can be seen on the tourist streets in the city of Bakhchisarai, where cafes and restaurants offering dishes of the national Crimean Tatar cuisine for every taste and "purse" are located near local attractions. The architectural appearance of these catering establishments is made in the historical style and is a continuation of the architectural style of the museum and exhibition complex. All these factors allow the tourist to fully plunge into the historical era, not only spiritually, but also gastronomically.

Conclusion: Tourism is one of the main directions of development of the Crimean peninsula.

Tourism is a multifaceted phenomenon, covering a huge number of human interests and hobbies. [3]

Various types of tourist recreation attract a large number of tourists to the Crimea.

Considering various types of recreation in terms of organizing public catering, the main problems in organizing public catering establishments near most of the museum and exhibition complexes of the peninsula were identified, namely:

- lack of catering establishments within walking distance from the museum and exhibition complexes;
- public catering establishments existing near the museum and exhibition complexes operate only during the tourist season (summer period), despite the fact that the museum and exhibition complex operates all year round;
- the concept of public catering enterprises existing near the museum and exhibition complexes does not correspond to the concept of the museum and exhibition complex.

The solution of the problems listed above will increase the level of tourism services provided, which in turn will lead to an increase in the tourist flow.

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ДЕМОКРАТИЗАЦИЯ ПОЛИТИЧЕСКОЙ КОММУНИКАЦИИ И ПОЛИТИЧЕСКОЕ УЧАСТИЕ С ПРИМЕНЕНИЕМ ТЕХНОЛОГИИ ЭЛЕКТРОННОЙ ДЕМОКРАТИИ

DEMOCRATIZATION OF POLITICAL COMMUNICATION AND POLITICAL PARTICIPATION WITH USING E-DEMOCRACY TECHNOLOGY

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Аннотация

За последние несколько лет правительства во всех странах демократического спектра неоднократно прибегали к чрезмерному надзору и дискриминационному ограничению свобод, ограничивали передвижение и массовые собрания. Применялись насильственные ограничения со стороны негосударственных субъектов. Большое количество ложной информации в некоторых случаях преднамеренно созданной политическими лидерами, скрывало достоверные данные и вводило в заблуждение сотни граждан. Возникла потребность в поддержании стабильной демократии и новых форм её проявления. Для такой задачи необходимо сбалансированное законодательство и институты защищающие от накопления власти в руках меньшинства.

Материалы, методы, результаты и обсуждения

С точки зрения геополитического подхода, настоящее стремление государств к усилению регулирования повышает риск использования власти правительством в своих, целях ущемляя права граждан. Наиболее многообещающее законодательство для решения этой проблемы направлено на онлайн пространство, при одновременном приведении корпоративной и государственной практики в соответствие с международными принципами прав человека.

Социальные сети, такие как Facebook и Twitter, давно способствуют продвижению задач и работают как инструмент продвижения демократических ценностей. Они поднимают инфоповоды на глобальный уровень и обращают внимание общественности на возникшие проблемы. Социальные сети стали важным местом проведения ряда уже установленных сфер деятельности. Среди них для исследования наиболее интересно политическое участие в форме обсуждений и выражения политических взглядов.

Заключение

Рассмотренный в статье опыт событий прошедшего десятилетия показал влияние политической активности в социальных сетях на процессы демократизации и политической коммуникации с применением технологий электронной демократии. Также засвидетельствовано появление новой формы политической активности, которая происходит исключительно в социальных сетях.

Ключевые слова: Демократизация, арабская весна, протесты в Венгрии 2014 год, политическая активность, политическая коммуникация, электронная демократия, гражданская активность.

Abstract

Over the past several years, governments across the democratic spectrum have repeatedly resorted to excessive oversight and discriminatory restrictions on freedoms, movement, and mass gatherings. Violent restrictions by non-state actors were applied. A large amount of false information, in some cases deliberately created by political leaders, concealed reliable information and misled hundreds of citizens. There was a need to maintain stable democracy and new forms of its manifestation. Such a task requires balanced legislation and institutions to protect against the accumulation of power in the hands of the minority.

Materials, methods, results and discussions

From a geopolitical perspective, the real desire of states to strengthen regulation increases the risk of the government using power for its own purposes, infringing upon the rights of citizens.

The most promising legislation to address this issue is directed at the online space, while aligning corporate and government practices with international human rights principles.

Social media such as Facebook and Twitter have long been instrumental in advancing the agenda and working as a tool for promoting democratic values. They raise news feeds to the global level and draw public attention to the problems that have arisen. Social media has become an important venue for a number of already established fields of activity. Among them, the most interesting for research is political participation in the form of discussions and the expression of political views.

Conclusion

The experience of the events of the past decade considered in the article has shown the influence of political activity in social networks on the processes of democratization and political communication with the use of e-democracy technologies. Also witnessed the emergence of a new form of political activity, which occurs exclusively on social networks.

Key words: Democratization, Arab Spring, protests in Hungary in 2014, political activity, political communication, e-democracy, civic engagement.

Main part of the study. The relevance of the topic is due to the need to transition countries with a democratic way to a new level of democratic development using innovative technologies in the field of communication and management of political processes.

Modern political processes are characterized by many factors and are largely determined by the peculiarities of the political system and the existing regime. The democratic system corresponds to the type of political process, which is distinguished by the socio-political activity of individuals and social groups. The formation of such a regime is characterized by gradual steps to introduce democratic principles into the political system, public institutions, culture, and lifestyle. Such a conflict-free transition to a democratic regime can be called democratization.

According to S.F. According to Huntington, there have been three waves of democratization in modern history. The first wave lasted from 1828 to 1926, the second wave called the "short wave" lasted from 1943 to 1962, the third wave began in 1974 after the change of authoritarian regimes in a number of countries in Africa, Europe and Latin America and after the partial liberalization of a number of countries. At the same time, Huntington defines a wave of democratization as a group of transitions from non-democratic to democratic regimes that take place within a certain period of time and the number of such transitions exceeds the number transitions in the opposite direction.

A number of researchers consider the processes of democratization in conjunction with the economic inefficiency arising from the transformation of the political regime. There are problems

of delegation of authority from higher authorities - a conflict between the expansion of political rights and the economic feasibility of delegating financial authority to local governments.

Other researchers associate democratization with the possibilities of Internet technologies. They see a potential way in the use of Internet technologies for the real participation of citizens in the activities of government and the development of deliberative democracy. Known and described are examples of such use of Internet technologies and communication within the network in different countries, including authoritarian ones. A number of researchers are ambivalent about the role of the Internet in the processes of democratization and turn their attention to the problem of reducing civic activity. N. Luman [10] points to the "Digital Divide" as a phenomenon in which part of the population will not be able to contribute to the functioning of the political system of society due to unequal access to the Internet.

Examples of democratization and political participation with the use of information and communication technologies. One such example was recorded in Guangdong Province, China. In 2003, Sun Zhigang was taken into custody for not having a temporary residence permit and an identity card to present to the police. Sun Zhigang died three days later. The official cause of death was a heart attack. An autopsy, sanctioned by relatives, found evidence of a severe beating of the prisoner, after which the story was transferred by Sun Zhigang's parents to the liberal newspaper Southern . metropolis Daily . After the publication of the newspaper's own investigation, newspapers and websites across the country re-published it on their resources, the story quickly became national and raised a wave of outrage. The central government was forced to conduct its own investigation, after which twelve people were found guilty of San's death. The case where malfeasance was exposed and punished in 2003 was very rare in China and sparked nationwide discussions about "guardianship and repatriation" measures, resulting in many Chinese citizens posting their stories and outrages online about their own experiences with government agencies. Online petitions were created asking for a review of the work of law enforcement agencies, after which it was closed more than eight hundred detention centers throughout the country [3].

The Sun Zhigang case was one of the first unique examples of indirect e-democracy in a country like the People's Republic of China. The positive results of such a case were the massive involvement of citizens in the political process, the unification of the masses by one idea and the effectiveness of e-democracy.

In modern public politics, representatives of power structures seek to find ways for the development of forms of public participation in the processes of making political and managerial decisions, and interest groups are trying to improve the quality of the policy and its legitimacy. At the same time, the tools of e-democracy are not the reincarnation of the old means of political communication; in such cases, we are talking about democratization and neoliberal ideology within civil society.

In this environment, e-participation affects not only the issue of public engagement in political processes, but also the role of innovation in general. And it can be considered not only as a tool of democratization, but also as a tool of authoritarian control, including as a means of influencing the electorate.

Another striking example of civic activism and the influence of the majority of citizens through the online medium was the revolutionary wave of Arab Spring demonstrations. After a sole act of protest on December 18, 2011 in Tunisia, a wave of controversy and discontent followed. Protest moods have affected Oman, Sudan, Kuwait, Western Sahara, Saudi Arabia and Iran. Protest moods gained rapid and wide coverage with the help of Facebook and Twitter , virtual controversy turned into street manifestations that led to a revolution and regime change of President Zine el-Abidine Ben Ali. The former US Secretary of State (as part of her keynote speech at George University) praised the role of social media in promotion of democracy in Middle East [5, p. 675–679].

Such experience of the events in Tunisia and Egypt showed the online environment as a new, but not the only way to consolidate people with a common ideology.

Phenomena such as the Arab Spring have made the use of ICTs a strategic factor to bypass institutionalized political and information chains to promote political participation. The goal of such movements is not to democratize communication, but to influence the political system widely. Moreover, in this regard, some authors note a greater dependence of these processes on structural factors, and not on the use of non-traditional means such as social media [2, p. 167–188].

Russian reality is full of similar examples, these are protest rallies after the party reform, which significantly changed federal legislation from 2012-2014. The reform reduced the minimum number of political party members to 500, exempted registered parties from collecting voter signatures, and restored direct gubernatorial elections. The most striking of the subsequent protests, mobilized with the help of online space and social networks, is the "Swamp Revolution" protest movement, mass protests in 2019, 2020-2021.

Under the influence of new approaches to the study of the phenomenon of participation, with the advent of new tools of political communication, some researchers of public administration processes find formatted public participation to be highly costly and inefficient [8, p . 564-575]. For the functioning of public participation as a tool for ensuring the rights and opportunities of the public with subsequent participation in the decision-making process, a phased organization is required, consisting of five steps: informing, identifying opinions, discussion, decision-making, feedback [11].

While e-democracy involves all stages of organization in political decision-making, information is most important for political participation.

Mass demonstrations and major protests over the past decade have shown the active integration of social media into political communication and into collaborative political decision-making. Uniting like-minded people, organizing demonstrations or creating collective petitions happens in a short time. A fundamental factor in the rapid organization was the informing of the masses through social networks. As a result of the use of this format by the population to unite people for political purposes, the importance of society as a political unit has increased, the pace of democratization has increased, democratization has been actively initiated from the bottom up, and the quality of e-democracy has increased.

On the example of the country, the unique experience of democratization in the history of Hungary is interesting. The peculiarity of democratization in the country was the prevailing conditions by the beginning of the transitional stage in 1962. The country achieved certain long-term economic reforms and a liberal mood in society until 1980, the rhetoric of power changed. Economic, political and social conditions of democratization have developed in the system of relations "power – population". Pluralism in the political sphere became a political condition: the adoption by the parliament of the "democratic package", the changed social and public moods, reflecting the society's readiness for change.

In the summer of 1989, a number of round tables were held between the opposition and the current government. The subject of discussion was the main ways and mechanisms of transition from authoritarianism to democracy. As a result, 1989 became a bifurcation point, after which a full-scale transition began from the one-party regime of the Hungarian People's Republic to a multi-party parliamentary republic, and in November 1989 a referendum was held to consider issues that could not be resolved during the round tables.

In 1990, after free and competitive parliamentary elections, the center-right Christian Democratic Party won a landslide victory, Hungary became a parliamentary republic, a member of NATO since 1999 and a member of the European Union since 2004. The example of Hungary in the transformation of the political regime can be considered unique due to the initiation of the transition to democracy from above from the ruling party after the removal of Janos Kadar from the post of HSWP General Secretary.

Until recently, Hungary's democracy has developed steadily after the transformation of the political regime, despite initial economic difficulties, stagnation and economic expansion in order to expand the sphere of influence.

In accordance with the recommendations of the Council of Europe, which describe the conditions for the establishment of e-democracy: "E-democracy flourishes best where there is political will and leadership capable of working effectively to introduce structural changes, reforms," the Hungarian government sets a state goal - the modernization of public administration and expanding the use of modern information and communication technologies in the interaction between government agencies and between government agencies and citizens, the development of e-government. Until 2010, the country observed the use of ICT exclusively for the creation of e-government and e-inclusiveness, but after 2010, the first online platforms began to function to promote civil initiatives. Mostly new technologies and online space were used for debate, community building and social movement mobilization. Such a development of the political regime would have been impossible without the previously created conditions and subsequently strengthened the prerequisites for further democratization of relations between the authorities and the population. After the change of government in 2010, the vector of ICT use in the country's politics changed. If, before the change of power, ICT was used to increase the transparency and openness of political processes with a general view of online communication as a progressive tool, after that, the main reason for using such technologies was the implementation and demonstration of political statements from the opposition.

The main technologies of e-democracy in Hungary, on the way to its democratization, were online portals for the adoption of civil initiatives, technologies for organizing the political process using online space, and now the Internet space and social networks are an active participant political processes in Hungary.

Drawing an analogy with other European states, it is worth noting the Kingdom of Norway, where political television advertising is illegal due to its great influence on the masses and may reflect a distorted view of the complex problems in the country, slowing down the democratization process. At the same time, there are no restrictions for political advertising on the Internet, stimulating political communication in the online space. As a result, political parties are allocating an increasing share of their budgets to digital platforms, and there is an outflow of human and financial capital in favor of digitalization.

The space of political communication is functionally connected with a triangle consisting of politicians, citizens and the media [1].

The Hungarian legal system in relation to the channel of political communication - the media - is ambiguous. The Hungarian Media Law grants control of the press to a media council composed of representatives of the ruling party, with council members empowered to decide on fines for print media for unbalanced reporting and violation of moral principles. Such a policy is negatively perceived in society as restricting freedom of speech in the country, hindering democratization and subjected to harsh criticism in the European Union. The European Parliament adopted a resolution on the media in Hungary. In response to the worried rhetoric from the international community and the European Union in particular, the Hungarian government cites the example of a number of EU countries, including Austria, Belgium, Denmark and Sweden, in which, according to the Hungarian government, the media are less independent of the government than in Hungary because . members of the media regulatory bodies in these countries are appointed by the government.

It is worth noting the existence of nuances in the appointment system, which were not mentioned in the statements of the Hungarian government. In Sweden, the press council is funded by the Journalists' Union and the Association of Newspaper Publishers. There is a mechanism for self-regulation of the media - an ombudsman independent of the editor-in-chief or the editorial board, with the functions of monitoring observance of the rights and interests of the media audience. Given the above, countries such as Sweden are more independent and to the greatest extent independent of the government, have independent observers, in the case of the ombudsman - employees with the responsibility of monitoring the quality of the media.

The uniqueness of the legislation in Hungary in relation to the media lies in the opportunities for more intensive development of online channels for the dissemination of political infor-

mation. In accordance with an amendment to the media law in Hungary, bloggers and individual users of Internet resources do not belong to the media and, as a result, are not subject to the law, while there is an ambiguous policy towards Internet resources. In 2015, the popular information site “444. hu " for posting a link to a YouTube video that damaged the reputation of the right-wing nationalist political party Jobbik . Despite this, open Internet sites do not go unnoticed and are becoming the most in demand for political communication, especially from the opposition. There is a growing popularity of their use to identify public opinion on fundamental political decisions and developments in the country. rises use of the network as a platform for political discourse and election campaigns, to provide information about the electoral process in the country and for other forms of e-democracy.

The ruling party's 2014 initiative to impose a telecommunications tax on the use of Internet traffic proved the importance of the Internet not only as an information function, but also as a channel for political communication. The fact of this was the emergence of active protests in the network. The civil initiative on Facebook created the page “One Hundred Thousand Against the Internet Tax”, which collected 225 thousand “likes”, a large number of thematic hashtags of protest content addressed in support of the protest appeared on the social network Twitter . Such initiatives are a vivid example of the manifestation of e-democracy. Political discontent among citizens was also reflected in two major protests in Budapest. Despite the previously recorded broad opposition of civil society to the government in 2014, a large number of those who took to the demonstrations (according to Reuters , about 100 thousand people came to Jozsef Nador Square) [9] expresses the desire of the population to freely use the functions of Internet resources. The Hungarian government also does not engage in politically motivated blocking or filtering of online content, but the declining diversity of online media deserves consideration, which can be attributed to politically biased distribution of advertising revenue. This distribution has led to the closure of some independent online publications over the past few years, such as Magyar Nemzet , Budapest beacon .

As a result of interviews with protesters, general protest moods were identified, to a greater extent related to the widespread dissatisfaction of people with the government. The telecommunications tax served only as a last resort for demonstrations, and the issue of the network traffic tax proved to be formal and suitable for consolidating a number of complaints and grievances against an oppressive government, opening the door for extended criticism towards the regulator. There are also opinions against taxes on the Internet based on the power of the "Internet" idea that can be mobilized to counter politics. For many people in Hungary, the new tax would be a big financial burden that would cause them to abandon access to the Internet, including from the possibilities of e-democracy. Comparing the reasons for the protests, we can conclude that the Internet is a symbol of various types of social processes and political values, as an independent platform with free entry [4, p. 1-16].

Thus, the population protects not only the right to use Internet opportunities, but also expresses its desire to actively use a number of opportunities for e-democracy. This is an open political discussion on the Internet and the use of an independent information field, while the population justifies this with the daily practice of using the Internet, emphasizing the importance of e-democracy.

The Ministry of the Interior is responsible for establishing the general principles of e-government in Hungary, for shaping government policy regarding the development of information technologies in the field of public administration and the development of services, as well as for coordinating legislation related to e-government. For comparison, in Norway, the participants in the administrative chain responsible for elections and e-voting are the Ministry of Public Administration and Reform, the Ministry of Local Government and Regional Development, the Norwegian Technology Council (The Norwegian Board of Technology (NBT)). This distribution of governing bodies in Norway compared to Hungary speaks of a narrow focus on development in the field of technology and detailed control over execution.

Modern trends in the democratization of political communication. The mediatization of political communication has expanded the capabilities of citizens, allowed the democratization

of the online space, made political actors and the media the main producers of information. The new role of citizens and, as a result, of other political actors has reduced the level of mediation. Today, anyone with a social media account, a computer, tablet or smartphone with Internet access can become part of political communication.

This form of political participation is considered one of the lower forms of participation, since it is evasive and impersonal [6].

The progress of information technology is not the only reason for the introduction of e-democracy and the democratization of political institutions. Statistical studies of recent years confirm the general positive changes for democratization and consequent changes in political activity.

On the example of the Russian Federation, according to VTsIOM for 17 years, the number of Russians participating in elections has reached a minimum value, but at the same time, the participation of citizens in collective appeals (petitions) has increased from 4% to 8%, the number of civil activists has increased from 9% to 20% , the number of Russians participating in public organizations and local self-government has tripled. General public attention has shifted from elections to other collective initiatives aimed at improving the living environment and self-organization.

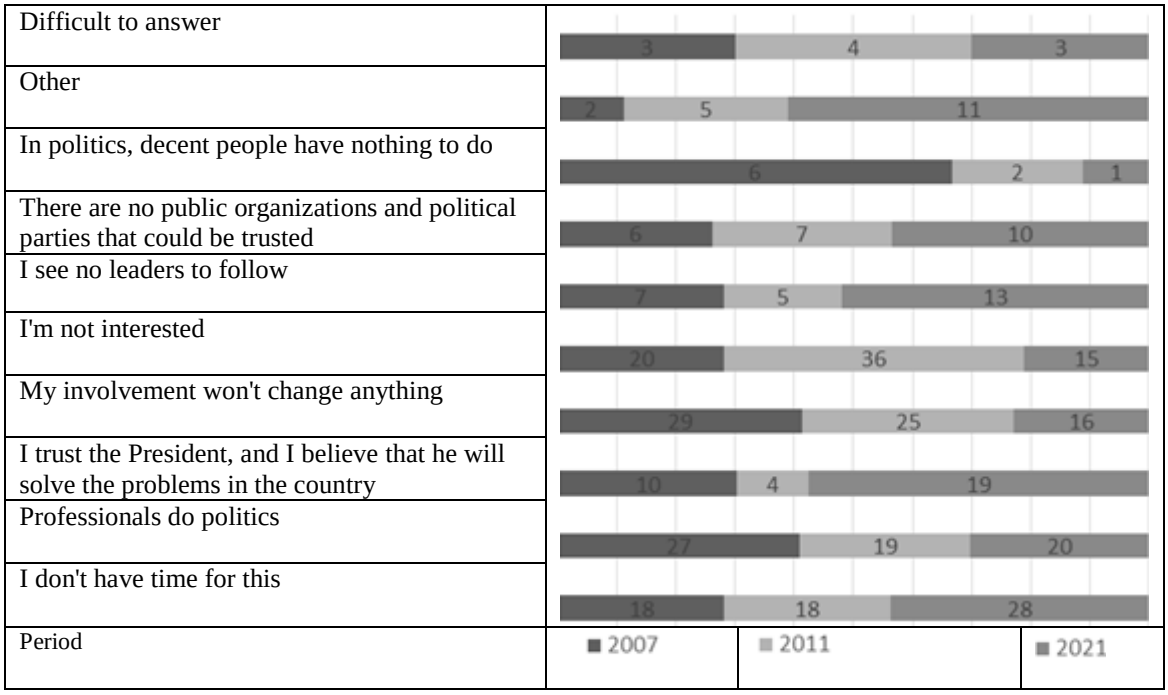

Fig.1. Reasons for refusal to participate in public and political life in Russia, in % of those who did not participate in public and political life

Of those who do not participate in political and public life, 28% argue their position with the lack of time, 20% prefer to leave it to professionals, 19% fully trust the regulator and 16% are convinced that their participation in politics is pointless, this figure peaked in 2021 over the period 2007 according to the All-Russian Center for the Study of Public Opinion [12].

Summarizing the considered trends, we can talk about a change in priorities in the political activity of citizens, about a decrease in interest in one of the most common forms of civic participation in the public and political life of the state - elections. Interest in collective appeals, online petitions, collective initiatives, targeted communication has increased, as a result, the importance of using online space and e-democracy tools has increased.

Conclusion

The concept of decentralized civic engagement has always been considered central to understanding the phenomena of democracy in its various forms [7]. The emergence of one of these forms was facilitated by the development of many technological online platforms that can stimu-

late civic participation and e-participation in equal measure. Promoting more decentralized, workable civic participation platforms outside of the traditional public e-participation ecosystem could provide a democratic platform for promoting civic engagement, building a network to communicate and actually address and impact emerging issues rather than function as a mere public service. The available statistical studies have shown the interest of the population of the Russian Federation in using such opportunities. In this case, the government should take the place of the coordinating center and link the network relations between civil society and the state. With the help of such platforms, lobbying activity of citizens can be carried out online, the need of the population for rallies, protest marches, and demonstrations will decrease, examples of which are described in this paper. The need for other protest forms of public expression of public opinion on topical issues of a predominantly socio-political nature will also decrease.

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ЭВОЛЮЦИЯ ВЗГЛЯДОВ ПРЕЗИДЕНТА В.В. ПУТИНА НА ГРАЖДАНСКОЕ ОБЩЕСТВО И ЕГО РОЛЬ В «ОБЩЕСТВЕ РИСКА»

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THE EVOLUTION OF PRESIDENT VLADIMIR PUTIN'S VIEWS ON CIVIL SOCIETY AND ITS ROLE IN THE "RISK SOCIETY"

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Аннотация

В начале XXI века перед институтом государства возникают новые вызовы и риски, связанные не только с новыми неоднозначными тенденциями глобализационных процессов в мире, но вызовами и угрозами в политической, социально-экономических сферах, а в целом политической стабильности и устойчивому развитию.

Материалы и методы, результаты и обсуждения

Особенно актуальными направлениями деятельности государства в данном контексте становятся поиск новых и перспективных ресурсов для обеспечения политической стабильности и устойчивого развития и адекватного ответа на возникающие угрозы и вызовы при осуществлении политического управления. Поэтому бюрократический аппарат государства вынужден обращаться к гражданскому обществу. И для этого государство заинтересовано в стимулировании появления и становления институтов гражданского общества. С приходом к власти В.В. Путина вопросы развития и функционирования гражданского общества стали одним из значимых направлений в политическом процессе современной России.

Заключение

В этой связи одним из важнейших факторов, определяющих направленность развития гражданского общества в России, была и остается публичная позиция президента Российской Федерации В.В. Путина, выступающего центральной фигурой в выстраивании взаимодействия между властью и институтами гражданского общества, а в целом развития и активизации гражданского общества. В этом контексте изучение основных направлений привлечения ресурса гражданского общества представляется достаточно актуальным.

Ключевые слова: гражданское общество, политическое управление, политический процесс, государственная власть.

Abstract

At the beginning of the XXI century, the institution of the state faces new challenges and risks associated not only with new ambiguous trends of globalization processes in the world, but also with challenges and threats in the political, socio-economic spheres, and in general, political stability and sustainable development.

Materials and methods, results and discussions

In this context, the search for new and promising resources for ensuring political stability and sustainable development and an adequate response to emerging threats and challenges in the implementation of political governance become particularly relevant areas of state activity.

Therefore, the bureaucratic apparatus of the state is forced to turn to civil society. And for this purpose, the state is interested in stimulating the emergence and formation of civil society institutions.

Conclusion

With the coming to power of Vladimir Putin, the issues of the development and functioning of civil society have become one of the most important areas in the political process of modern Russia. In this regard, one of the most important factors determining the direction of the development of civil society in Russia was and remains the public position of the President of the Russian Federation V.V. Putin, who acts as a central figure in building interaction between the authorities and civil society institutions, and in general, the development and activation of civil society. In this context, the study of the main directions of attracting the resource of civil society seems to be quite relevant.

Key words: civil society, political management, political process, state power.

In modern concepts of political management, civil society appears as its integral element, which performs a number of control functions in relation to the authorities and acts as a customer and client before the state [13].

This is the so-called public policy as a sphere of political management controlled by the public, which involves the involvement of public control in the implementation of state programs, the coordination of interests between various social groups, as well as between them and the state . In this regard, the emergence of civil society is associated with a discussion about improving political governance and increasing its effectiveness. In accordance with this, the mechanisms of political management reach the greatest development where a strong civil society has been formed, which, through its institutions, can constantly and effectively influence the state, the development and implementation of political decisions in the country [30] . And, conversely, without a developing civil society capable of controlling the ruling bureaucracy, the state will never be democratic, it will become one of the varieties of authoritarian regimes [13] .

Today, a versatile discussion is underway in many areas of development and the state of civil society in Russia. It should be noted that more often the conversation begins with a statement of the inefficiency and weakness of civil society. Thus, characterizing the current state of civil society in Russia, a number of researchers emphasize the insufficiency / weakness of the participation of civil society in the political process. O.V. Gaman-Golutvina notes that “we have to state the weakness of civil society in the country, not least due to insufficient resource provision ...” [15]. According to T.E. Tkachenko "the unformed civil society is one of the features of the civilizational development of Russia" [29] . In his opinion, this happens due to the immaturity of civil society institutions, which should limit the omnipotence of state authorities and control their actions. Researchers D.Yu.Znamensky and A.N. Shilenkov believe that the main problems of inactive interaction between the state and civil society are "the weak work of public institutions and the unwillingness of power structures to carry out a direct dialogue with citizens" [6] .

The starting point of the modern period of development of civil society in Russia is undoubtedly connected with the onset of the post-Yeltsin era and with the coming to power of V.V. Putin. In this regard, one of the most important factors determining the direction of the development of civil society in Russia has been and remains the public position of the President of the Russian Federation V.V. Putin, who is the central figure in building interaction between the authorities and the institutions of civil society, and in general the development and activation of civil society. In this regard, it is interesting to follow how the discussion about the essence, place and role of civil society in the political process of Russia developed. Why has there been a turn to-

wards the development of civil society? What is the actual political meaning of the appeal to civil society? What prompted V.V. Putin, since 2001, to regularly return to the conversation about civil society and how the tone of V.V. Putin in relation to civil society? What are the President's expectations from civil society?

In search of answers to these questions, we will start from the official speeches of President V.V. Putin in the period from 2000 to **2008** , using materials on the kremlin website as a source base . ru , and others found by the query "civil society".

First of all, we note that for the first time about the ways of formation and development of civil society on behalf of the state V.V. Putin spoke on June 12, 2001 at a meeting with representatives of non-governmental associations and NGOs on the eve of the first Civil Forum. Experts note that this event was the first all-Russian "platform for determining ways of dialogue between civil society and the authorities, as well as searching for opportunities for civil society to influence the course of reforms in Russia" [9] .

Further, already at the opening of the Civil Forum itself on November 21, 2001. the head of state expressed the key problems and tasks of the development of civil society "our civil society cannot yet be considered finally formed", and at the same time the task was voiced "to create the most favorable environment for the development of civil society [7]".

The formulation of this problem makes it possible to emphasize the importance of civil society in the political process in Russia. In particular, V.V. Putin noted that the state "is judged not only by political success and economic development, but, above all, by people, by the level of their personal freedom. By how influential civil society is there"…. "Without a truly partnership between the state and civil society, there can be neither a strong state, nor a prosperous, prosperous society. We need a dialogue on an equal footing here," while the President stressed that "the effectiveness of this dialogue largely depends on us, on the authorities, on the authorities as a whole," and expressed the state's readiness to "take the necessary organizational and, if necessary, legislative measures." to provide effective "feedback" of the society with the state apparatus [7] ."

Thus, the importance and necessity of civil society was noted, some prerequisites appeared for strengthening the influence and role of civil society in the state and political life of the country. Actually, the key task was voiced - the creation of conditions, conducive to the formation of a developed civil society in the country, balancing and controlling power. Thus, the president stressed that the authorities in our country are ready to engage in dialogue with civil society, agree to establish constructive interaction, and recognize the importance of such cooperation.

In the 2002 FC message, the topic of civil society was inscribed in the context of the formation of a strong state, in which information about the activities of state bodies should be "publicly available" for the development of civil society and the interaction of civil society and state bodies. In particular, it was emphasized that "it is necessary to decide on a clear list of information that state bodies are obliged to make publicly available. And this list must be approved by law, as it is necessary for the development of civil society [17]. The head of state also stated that "full-fledged interaction between the authorities and civil society institutions is impossible without information openness, which consists in establishing channels for two-way communication between state bodies and public organizations dealing with similar problems" [17].

The continuation of the theme of the need for transparency and openness in the activities of state power structures, the elimination of unreasonable state interference in the economy took place during the direct line of President V.V. Putin on December 19, 2002. In particular, when an-

swering a question that was raised, the topic of which was relevant and had a high socio-political significance. The essence of the question boiled down to the fact that “no matter what they say in Moscow about simplification of conditions for small business, here the bureaucracy is invincible. If you want to work, you still have to pay fees. For officials, we entrepreneurs are a class enemy. And that is why we need to be pressured with checks and put in our place, to beat out bribes. Is there anything that can be changed?"

When answering the question, recognizing the problem of bureaucratization and corruption as one of the key issues, the head of state stressed that "administration should be transparent, clear, understandable and technological." He further explained that the regulation of issues and problems of this kind requires a civil examination “we must, getting rid of excessive regulation, in the future establish a procedure in which the state body must prove any new regulation, and prove it publicly, with the involvement of civil society expertise [27] ".

Thus , in our opinion, the desire of the head of state to activate civil society is aimed at solving the traditionally strong influence of bureaucracy on public life in Russia, the informational closeness of public authorities, which consists in the constant desire of state structures not to interact with civil society, but to manage them, ignoring bottom impulses .

On May 16, 2003, in the Address of the President to the Federal Assembly of the Russian Federation, the topic of civil society became one of the key ones. In fact, this message clearly and unequivocally recorded the inextricable link between a developed civil society and democracy, capable of creating decent conditions for people's lives "Russia should be and will be a country with a developed civil society and stable democracy" [20].

Moreover, it was in this document that a strategic line was outlined to increase the role of the state in the formation and functioning of civil society institutions "in the country, conditions have been created for the development of a full-fledged civil society." In addition, in the Address , “ consolidation, mobilization of intellectual forces, the combined efforts of authorities and civil society [20] ” were considered in the context of solving national problems, including: “unstable and very weak economic foundation, underdeveloped political system, inefficiency of the state apparatus , non-competitiveness of most sectors of the economy, population decline, difficult international situation, high level of competition in the global economy”.

It is noteworthy that in the message of 2003 it was emphasized that the reduction of the functions of state structures is one of the core conditions for strengthening the role of civil society "a fully developed civil society will arise only in conditions of a radical reduction in the functions of the state apparatus, overcoming mistrust between various social groups" [20] .

Thus, the content of the speeches of the President of Russia V.V. Putin emphasizes that the development of civil society is becoming one of the main political tasks of the state. Since the formation and development of civil society institutions are considered by the President of the Russian Federation, first of all, as the most important resource for solving urgent socio-political problems and maintaining political stability and sustainable development, through.

The need for a mature civil society and the “duty of the state to create the necessary legal and economic base” for the development of a “capable civil society” was repeatedly discussed by the head of state in 2004 in the context of pre-election tasks. Thus, in particular, on February 12, 2004, at a meeting with trusted representatives, it was noted that “without a mature civil society, it is impossible to effectively solve pressing problems. I am convinced that only a developed civil society can ensure the inviolability of democratic freedoms, guarantees of human and civil rights”

[5] . In addition, the task of strengthening civil society was discussed on March 15, 2004 at a meeting with journalists at the campaign headquarters for the presidential elections in Russia “We will strengthen civil society. And at the same time, we will create conditions under which neither officials, hiding behind the interests of the state, nor all sorts of rhetoricians, hiding behind democratic phraseology, could fill their pockets” [23]. In addition, the commitment to the development of civil society was also emphasized in the course of answering a journalist's question about the priority of the planned reforms in domestic policy, “ We must make much more efforts in order to strengthen the institutions of civil society. Now, if we manage to do all this, then this will be a good basis for building a modern economy” [3] .

Thus, we observe that the president expresses the readiness of the state to provide an economic and legal basis for the formation of a developed civil society, continues to demonstrate the desire to strengthen civil society, considering it the basis for countering bureaucratic arbitrariness, as well as solving economic problems and challenges .

In the May 26, 2004 message to the FC, the topic of civil society was inscribed in the context of the implementation of three "national projects": overcoming poverty, modernizing the armed forces and housing reform. “Certain economic opportunities, political stability and an active civil society” were declared the most important prerequisites that could lead to the **expected results in the implementation of these projects** “a high standard of living in the country, a safe, free and comfortable life, a mature democracy and a developed civil society, strengthening Russia's position in the world [eighteen]".

Thus, in 2004 the issues of strengthening and developing civil society continue to be one of the most significant areas in the official speeches of the Russian leadership.

In this regard, there is every reason to assert that one of the grounds for the head of state to turn to the resource of civil society is the current risks and challenges to political stability and sustainable development of Russia. Thus, for example, the problems of terrorism and the threats and security risks caused by it prompted the authorities to turn to the resource of civil society. In particular, in 2004, the tragic events that took place in Beslan became the starting point for political reforms, one of which was directly related to civil society. First of all, we are talking about the creation of the Public Chamber. “We are counting on society's help in the fight against terrorists. In this regard, I consider the idea of establishing a public chamber as a platform for a broad dialogue to be thought out,” said President V.V. Putin on September 13, 2004 during a speech on the problems of state building and external threats and challenges . It was also noted that "the fight against terror is our common and main goal, and its achievement directly depends on how effectively all the resources of the state and civil society are mobilized [8]".

Thus, it can be argued that against the backdrop of threats and challenges of the spread of terrorism, attempts to activate civil society continue. Undoubtedly, the leading and decisive role in countering terrorist activities belongs to the state and their competent authorities, but at the same time, the leadership of state agencies in these matters does not exclude, but, on the contrary, involves the involvement of civil society institutions, traditional religious communities, and scientific institutions in countering terrorism. and educational institutions, mass media, NGOs [28].

In addition, the course pursued in the country for the development of civil society in 2004 received reinforcement through the creation of the Council under the President of the Russian Federation to promote the development of civil society institutions and human rights (since 2011 - the Council under the President of the Russian Federation for the development of civil society and

human rights) . The Council is an advisory body formed to assist the head of state in exercising his constitutional powers in the field of ensuring and protecting the rights and freedoms of man and citizen, informing the President of the Russian Federation about the state of affairs in this area, promoting the development of civil society institutions, preparing proposals for the head of state on issues within the competence of the Council" [16] .

Thus, in 2004, the calls in the speeches of the President of the Russian Federation V.V. Putin to strengthen and develop civil society were reinforced by creating, including on his initiative, a number of civil society institutions that determine the image of civil society in modern Russia.

So, during the first term of his presidency, the core idea in the speeches of President V.V. Putin had the idea of unlocking the potential and strengthening civil society in Russia and building up interaction between the government and civil society . These tasks were considered as mandatory objective prerequisites, without which it is impossible to resolve the accumulated urgent problems and ensure order and political stability and sustainable development, as well as to counter the challenges and threats that are relevant at the beginning of the 21st century.

The tasks of strengthening and activating civil society, involving civil society in interaction with authorities at all levels were repeatedly discussed in presidential speeches in 2005. So, on April 25, 2005, in the Address of President V.V. Putin's FS contained a repeated appeal to the problems of civil society and the formation of Russian democratic statehood. In particular, the development of civil society as a whole was designated as one of the three priority areas along with the development of the state and the strengthening of the law, and the development of the political system, increasing the effectiveness of justice.

At the same time, the message contained criticism of the mechanisms of interaction between the authorities and civil society in Russia. In particular, harshly assessing the role of the bureaucracy in the development of the country and civil society, it was emphasized that "our bureaucracy is still largely a closed and arrogant caste that understands state interests as a kind of business. If we do not fight this, corruption will continue to flourish, the isolation of officials from society, the potential of civil society will remain unclaimed " [19]. At the same time, in order to prevent such an option, the need was emphasized "to expand the control functions of civil society institutions, to provide them with direct access to state television [14] ".

Thus, one of the most important factors determining the direction of the development of civil society in Russia has been and remains the desire to reduce the traditionally strong influence of bureaucracy on public life in Russia, which carries risks and threats to political stability and sustainable development.

Of particular interest in 2005 is also the formulation of the task of developing civil society in the context of combating corruption, which has taken "acute forms" in the country. This is evidenced, in particular, by the president's response to a question from the CBS television channel , in which he expressed confidence that "we will be able to effectively fight corruption only if we really contribute to the development of media independence and the creation of effective civil society institutions" [24].

The topic of civil society in the context of combating corruption was touched upon on September 27, 2005 and during the annual direct line. In particular, the president focused on the need for civil society to control the spending of budgetary funds, "I very much hope that civil society and various public organizations will control the spending of budgetary funds" [27] .

Thus, the president's appeal to civil society in the context of combating corruption, as was said, is justified in connection with the growth of corruption. So, in particular, on July 21, 2005, G. Satarov's article on corruption in Russia, published in Izvestia, noted that "in 4 years, corruption in Russia has grown almost tenfold." The scale of this phenomenon in Russia is confirmed by the stereotype of a "corrupt official and politician" that has formed in Russian society [2], which exacerbates the feeling of social injustice among the broad masses of the population and poses a real threat to the sustainable development of the state and the implementation of national projects, undermines the population's trust in the authorities.

At the same time, it should be noted that it is impossible to effectively fight corruption within the framework of only state structures. Hence, there was a radical reassessment of the role of civil society, which began to be regarded as an important element aimed at improving public administration, capable of ensuring openness and transparency of the activities of government bodies, combating corrupt practices and ensuring the protection of human rights and freedoms.

In 2006 , the President paid attention to the topics of civil society in his Address to the Federal Assembly and at a meeting with representatives of political parties .

The Message of the President of the Russian Federation to the Federal Assembly dated May 10, 2006 reaffirms the strategic course for the development of democratic statehood in Russia, expresses Russia's readiness to counter existing external threats, including terrorism, strengthening the nuclear nonproliferation regime. At the same time, it is stated that "we will not be able to solve any of the urgent tasks facing our country without ensuring the rights and freedoms of citizens, without the effective organization of the state itself, without the development of democracy and civil society" [22].

In addition, at a meeting with representatives of political parties on December 6, 2006, the subject of civil society was touched upon in the context of countering terrorism and extremism "countering extremism is not only the task of the state, although, of course, the state must first of all respond to manifestations of this kind. Effectively one state is not able to cope with this problem. Here we need the consolidated efforts of political parties, other public organizations, the entire civil society, all citizens of the country [4] .

Despite the fact that it was possible to significantly reduce the level of terrorist threat and the number of terrorist attacks on the territory of Russia, the threat of the spread of extremism and terrorism in Russia in 2006 has not been completely eliminated. In particular, we are talking about an attack on government officials in the North Caucasus and the explosion of the Nevsky Express train, **on August 21, 2006,** an explosion at the Cherkizovsky market in **Moscow** , which killed 14 people and injured 61 people [26] .

And it is quite natural that one of the aspects and forms of countering this type of threats and challenges has become the need for a comprehensive solution to the problem through cooperation in anti-terrorist actions of special services and civil society. Religious organizations occupy a special place among public associations in the context of the struggle against terrorism and extremism under consideration. No less significant in countering terrorism is the role of the mass media.

Thus, in the light of the ongoing events regarding the threat of the spread of extremism and terrorism , it has become a fairly serious reason for adjusting the political system in the direction of further strengthening civil society.

In 2007, in his public speeches, the head of state again expressed his desire to strengthen and significantly expand the areas of interaction between state power and civil society.

First of all, on January 11, 2007, at a meeting with representatives of the public, the president noted that “the state will continue to support civil society structures, including in the implementation of public control over the activities of law enforcement agencies, in the fight against extremism, drug addiction, youth crime and child homelessness” [25].

The topic of combating corruption through civil society was raised at the annual press conference on February 1, 2007. Despite the ongoing state anti-corruption policy, the political mechanisms involved, the situation in our country has not changed significantly for the better, continuing to cause serious concern on the part of society. This is evidenced by the question addressed to the president regarding "how can officials prevent theft by officials of the budget allocated for the APEC summit in the Far East." When answering the question, it was emphasized that “the most effective way to fight corruption is to strengthen civil society and develop the media” [10].

All these and other facts testify to the fact that it is impossible to effectively fight corruption within the framework of state structures. Hence the growing importance of civil society.

The topic of Russian civil society became one of the key topics in the President's Address to the Federal Assembly in 2007. First of all, the message clearly outlined national priorities - the formation of a **capable civil** society, the construction of an effective state that ensures the safety and decent life of people, the establishment of free and socially responsible entrepreneurship, the fight against corruption and terrorism, the modernization of the Armed Forces and law enforcement agencies, and finally, significant strengthening of the role of Russia in international affairs” [19].

As confirmation of the positive dynamics in the development of civil society, an increase in the number of registered media and non-governmental associations (NGOs) was noted, and it was emphasized that “in a democracy, it is impossible to imagine political processes without the participation of non-governmental associations, without taking into account their opinions and positions” [19].

Particularly positive was the impact of the Civic Chamber “on rule-making activities, on the activities of the Government and the Federal Assembly, as well as on the administrative practice of ministries and departments. The Public Chamber did not stand aside from the fight against xenophobia and hazing in the army. It makes a significant contribution to strengthening the rule of law and protecting human rights [19].” Summarizing what was said, the head of state emphasized, “All these are real indicators of the formation of an active civil society in Russia [19] .

Emphasizing the importance of civil society, the Russian leadership is active in its speeches, not missing the opportunity to make proposals on various aspects of the activation and strengthening of civil society. Thus, on December 17, 2007, during a speech at a meeting of the VIII Congress of the United Russia party, the president emphasized the importance of dialogue with civil society organizations “United Russia should be open to dialogue and cooperation with civil society institutions, with all responsible and constructive political forces in the country" [6].

Thus, during the second presidential term after the stabilization of the political and socio-economic situation in the country, V.V. Putin revealed in sufficient detail in his speeches at various meetings and forums his vision of the formation of civil society in Russia and the features of its functioning in the Russian political system. The emphasis was placed not on the classical and self-sufficient confrontation between the institutions of civil society and the state, but on their interaction aimed at consolidation and social responsibility, public control and civic activity [1].

It was repeatedly emphasized that it is the degree of development of civil society, its institutions and the degree of interaction between the institutions of power and civil society that deter-

mine the solution of such tasks as: combating corruption and other negative manifestations in the institutions of state power; increasing the responsibility of the state apparatus and state institutions to society; effective fight against terrorism and extremism **.**

Thus, the analysis of the public speeches of the Russian president allows us to identify several trends in addressing the topics of civil society within the framework of official public discourse.

During the first period of presidential rule V.V. Putin emphasized, first of all, the need to strengthen and unlock the potential of civil society in Russia. This task was seen as an obligatory objective prerequisite, without which it would be impossible to resolve the accumulated urgent social problems and ensure order and stability in Russian society.

During the second presidential term, the emphasis was placed on the interaction of civil society and government agencies, aimed at consolidation and social responsibility, public control and civic activity.

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ТИПОЛОГИЯ ФОРМ ПОЛИТИЧЕСКОГО УЧАСТИЯ

TYPOLOGY OF POLITICAL PARTICIPATION FORMS

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Аннотация

В современной политической науке, что не так часто встречается применительно к ее базовым концептам, в целом достигнут консенсус относительно того, что же понимать под политическим участием. Сегодня большинство авторов проводят свои исследования в русле «реалистичного» подхода, при котором политическое участие трактуется как некая совокупность успешных и неуспешных попыток повлиять на процесс принятия политических решений. Ученые, посвятившие свои исследования политическому участию, соглашаются, что оно может приобретать различные формы. Однако по-прежнему нет единой точки зрения, какие конкретно формы следует различать и как их дифференцировать. Цель настоящего исследования состоит в том, чтобы систематизировать существующие в литературе классификации форм политического участия и разработать обобщающую их типологию.

Материалы и методы, результаты и обсуждения

В статье автор, подвергнув анализу широкий пласт соответствующей научной литературы, выявляет три подхода к определению политического участия: «оптимистичный», «пессимистичный» и «реалистичный». Доказывая преобладание в современных исследованиях «реалистичного» подхода, он приходит к выводу, что ученые анализируют большое разнообразие форм политического участия, которое требует систематизации.

Заключение

В итоге он предлагает авторскую типологию форм политического участия, включающую в себя семь критериев.

Ключевые слова: политический процесс, политическое участие, формы политического участия, конвенциональное участие, неконвенциональное участие

Abstract

In modern political science, which is not so common in relation to its basic concepts, a consensus has been reached on the whole as to what is meant by political participation. Today, most authors conduct their research in line with a "realistic" approach, in which political participation is interpreted as a certain set of successful and unsuccessful attempts to influence the political decision-making process. Scientists who have devoted their research to political participation agree that it can take various forms. However, there is still no single point of view on which specific forms should be distinguished and how to differentiate them. The purpose of this study is to systematize the existing classifications of forms of political participation in the literature and to develop a generalizing typology of them.

Materials and methods, results and discussions

In the article, the author, having analyzed a wide range of relevant scientific literature, identifies three approaches to the definition of political participation: «optimistic», «pessimistic»

and «realistic». Proving the prevalence of the «realistic» approach in modern research, he comes to the conclusion that scientists are analyzing a wide variety of forms of political participation, which requires systematization.

Conclusion

As a result, he offers the author's typology of political participation forms, which includes seven criteria.

Key words: policy-making process, political participation, forms of political participation, conventional participation, unconventional participation

Introduction and relevance. In modern political science, which is not so common in relation to its basic concepts, there is generally a consensus on what is meant by political participation. Today, most authors conduct their research in line with a "realistic" approach, in which political participation is interpreted as a certain set of successful and unsuccessful attempts to influence the political decision-making process. Scholars who have devoted their research to political participation agree that it can take many forms. However, there is still no single point of view on what specific forms should be distinguished and how to differentiate them. The purpose of this study is to systematize the classifications of forms of political participation existing in the literature and develop a typology generalizing them.

Materials and methods. The results and conclusions of this study were obtained using comparison and classification methods, which made it possible to single out both the actual forms of political participation and build a typology that includes various classifications. In parallel, a content analysis of specialized literature was used, which made it possible to substantiate the criteria for distinguishing these forms.

Literature review. In the political science literature, there are three main approaches to understanding political participation, which can be called "optimistic", "pessimistic" and "realistic". From the point of view of the "optimistic" approach, political participation is the direct participation of citizens in the decision-making process. According to, for example, K. Gould, political participation is characterized by the direct and direct involvement of stakeholders in the decision-making process [1]. In her opinion, only those activities that involve the direct exercise by citizens of the power given to them, and not its delegation to one or another representative, can be called political participation. According to B. Barber, political participation is rather the self-government of citizens, weakly connected with the activities of the government [2]. As a consequence, political participation can only take place in spaces that are not part of national and regional participatory systems. Based on a "pessimistic" approach, ordinary citizens cannot have any influence on the political decision-making process and therefore are content with only conversations and discussions. Hence, political participation is the participation of citizens in political discussions that flare up around certain pressing problems. So, S. Chambers argues that political participation is focused not so much on the decisions made, but on the formation of an opinion that accompanies these very decisions [3].

In the "realistic" approach, which is most widespread and prevailing in the texts of textbooks and scientific articles, political participation is a certain set of attempts, both successful and unsuccessful, to influence the process of political decision-making. So, according to S. Verba and N. Nye, political participation refers to the actions of private citizens, i.e. citizens who do not hold official positions, aimed at influencing the government, either on the choice of government personnel, or on the choice that these government personnel make [4]. From this perspective, participation is an instrumental act by which citizens attempt to force elements of the political system to obey their will, a mechanism of representation through which officials are informed about the preferences and needs of society and encouraged to respond to these preferences and needs.

All so-called. "classic" definitions of political participation are formulated within the framework of this approach. L. Milbreth and M. Goel call political participation the actions of ordinary citizens, through which they try to influence the government and politics or support them [5]. M. Kaase and A. Marsh define political participation as any voluntary activity of individual

citizens aimed at having a direct or indirect influence on political choice at various levels of the political system [6]. G. Perry, D. Moiser and N. Day understand political participation as the actions of citizens aimed at influencing decisions made by members of the public and officials [7].

Based on the definitions developed within the "realistic" approach, political participation has the following main properties. First, political participation refers to individuals in their role as citizens, not as politicians or civil servants. Secondly, political participation is activity; the study of political materials broadcast on television or published on social networks, or political statements cannot be considered participation. Thirdly, political participation is an activity undertaken by citizens voluntarily, and not under the coercion of the ruling class or in compliance with certain laws (this property does not apply if we assume the existence of autonomous and mobilization participation). Finally, fourthly, political participation concerns the entire mechanics of the political system, not limited to specific stages (for example, the adoption of parliamentary decisions) or specific levels (for example, national elections) [8].

Results and discussion. With almost complete consensus on the essence of political participation, researchers distinguish many of its specific forms. An analysis of the specialized political science literature shows that most often, to classify forms of political participation, scientists are guided by seven criteria: the scale of involvement, the degree of involvement, incentives for participation, the type of participants, the environment for participation, the type of activity, and compliance with norms.

The first criterion for classifying forms of political participation used by scientists is the scale of involvement. From this point of view, political participation can be individual and collective. A citizen can donate funds to one or another political party, individually getting involved in political activities. At the same time, a citizen can take part in political demonstrations or rallies, which involve the interaction of many participants and, therefore, collective activity. The choice in favor of individual or collective participation largely depends on the personality traits [9].

The second criterion for the classification of political participation can be called the degree of involvement of citizens. Based on this criterion, democratic, balanced and limited participation are distinguished [10]. Democratic participation implies the constant and diverse involvement of citizens in the activities of political institutions, as a result of which they receive real leverage. With balanced participation, citizens are involved in politics periodically and more uniformly, and they are able to exert any significant influence only after reaching a consensus with the authorities. Limited participation occurs when citizens are involved in politics only in situations and in forms beneficial to the authorities. In this case, they have no opportunity to influence the decision-making process, acting only as a legitimizing resource.

The third criterion used in science to distinguish between forms of political participation is the incentives that push citizens to such participation. Based on this criterion, political participation is divided into autonomous and mobilization [11]. Autonomous participation implies that citizens independently, voluntarily, engage in political activity, pursuing their own interests. Mobilization participation, on the contrary, assumes that citizens are not independent, forcibly involved in political activity, reacting to administrative pressure or adhering to traditions. As a rule, autonomous participation is characteristic of systems with democratic regimes, and mobilization is characteristic of authoritarian regimes, which are characterized by frequent attempts to symbolically involve citizens in various political events in order to simulate mass support [12].

The fourth criterion for classifying participation is the type of participants. According to this criterion, two forms of political participation are distinguished: the participation of public actors and the participation of political consumers. They differ from each other in interest and organization. If social actors are focused on solving problems that are significant for the whole society and are more or less formally organized, then political consumers are focused on realizing their own interests and act in an informal way. As a result, the former, who are called "political optimists", treat the world of politics with much more confidence than the latter, who constantly demonstrate their pessimism [13].

The fifth criterion for the classification of political participation, which is now widely used in scientific research against the backdrop of the rapid development of Internet resources and information technology, is the environment of participation. Based on this criterion, offline participation and online participation are distinguished. As the names suggest, offline participation involves the involvement of citizens in actions held in a physical, real space, while online participation involves actions in the Internet space [14]. Researchers have different attitudes towards singling out online participation as a separate form. Some consider it a new full-fledged form of participation [15], while others point out that it is just an illusion of real participation [16].

The sixth criterion for classifying forms of political participation is the type of activity. So, S. Verba and N. Nye in their often cited classification distinguish 4 types of political participation: voting, campaigning activity (for example, work in the interests of parties, etc.), contacts with officials, public activities (interactions focused on problems of the local community) [17]. J. Theorell, M. Torkal and H.R. Montero offer an even broader classification, covering 5 types: electoral participation (voting in elections), consumer participation (financial donations, signing petitions, etc.), party participation (party membership), protest participation (participation in rallies, demonstrations, etc. .) and contact participation (contacts with politicians, officials, etc.) [18].

Finally, as the seventh criterion for classifying forms of political participation, one can single out compliance with norms. Participation may or may not comply with laws, traditions, accepted practices. J. Ekman and E. Amna distinguish between formal (voting in elections and referendums, contacts with political representatives and civil servants, monetary donations to political parties and organizations, etc.) and informal political participation, the latter being subdivided into legal (boycotting, signing petitions, distribution of leaflets, etc.) and illegal (civil disobedience, politically motivated attacks on property, etc.). At the same time, these scientists refer formal and informal participation to manifest participation, which is preceded by latent participation, which consists in showing citizens' interest in political problems [19]. Analyzing the links between political trust and forms of political participation, M. Hooghe and S. Marien proceed from the division of forms of participation into institutional and non-institutional [20]. However, most often scientists, trying to classify the forms of participation on the basis of the criterion of compliance with the norms, operate with the concepts of conventional and non-conventional participation, as is done, for example, by I. Lamprianu [21] and E.N. Maksimov [22].

Table

Typology of forms of political participation

Criterion	Forms
Scale of involvement	individual, collective
Degree of involvement	Democratic, balanced, limited
Participation Incentives	Autonomous, mobilization
Participant Type	Participation of public actors, participation of political consumers
Participation environment	Offline participation, online participation
Activity type	Voting, campaign activity, contacts with officials, social activities Electoral participation, consumer participation, party participation, protest participation, contact participation
Compliance	Formal, informal Institutional, non-institutional conventional, non-conventional

Conclusion. After examining various classifications of forms of political participation, a typology can be proposed that includes the following criteria: scale of involvement, degree of involvement, incentives for participation, type of participants, environment for participation, type of activity and compliance with norms (Table 1).

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НА ПУТИ К ПОСТРОЕНИЮ СИСТЕМЫ БЕЗОПАСНОСТИ БОЛЬШОГО ПРИЧЕРНОМОРЬЯ: ВЫЗОВЫ, МЕХАНИЗМЫ, СТРАТЕГИЧЕСКИЕ ПОДХОДЫ

TOWARDS THE BUILDING A WIDER BLACK SEA REGION SECURITY SYSTEM: CHALLENGES, MECHANISMS, STRATEGIC APPROACHES

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Аннотация

Перестройка и последующий распад Советского Союза стали причиной тяжелейших социальных потрясений и вызовов национальной безопасности практически во всех новообразованных государствах постсоветского пространства.

Материалы и методы, результаты и обсуждения

Ослабевшая власть Москвы разморозила этнополитические конфликты на Кавказе (в Нагорном Карабахе, Абхазии, Южной Осетии, Чечне) и спровоцировала сепаратизм в Молдавии (Гагаузия, Приднестровье), обострила межэтнические противоречия в Центральной Азии. Постсоветские этнополитические конфликты, то есть те, что связаны с вопросами политического самоопределения этносов, были всецело сконцентрированы в регионе, называемом Большим Причерноморьем, куда помимо прибрежных государств относят Армению, Азербайджан, а также некоторые балканские страны.

Заключение

Высокая конфликтогенность Большого Причерноморья в сочетании с его абсолютной геостратегической значимостью предопределили важность региона для интересов для таких ключевых акторов современных международных отношений, как НАТО, ЕС, выступающих единым фронтом, и РФ. Особую роль в регионе играет Турция, умело балансируя между интересами коллективного Запада и Россией и продвигая независимую повестку.

Ключевые слова: Большое Причерноморье, система безопасности, геостратегическая точка, этнополитический конфликт, баланс сил, Организация черноморского экономического сотрудничества, нейтралитет.

Abstract

Perestroika and the subsequent collapse of the Soviet Union caused severe social disturbances and challenges to national security in almost all newly formed states of the post-Soviet space.

Materials and methods, results and discussions

The weakened power of Moscow reenergized ethno-political conflicts in the Caucasus (Nagorno-Karabakh, Abkhazia, South Ossetia, Chechnya) and provoked separatism in Moldova (Gagauzia, Transnistria), exacerbated interethnic contradictions in Central Asia. Post-Soviet ethnopolitical conflicts, that is related to the issues of political self-determination of ethnic groups, were entirely concentrated in the region called the wider Black Sea region, which, in addition to the coastal states, includes Armenia, Azerbaijan, and also some Balkan countries.

Conclusion

The high conflict potential of the wider Black Sea region, combined with its absolute geostrategic significance, predetermined the importance of the region for the interests of such key actors in contemporary international relations as NATO and the EU, acting as a united political

player, and the Russian Federation. Turkey plays a special role in the region, skillfully balancing between the interests of the collective West and Russia and promoting an independent agenda.

Key words: wider Black Sea region, security system, choke point, ethno-political conflict, balance of power, Organization of Black Sea Economic Cooperation, neutrality.

Introduction. The specificity of the Greater Black Sea region, which consists in a combination of two fundamental factors of the conflict potential of this region: the rarest religious and ethnic diversity and the high geostrategic significance of the territory, excludes the stochastic nature of ethnopolitical movements. Such movements and the conflicts corresponding to them are quite natural and even textbook in the conditions of the indicated features of the region. And, on the contrary, the absence or even a small number of ethnopolitical movements in the Black Sea region would be completely illogical and would contradict the basic principles of geopolitics. As Georgetown University professor Charles King notes, "for most of the past two centuries, the strategic environment of the Black Sea zone has been shaped by three factors: the changing balance of power between European and Eurasian states and empires; political ambitions of small states and peoples directly affected by the actions of these powers; and the region's status as a transit point for goods on global east-west and north-south trade routes. In many ways, these factors continue to determine the problems and interests in the Black Sea region today" [7]. Indeed, incorporating the Caucasus and almost the entire Balkan Peninsula, it is fair to designate the Great Black Sea region as a key region of the Eurasian space, where the interests of the great powers of a particular era were regularly suppressed. Occupying the border area between Europe and Asia and always being at the crossroads of transregional and even transcontinental trade arteries (the Great Silk Road, the route "from the Varangians to the Greeks", etc.), this region has always been one of the most significant geostrategic points in the world. Given the above and the role that the region plays in the foreign policy interests of the Russian state, the relevance of creating a sustainable security system in the Greater Black Sea region is beyond doubt.

Research methodology. The study was conducted within the framework of the theories of neorealism and constructivism. As the main methods of analysis, retrospective, comparative geopolitical, conflictological and prognostic methods are used.

Research material: statistical data, individual and collective research studies, materials of congresses, conferences, symposiums.

Research results and their interpretation. Over the past centuries, the main actors in the region have been Russia, Turkey and the so-called collective West, consisting of countries concerned about Russia's expansion in the Balkans. Control over the Black Sea straits, access to the warm seas was one of the priority goals of Russia's foreign policy in the 18-19 centuries. Having lost many years of struggle for the Balkans, Russia returned there by the middle of the 20th century, almost completely covering the Balkans with its sphere of influence, not including only Greece and Turkey (largely due to the implementation of the Truman Doctrine). The collapse of the USSR radically changed the balance of power in the region. Weak post-Soviet Russia could not oppose anything to the methodical strengthening of the positions of the collective West in the form of the EU and NATO in the entire Greater Black Sea region. The key stages of this strengthening were expressed in the following events:

1. The Yugoslavian wars, as a result of which NATO and the EU increased their influence in the Balkans.
2. Accession to NATO of Bulgaria and Romania in 2004.
3. Unilateral declaration of independence of Kosovo in 2008.
4. Color revolutions in Georgia in 2003 and in Ukraine in 2004 and 2013-2014.

How productive were these events for the Western agenda in the region, how destructive they were for the Russian? However, by the mid-2000s, the Russian state managed to return to the path of restoring its geopolitical positions in the region, which led to a new round of confrontation in the region along the Russia-West line. If Russia could not physically prevent the unilateral

recognition of Kosovo's independence in any way, being situationally limited only by diplomatic tools, then in the case of the events in Georgia in 2008 and in Ukraine in 2014, which had an open anti-Russian background, Moscow showed unshakable determination in the matter of maintaining its influence in life. important post-Soviet space and curbing the ambitions of the Euro-Atlantic community to turn the Black Sea into a "NATO lake". As a result of these events, the Russian Federation recognized the independence of Abkhazia and South Ossetia in 2008, and returned Crimea to its territory in 2014.

Nominally, the configuration of forces in the Greater Black Sea region in terms of ensuring military-political security is currently dichotomous. On the one hand, these are NATO forces, represented not only by member countries, but also by states loyal to the Alliance represented by Georgia and Ukraine, and on the other hand, by the Russian Federation. In fact, the situation is multifaceted. In recent years, there has been a development of close cooperation between Russia and Turkey in the issue of ensuring regional security, as well as bilateral relations. The growing political and economic interaction between the two countries, which has obvious signs of a forced situational alliance, equally distributes the influence of both states in the region. Recently, Turkey has been systematically increasing its influence in the Balkans, the South Caucasus and the Middle East. Given the fact that Turkey is a NATO member and has the second largest army in the Alliance after the United States, it would be logical to expect another Russian-Turkish confrontation for zones of influence in the Great Black Sea region, of which there have been more than enough in history. Nevertheless, the two states have so far not only managed to avoid the deterioration of relations, but also successfully agree on many important issues, including such fundamental ones as the joint settlement of the Nagorno-Karabakh conflict and the division of spheres of influence in Syria. Favors the development of bilateral cooperation between Russia and Turkey and the growth of trade between the countries. In recent years, major investment projects have been implemented, such as the construction of the Turkish Stream gas pipeline and the Akkuyu nuclear power plant. And the purchase by the Turkish side of the Russian S-400 anti-aircraft missile systems led to a deterioration in relations between Turkey and the United States.

Ankara's actions to promote an independent agenda in the region, which contradicts the principle of solidarity of NATO member countries and led to a tactical partnership with Russia, testify to the presence of a virtual third independent force in the region. Thus, the global transboundary nature of the Greater Black Sea region today is represented by the watershed of the spheres of influence of the West represented by NATO, Russia and Turkey, balancing between them and promoting an independent agenda. This situation surprisingly accurately reproduces the triangle of confrontation between the Russian Empire, Western countries that acted collectively in the policy of containing Russia in the Balkans (for example, in the Crimean War), and the Ottoman Empire in the 18-19 centuries. Even individual historical events in the region, such as, for example, the annexation of Crimea to Russia in 2014, tend to repeat themselves.

In the context of the presence of relatively equal in potential actors opposing each other, one of the most effective mechanisms for ensuring the security of the region seems to be the balance of power. In essence, such actions as the recognition of the independence of Abkhazia and South Ossetia, as well as the incorporation of Crimea by Russia, in addition to the obvious context of defending their national interests, are also an attempt by Moscow to maintain the balance of power in the region, upset in favor of the West as a result of NATO expansion in the Balkans and pro-Western orientation of Georgia and Ukraine. The effectiveness of regional security based on the balance of power has been tested by time and does not require a detailed analysis. This mechanism will continue to play a stabilizing role in the region until the military-strategic potentials of the warring parties are relatively equivalent or until the agendas of these parties coincide, thereby eliminating the grounds for confrontation. In the context of fundamental differences in the views of Russia and the West on many key issues in the development of international relations, the latter assumption seems to be very utopian.

Nevertheless, the balance of power cannot be a panacea for ensuring security, and even more so for such a complex and geostrategically attractive region as the Greater Black Sea region. The West still has trump cards up its sleeve in the form of the potential accession of Georgia and Ukraine to the North Atlantic Alliance [1, 2], while Russia, in fact, will have nothing to answer for this. Of course, Moscow can recognize the independence of the so-called L-DNR or include them in its composition, but this will not be an adequate response to the membership of Georgia and Ukraine in NATO. However, it is unlikely that Russia will take such legally unjustified steps, because joining any international organization is the sovereign right of states, and thus Russia will demonstrate disrespect for the principle of territorial integrity, to which it appeals, in particular, in the issue of recognizing the independence of Kosovo. The apparent parallel with the annexation of Crimea is actually false - the peninsula was annexed on the basis of the will of the people of Crimea under the conditions of the illegitimate government of Ukraine as a result of a coup d'état, on which Moscow's official position is based [3]. Now the Ukrainian authorities are recognized by the Russian Federation. In addition, recognition of the independence of the "people's republics" of Donbass or their inclusion in Russia will reveal the inconsistency of Moscow's statements regarding the lack of alternatives to the Minsk agreements [5], which, of course, will be a severe blow to the business reputation of the current Russian government.

Thus, in today's rapidly changing world, the balance of power can be a very ephemeral phenomenon. In addition to attempts to maintain a balance of power, it is also necessary to build full-fledged cooperation in the region. To a certain extent, this can be done within the framework of the Black Sea Economic Cooperation Organization (BSEC). Today, the BSEC is the only intergovernmental organization uniting the countries of the Greater Black Sea region. The absence of diplomatic relations between some of the BSEC member states (between Armenia and Azerbaijan, Armenia and Turkey, Russia and Georgia) did not become an obstacle to their work in the organization. Consequently, the development of the BSEC seems to be one of the mechanisms within the framework of the strategy of building a full-fledged security system in the Greater Black Sea region. The high interdependence of the countries of the region will inevitably level out the existing contradictions and make possible a productive dialogue based on mutual concessions.

Other approaches are also being developed. For example, the idea of a Euro-Atlantic vector for the development of the security system in the Greater Black Sea region is quite popular in Western scientific circles, rejecting the significant Russian factor and the attraction towards Moscow of literally all unrecognized quasi-states in the region. For example, political scientists Dimitrios Triantafillou and Mitat Chelikpala propose to be guided only by the NATO factor and the implementation of the Euro-Atlantic security model in the region on the grounds that “three of the six Black Sea coastal states are NATO members, and the other two (Ukraine and Georgia) are actively cooperating with Alliance” [9].

However, it is obvious that without a dialogue with Moscow it is impossible to build a truly effective security model for the Black Sea region. Moreover, ignoring the interests of Russia in the region is fraught with the growth of tension, which in the end can aggravate the situation. There is a need for a dialogue between all the forces in the region with the possibility of a compromise. In fact, modern Russian-Turkish relations can serve as a vivid example of such an approach. There are many contradictions between Moscow and Ankara. Turkey does not recognize Crimea as Russian, declaring this at any opportunity. The countries implicitly compete in the South Caucasus and Syria. But despite all the differences, they manage to find common ground and negotiate. Such could be Russia's relations with other actors in the Black Sea region. In fact, all that is needed is political will.

Some steps in this direction are already being taken. From 2017 to 2021, a major scientific project was implemented on the basis of the University of Graz to exchange knowledge in the Black Sea region [8]. The project united 12 research centers of the Black Sea countries, including Russia (Pyatigorsk State University) [8]. Also, since 2019, under the auspices of the Vienna Institute for Security Policy, a series of expert seminars has been held with the participation of repre-

sentatives of Russia, the United States, the countries of the European Union and the post-Soviet states of the Greater Black Sea region [4]. These meetings have already revealed and confirmed both the existing contradictions and common ground [4].

It is easy to see that today Austria plays a special role in the context of building a dialogue between Western countries and Russia. This, above all, contributes to the neutral status of the Austrian state. In this regard, the well-known Russian political scientist-Caucasian Sergey Markedonov, together with his Austrian colleague from the University of Vienna, Alexander Dubovy, expressed an interesting idea of another approach to ensuring the security of the Greater Black Sea region. Markedonov and Dubovi draw an interesting parallel with the international order after the Second World War and the order that, in his opinion, can be constructed today in the region. According to researchers, after World War II, Austria, being on the border of the spheres of influence of the USA and the USSR, chose the path of neutrality, agreed not to enter into military alliances and not allow foreign military personnel to enter its territory [4]. Neutrality became synonymous with independence and helped the country to find a new strong state identity after the loss of the imperial heritage and the mistakes of building the first Austrian republic [4].

Markedonov and Dubovi describe the possibility of an original understanding of their neutrality by the post-Soviet countries of the Great Black Sea region: “speaking of neutrality and the Austrian concept of neutrality as an example to follow, we must remember that there is no single correct concept of neutrality. Just as Austria developed its own understanding of neutrality based on the Swiss model, the post-Soviet states of the Black Sea region can develop their own understanding of neutrality. Neutrality is a complex, multifaceted process, not a dogma or a "bargaining chip", but a way of life. It is not a panacea, but a long-term process within the framework of public policy. By the way, the adoption of neutrality in fact is impossible without the definition of certain rules of the game between the great powers. The same Swiss model was the result of the “European Concert” that took shape at the final stage of the Napoleonic Wars and during the work of the Congress of Vienna. The Austrian model was given an external impetus by the American-Soviet consensus about the future of this country after the end of World War II. <...> “In connection with the change in the world order and the lack of trust between the collective West, Russia and some states of the Black Sea region, neutrality can and should be compensated by multi-vector economic cooperation. Thus, it will contribute to the diversification of the foreign policy of the Black Sea countries and the development of partnerships with other centers of power involved in regional geopolitics” [4].

Conclusions. The Great Black Sea region, due to its high geostrategic significance and cultural and civilizational heterogeneity, plays a special role in the modern system of international relations and is subject to serious security challenges. The security of the region can only be ensured by a combination of mechanisms for the balance of power, the development of trade and economic relations between the countries of the region, civil diplomacy, as well as by establishing the neutral status of the post-Soviet countries of the Greater Black Sea region. The latter approach, formulated by the Caucasian scholar Sergei Markedonov together with the Austrian researcher Alexander Dubovi, is very realistic and fully meets the requirements of the time and circumstances in the issue of designing a security system in the region. The neutrality of Armenia, Azerbaijan, Georgia, Moldova and Ukraine will emphasize their special status, set them apart from the politically biased states of the region, and make relations with them more trusting and stable. This became a good guarantee of the stability of the security system in the Greater Black Sea region for a fairly long term.

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ОСНОВНЫЕ НАПРАВЛЕНИЯ РОССИЙСКО-БРИТАНСКОГО ПРОТИВОСТОЯНИЯ ВОСТОЧНОЙ ПЕРСИИ

THE MAIN DIRECTIONS OF THE RUSSIAN-BRITISH CONFRONTATION OF EASTERN PERSIA

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Аннотация

Продвижение России и Великобритании к границам Восточной Персии в последней трети XIX.: геополитические интересы сторон и проблема научного освоения региона.

Материалы и методы, результаты и обсуждения

Долгое время в России не имели точных сведений о Восточной Персии. Исследования зарубежных авторов также не могли успешно решить данную задачу. Так как, достоверность содержавшихся в них сведений вызывала большие сомнения. Они зачастую опирались на рассказы местных жителей и исследования более ранних авторов, зачастую не совпадавших с реальностью. Военное ведомство страны, составляя справочники по Персии и географические карты, стремилось собрать обстоятельные сведения о расстоянии между основными населенными пунктами страны и состоянии транспортных коммуникаций

Заключение

Великобритания, используя свое военное и экономическое превосходство над Персией, стремится пересмотреть ее восточную границу в пользу Афганистана и Британской Индии. В результате она навязала Тегерану несколько не выгодных договоров о демаркации границы, что привело к существенным территориальным потерям. Забота Великобритании об Афганистане в основном объяснялась ее желанием создать буфер между Россией и Британской Индией, в том числе в случае захвата Санкт–Петербургом Хорасана и других районов Восточной Персии.

Ключевые слова: *Россия, Британия, противостояние, Восточная Персия.*

Abstract

The advance of Russia and Great Britain to the borders of Eastern Persia in the last third of the XIX century: the geopolitical interests of the parties and the problem of scientific development of the region.

Materials and methods, results and discussions

For a long time, Russia did not have accurate information about Eastern Persia. Studies by foreign authors also could not successfully solve this problem. Since the reliability of the information contained in them caused great doubts. They often relied on the stories of local residents and the research of earlier authors, which often did not coincide with reality. The military department of the country, compiling reference books on Persia and geographical maps, sought to collect detailed information about the distance between the main settlements of the country and the state of transport communications

Conclusion

Great Britain, using its military and economic superiority over Persia, seeks to revise its eastern border in favor of Afghanistan and British India. As a result, it imposed on Tehran several

unprofitable agreements on the demarcation of the border, which led to significant territorial losses. Britain's concern for Afghanistan was mainly explained by its desire to create a buffer between Russia and British India, including in the case of the capture of Khorasan and other areas of Eastern Persia by St. Petersburg.

Key words: *Russia, Britain, confrontation, Eastern Persia.*

Sistan becomes an important disputed territory in the relations of Persia with Afghanistan and British India [1]. After the collapse of the power of Nadir Shah, Sistan becomes the object of confrontation between Persia and Afghanistan. During this period, Sistan retained an independent status for some time. In 1802, most of Sistan was captured by Persia, which prepared the ground for the natural entry of the region into the country, trying to negotiate with local leaders. During this period, British diplomacy relied on the war between Persia and Afghanistan, not doubting the victory of Kabul [2]. In 1872, under the patronage of Great Britain, Sistan was divided between Persia and Afghanistan; as a result, Tehran recognized the partial loss of territory [3]. Great disputes over the delimitation were caused by the question of the division of the region's water resources, which were claimed by both Persia and Afghanistan. When there were disputes about the division of Sistan, London in this conflict constantly considered Sistan as a possible outpost of Russia to strike at India. The campaign of the Russian army through Afghanistan to India was fraught with great risks, due to limited resources and endless struggle with local tribes. The campaign through Sistan allowed Russia to bypass troubled Afghanistan [4]. In addition, in the region, her army could replenish supplies for a further campaign. In this regard, London chose the least of the "two evils", transferring a significant part of Sistan to Afghanistan.

Kabul claimed a number of other areas, raising the question of the need to populate the Sistan desert and irrigate it [5]. In 1896, a territorial dispute arose again between Afghanistan and Persia, Tehran turned to London for assistance, after which most of the border between the states was demarcated by 1903. The process of establishing the eastern borders of Persia dragged on in some areas until 1935. [6] The state border between Persia and Afghanistan violated the traditional routes of movement of nomadic tribes, to their great displeasure. True, they could easily bypass border points, but as control over the border tightened, tension on both sides of the border grew. In conditions of drought or locust invasion, the flow of migrants from Afghanistan was directed to Persia or vice versa. Often the two streams intersected.

The legal registration of the border between Afghanistan and Persia did not stop Kabul's new claims to Tehran. In the 80s–90s. 19th century Afghanistan more than once arbitrarily captured the border regions of Persia, including in Khorasan. This circumstance caused great concern in Russia. The inhabitants of the border regions were frightened by the hostile actions of Afghanistan, so more than once V.A. Oranovsky heard the question from the Khorasans about who is stronger Russia or Afghanistan [7].

Disputes between Persia and Great Britain arose over the determination of the border in Balochistan. From the 30s. 19th century Great Britain begins to actively interfere in the affairs of Balochistan. After the death of Nadir Shah, the region remained nominally dependent on Tehran without defining clear boundaries. It becomes a buffer between British India and Persia. British diplomats and the military understood the exceptional role of Balochistan in protecting India and Afghanistan in the event of a war with Russia. Through the region it was possible to quickly transfer troops to Herat and Kandahar [8]. In 1841 and 1854, London imposed treaties on the Kelat (Kalat) Khanate, making it, in fact, its own protectorate. In 1870–1871 the governor of Kerman undertook a campaign in Balochistan to consolidate the sovereignty of the country over the province. In 1871, he captured the port of Chehbahar, which had previously belonged to the Sultan of Oman. The successes of Persia caused concern in London. In 1870, he forced negotiations between Persia and Afghanistan on a delimitation in Balochistan. They were joined by negotiations between Great Britain and Persia on this matter. British experts drew a demarcation line without taking into account the opinion of the Persian side. The Persian delegation at the talks was headed

by a great patriot of the country, he refused to sign the agreements and achieved the transfer of negotiations to Tehran [9]. However, the Shah's government eventually capitulated to the British. As a result, in 1863-1872. a significant part of Balochistan became part of British India.

The demarcation of the border in Balochistan did not stop the British from further expansion in the region. At the beginning of the twentieth century. their attention was attracted by the city of Nusretabad, which became an important center for the intersection of communications, including the telegraph line. Roads connecting Sistan with Kerman ran through the city, rich water reserves were located in the city, and a fertile valley was located around it [10]. In the event of the capture of the city, it became an important outpost for the further expansion of Great Britain in the Persian part of Balochistan, Kerman and Sistan. The justification for expansion in Balochistan was the talk of the British about their civilizational mission and the need to modernize the "wild land".

Since the 70s. 19th century an important factor determining the policy of Persia in Central Asia is the promotion of Russia in the region. The Russian offensive in Central Asia enters an active phase in 1869, when troops under the command of General N.G. Stoletov landed on the eastern shore of the Caspian Sea, creating a stronghold - Krasnovodsk [11]. Russia gradually moved towards the borders of North-Eastern Persia. For some time, the lands inhabited by Turkmen tribes acted as a buffer between Russia and Persia. But this state of affairs was temporary.

After the fall of the Khiva Khanate in 1873 [12], Russia began to show interest in the lands of the Turkmen tribes, which could lead to its conflict with Persia, which traditionally closely followed the development of events north of Khorasan [13]. It should be noted that the appearance of Russia in Central Asia and its military successes, according to Niva journalists, led to the growth of its political authority within Persia [14].

In the first third of the XVIII century. most of the Turkmen lands were part of Persia, then Tehran gradually loses control over them. The lands of the Turkmens became the object of the struggle for dominance in the region of the Khiva Khanate and Persia. Attempts to restore the former influence over the Turkmens were unsuccessful for Persia in 1861, when the Persian army was defeated by the Turkmen tribes. In 1869, the Persian army won, but it had a local character and did not lead to a significant strengthening of the position of Persia in the region [15].

Persia's policy towards Russian advancement in the Trans-Caspian region was ambivalent. On the one hand, Persia was afraid of Russia's exit to Khorasan. On the other hand, Persia itself constantly suffered from the raids of warlike Turkmen tribes. Capturing the southeastern coast of the Caspian Sea, Russia reached the borders of Persia. In 1880–1881 General M. Skobelev carried out a successful Akhal-Teke operation, taking the Geok-Tepe fortress by storm in January 1881 [16]. Ashkhabad fell a few days later. This was a significant success of Russia in advancing in the zone of residence of the Turkmen tribes. In 1881, difficult negotiations were held between Russia and Persia, as a result of which Tehran recognized the accession of Turkmen lands to Russia by signing the Akhal-Khorasan Convention and the Tehran Treaty. The negotiations were successfully held by the Russian Ambassador to Persia, I.A. Zinoviev. This treaty and subsequent events caused a great stir in London. The British public was worried about the fate of Merv, which opened the way for Russia to the eastern part of Khorasan and Afghanistan [17]. By the way, British intelligence rather quickly, using their intelligence, got a map of the territorial delimitation between Russia and Persia [18].

When demarcating the border with Persia, the Russian side realized its complete ignorance of the landscape of the border area, without which it was impossible to establish a clear border. To eliminate this circumstance, a special expedition is sent to the Transcaspian region [19]. Her materials accelerated the course of negotiations. Finally, all the controversial points in the drawing of the border were settled by the Russian-Persian treaty of 1893 [20]

The drawing of the border between the Trans-Caspian region and Khorasan gave rise to many problems. Firstly, the use of water resources of the border rivers, which were claimed by both sides. Some of them started their course in the Transcaspian region [21]. The paradox was that Russia's access to the borders of Persia led to an increase in the population in Northern Khora-

san and its economic activity. This has led to an increase in the consumption of water resources. This trend also manifested itself in the Trans-Caspian region. Therefore, conflicts began to arise over the distribution of river flows between the Russian administration and the authorities of Khorasan [22]. In Khorasan, there are even problems with land irrigation. In 1881, the inhabitants of Persia in the Manysh valley, in violation of the agreements, significantly expanded their crops, which led to a sharp consumption of water and the shallowing of the Annau-Su River. As a result, a Russian military detachment occupied the area, destroyed fields and canals, returning the status quo [23]. Such conflicts arose in other parts of the border. In 1884–1885 the parties appoint authorized persons who monitor the use of water resources. As a result, the size of the population in the border areas, the size of sown areas and water consumption were clearly stipulated.

Secondly, the border cut the routes for the movement of nomadic Turkmens. For almost nine months they were in the territory of the Trans-Caspian region, and went to Khorasan for the winter. This moment also forced Russia and Persia to settle this controversial point. Most Turkmens accept Russian citizenship, as they paid less taxes in Russia than in Persia. In addition, they could count on the support of Russia, being in the territory of Persia. Tehran tried to win the Turkmen over to its side, temporarily completely exempting them from paying taxes [24]. As a result, some tribes went to Persia. Part of the Turkmen aristocracy also faced the choice of which state to swear allegiance to? Often, the decisive argument was the receipt of military ranks and gifts, in which Tehran was most successful. In this victory of the Persian Shah in Russia, he did not see anything terrible, doubting the business and personal qualities of many local aristocrats. The actions of Russia in the border zone were carefully monitored by British intelligence, in particular, the activity of the expedition of P.M. Lessar was the object of its close attention.

In January 1884, Merv (Mary) recognizes its entry into the Russian Empire [25]. Prior to this, the rulers of the city hatched a plan to join Persia, but nothing happened to them. The Turkmens repeatedly turned to Persia for help during the battles with the Russian army in the 80s. XIX century, but Tehran preferred to avoid open confrontation with Russia. In 1882, Russia created the Transcaspian region, and in 1880-1888. builds the Trans-Caspian railway, which testified to the thorough consolidation of its positions in Central Asia.

As a result of the demarcation of the border, not only the lands inhabited by Turkmens became part of Russia. In a number of cases, auls with a Persian population appeared on the territory of the empire. After the border was drawn, they were abandoned, and their inhabitants left for the territory of Khorasan. One of these auls was the Russian border checkpoint Garmuba. During the residence of the Persians in the village there were large orchards, solid dwellings. After their departure, everything fell into disrepair [26]. After the border was drawn, part of the Kurds also ended up on the territory of Russia, the Persian authorities forcibly resettled them in Khorasan so as not to lose the taxable population, although Russia did not mind that they remained on its territory.

The demarcation of the Russian-Persian border did not completely stop the Turkmen raids on Persian territory, the actions of the Turkmens engaged in banditry caused concern among the Russian administration. I.A. Zinoviev noted big problems with the protection of the border in the Transcaspian region, since the Turkmens, Kurds and other peoples who lived here were distinguished by obstinacy and even "predatory inclinations" [27]. Therefore, St. Petersburg had to take decisive measures to strengthen the border, using force and at the same time trying to find some kind of compromise with the local peoples.

In 1890 Lieutenant General VN Kuropatkin was appointed commander of the troops in the Transcaspian region. He will make great efforts to restore order on the border and combat banditry. In 1895, he went to Tehran to inform the Shah about the coronation of Nicholas II . During this visit, in addition to ceremonial functions, VN Kuropatkin discussed a number of problems in bilateral relations with representatives of the highest authorities of Persia. The central theme was the restoration of order on the border and the struggle against the Turkmen tribes [28]. The parties agreed to take measures to disarm the Turkmens, which, in their opinion, should have somewhat defuse the situation. True, V.N. Kuropatkin did not really believe in the combat effectiveness of

the Persian army and the country's financial capabilities, since such an action required significant resources. Instability on the northeastern and eastern borders of Persia forced Tehran to appropriately deploy armed forces on the territory of the country. Large military garrisons were stationed in Mashhad and Kerman.

According to I.A. Zinoviev, the annexation of the Transcaspian region was of great importance, both for Russia and for Persia. Russia secured its possessions in Central Asia from the raids of the Turkmen tribes, having received the opportunity to develop the resources of this region, especially after the completion of the construction of the main branch of the Trans-Caspian railway. Moreover, Russian exports got the opportunity not to be limited to trade with Northwestern and Central Persia, but to expand their potential by penetrating into Eastern Persia, including Khorasan, Sistan, Balochistan, Kerman, Yazd, and even Shiraz. In the diplomat's opinion, Persia also received undeniable advantages. Firstly, she was no longer subjected to constant attacks from the Teke Turkmen. Secondly, the relative stability on the borders of Khorasan led to its economic development and the growth of the well-being of the local population. Thirdly, Khorasan and other eastern provinces of Persia got the opportunity to create and expand economic ties with Russia and other European states.

Until the last third of the XIX century. Eastern Persia was one of the little-studied regions of Central Asia, remaining a "blank spot" in the military-political and scientific circles of Europe. It did not belong to the calm regions of the country, which made it difficult for Russian and British researchers to study it. Gradually, Eastern Persia becomes a buffer between Russia and British India, this fact caused its active study by scientists and military men from Russia and Great Britain.

Territorial disputes with Russia, Afghanistan and British India become a serious test for the country. In 1881, Persia was forced to sign the Akhal-Khorasan border convention with St. Petersburg, recognizing the border with Russia along the Atrek River. The advance of Russia to the borders of Khorasan caused an ambiguous attitude in Tehran.

Great Britain, using its military and economic superiority over Persia, seeks to revise its eastern border in favor of Afghanistan and British India. As a result, it imposed several unfavorable border demarcation treaties on Tehran, which led to significant territorial losses. Britain's concern for Afghanistan was mainly explained by its desire to create a buffer between Russia and British India, including in the event that Khorasan and other regions of Eastern Persia were captured by St. Petersburg.

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РОЛЬ ПРАВОСЛАВИЯ В ФОРМИРОВАНИИ РОССИЙСКОЙ НАЦИОНАЛЬНОЙ ИДЕИ

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THE ROLE OF ORTHODOXY IN THE FORMATION OF THE RUSSIAN NATIONAL IDEA

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Аннотация

Вопрос о национальной идее российского государства во все времена вызывал неподдельный интерес в научном сообществе, в политических кругах, среди философов и мыслителей. Остается актуальным он и в современной России, столкнувшейся с глобализационными вызовами секулярного мира. На разных общественных уровнях тема национальной идеи вызывает оживленные дискуссии и способствует возникновению целого ряда исследовательских проектов.

Материалы и методы

Цель: *взглянуть на выбор национальной идеи сквозь призму православных духовно-нравственных ценностей.* ***Методология:*** *комплексный ретроспективный анализ истории развития национальной идеи в России, синтез современных взглядов на данную проблему, обобщение полученных данных, формирование конкретных предложений на перспективу.*

Результаты и обсуждения

В ***результате*** *ретроспективного взгляда в отечественную историю выявлено, что именно православный фактор являлся ключевым при выборе национальных идей для российского государства. Это обусловлено уникальной ролью православия в жизни общества, которую сложно переоценить. Несмотря на светский характер современной России, православие по-прежнему остается одним из важнейших самоидентификаторов российского народа.*

Заключение

Вместе с тем, в научном дискурсе тема исследования роли православия в формировании российской национальной идеи имеет слабый отклик, в то время, как в обществе и государстве указанная проблематика приобретает все большую актуальность. В этой связи автор приходит к выводу о необходимости привлечения внимания научного сообщества к данной теме в целях разработки научно обоснованной базы для формирования качественной и эффективной современной национальной идеи, основанной на православных духовно-нравственных ценностях.

Ключевые слова: православие, национальная идея, национальное самосознание, русская православная церковь, церковь и нация.

Abstract

The question of the national idea of the Russian state at all times aroused genuine interest in the scientific community, in political circles, among philosophers and thinkers. It remains relevant in modern Russia, which has faced the globalization challenges of the secular world. At different social levels, the topic of the national idea provokes lively discussions and contributes to the emergence of a number of research projects.

Materials and methods

Purpose: to look at the choice of a national idea through the prism of Orthodox spiritual and moral values. Methodology: a comprehensive retrospective analysis of the history of the develop-

ment of a national idea in Russia, a synthesis of modern views on this problem, a generalization of the data obtained, the formation of specific proposals for the future.

Results and discussions

As a result of a retrospective look at Russian history, it was revealed that it was the Orthodox factor that was the key in the choice of national ideas for the Russian state. This is due to the unique role of Orthodoxy in the life of society, which is difficult to overestimate. Despite the secular nature of modern Russia, Orthodoxy remains one of the most important self-identifiers of the Russian people.

Conclusion

At the same time, in the scientific discourse, the topic of the study of the role of Orthodoxy in the formation of the Russian national idea has a weak response, while in society and the state this problem is becoming increasingly relevant. In this regard, the author comes to the conclusion that it is necessary to attract the attention of the scientific community to this topic in order to develop a scientifically grounded basis for the formation of a high-quality and effective modern national idea based on Orthodox spiritual and moral values.

Key words: orthodoxy, national idea, national identity, russian orthodox church, church and nation.

Introduction

In recent years, in the public-state and scientific space, discussions have increasingly arisen about the formation of a "national idea" designed to unite the Russian people, thereby ensuring the stability of the intensive development of the state. In our opinion, the solution of this problem must begin with a historical analysis of the issue and an assessment of the age-old Russian experience in this area. The purpose of this study is to study the issue of choosing a national idea through the prism of Orthodox values. The research methodology is based on a comprehensive retrospective analysis of the history of the development of the national idea in Russia, a synthesis of modern views on this problem, a generalization of the data obtained, and the formation of specific proposals for the future.

Research term base

First of all, let us turn to the concept of the national idea. The term "nation" comes from the Latin " natio " - tribe, people. Over the past two centuries, the concept of a nation has been the subject of numerous scientific disputes, but so far no universal definition has been developed, since there is no consensus on the criteria for the membership of a nation, its territorial and cultural boundaries, etc. In the framework of this study, the term "nation" will be identified with the Russian people as a whole, since it seems to absorb the category of "ethnicity", creating a broader community, for which the state, culture and economic activity are the determining factors.

As for the concept of "idea", it is derived from the Greek ἰδεῖν - image, representation, and is used in philosophy in various semantic meanings. For this study, the encyclopedic definition seems to be the most appropriate, by virtue of which "an idea is a form comprehension in thoughts phenomena objective reality , including in myself consciousness goals And projections further knowledge And practical transformation of peace" [1]. Thus, the concept of "national idea" includes two ambiguous terms that do not have a single definition. Accordingly, in this regard, the concept itself is also ambiguous and polysemantic.

The Philosophical Encyclopedic Dictionary proposes to understand the national idea as "a systematized, time-stable generalization of national self-consciousness, most often presented in the form of socio-philosophical or socio-political, artistic works, i.e. which can have both a rational and a figurative form [2]. According to Kutafin O.E., the national idea is "a concentrated expression of the identity of the people, a powerful integrator capable of consolidating the people into a single social integrity" [3]. The team of authors, led by Sulakshin S.S., defines the national idea as a way of internal self-identification of an individual citizen: "the national idea is turned inside the country, it asks and answers the questions: "Who are we? Why are we and why? What is our identity and meanings? How exactly do we live in order to live?" [4]. Korovnikova N.A. in her dissertation " Prerequisites and prospects for the formation

of the national idea of modern Russia" [5] proposed the following definition of the national idea: "a multifaceted, multifaceted concept that accumulates fundamental values and interests that contribute to the unification of all or the majority of the country's population, regardless of ethnicity, social status and forms some ideal as the goal of the development of the nation. Shchuplenkov O.V. defines the national idea as a trinity of the divine, social and state: "the logical structure of the national idea is not reduced either to its supermundane beginning - the divine plan, or to its reflection in human consciousness - the social ideal, or to its historically specific embodiment - the state, but represents is an interdependent unity of all the indicated moments of the idea, a system of dynamic synthesis of its superhuman and human, ideal and real nature [6].

As can be seen from the above definitions, they are based on various categories: national self-consciousness, the identity of the people, the synthesis of superhuman and human nature, the internal self-identification of an individual citizen, and fundamental values. Although these categories really determine the uniqueness of a particular nation, they are not identical to the national idea: N.A. Berdyaev characterized the national idea most succinctly and concisely. In his opinion, "the idea of a nation is not what it thinks of itself in time, but what God thinks of it in eternity ... witnessed by the religious character of the people, transformed and indicated by the most important events and the greatest personalities of our history [7]." In other words, the national idea is determined by God's plan, which is revealed to the people in a historical perspective in the context of their religiosity. Despite the fact that the principle of de-ideologization is formulated in the constitutions of many states, including the Russian one, not a single state can exist without a national idea. The presence of a common idea, which is a kind of consensus of various worldview positions, unites the people. In the absence of a national idea, society becomes amorphous and destructive, and its development, devoid of a meaningful goal, is chaotic and inefficient.

The historical path of transformation of the Russian national idea

The national self-consciousness of the Russian people, their identity, spiritual archetype and moral values are firmly connected with Orthodoxy. Once disparate tribes that were baptized, took shape in a single people who adopted the Christian tradition. Orthodox culture has introduced unique components into Russian life that have taken root and become key in the self-consciousness of the Russian people: an orientation toward sacrifice and duty (in contrast to Western rationalism and the motivation for benefit), catholicity (in contrast to Western individualism), the priority of spiritual values (in contrast to from the Western desire for consumerism as an end in itself), asceticism (in contrast to the Western culture of material prosperity), etc. In other words, metaphysical values and striving for God have been invested in the character of the Russian people for centuries.

The earliest attempts to fix the national idea are found in such ancient Russian works as the "Sermon on Law and Grace" by the Kiev Metropolitan Hilarion and "The Tale of Bygone Years" by the monk Nestor of the Kiev Caves Monastery. Their teachings contain the origins of the concept of the Russian national idea, based on Orthodox dogma and spiritual and moral self-improvement. However, the first, clearly defined national idea: "Moscow is the third Rome, and the last", was proposed by the monk of the Pskov Elizarov Monastery Philotheus during the period of the Muscovite kingdom. Its appearance is connected with the tragic events that shook the Orthodox East - the fall of Byzantium and the signing by the Greeks of the Ferrara-Florentine Union with the Latins. In this laconic formulation, quite significant thoughts are hidden, caught from the historical context, namely: loyalty to Orthodoxy, a symphony of church and state authorities, a focus on the monarchy. All these factors together served to significantly strengthen state power both in internal affairs and at the level of interstate relations.

For several centuries, this national idea has successfully fulfilled its functions, helping the state grow to imperial status and unite many peoples under the Russian flag. In the 17th - 19th centuries, the significance of Orthodoxy in the context of the national idea was especially expressed in the spiritual quest of the Slavophiles, who saw in Russia originality and their unique destiny, in contrast to the Westerners, who appealed to the universal European path of development. Thoughts about the special historical mission of Russia and its spiritual and cultural identity are found in the works of Aksakov K.S. [8], Dostoevsky F.M. [9], Kireevsky I.V. [10], Khomyakov A.S. [11]. How-

ever, the most resonant work of that period, reflecting the idea of the national idea, was the concept of the Russian idea of Solovyov V.S. [12]. According to the author, the Russian idea is connected with the strengthening of the role of Orthodoxy and its values for the Russian people, and Russia should become a spiritual authority to unite all Christian countries. Reflections of Solovyov V.S. prompted other thinkers to study this problem: soon the works of N.A. Berdyaev appeared [13], Ivanov V.I. [14], Ilyin I.A. [15], Lossky N.O. [16] and others who talk about the national idea of Russia. At the same time, it is important that, despite the diversity of views, the authors agreed on the main thing - in the central role of Orthodoxy and spiritual and moral values that determine the Russian national idea. In the 19th century, the Minister of Public Education of the Russian Empire Uvarov S.S. modernized and clarified the definition of the national idea, proposing a triune formula: "Autocracy. Orthodoxy. Nationality".

Thus, Orthodox axiology for many centuries underlay the state-legal mechanism of the Russian state and was one of the basic categories of national self-consciousness. And even in the Soviet godless years, the value paradigm of society was preserved in the Moral Code of the builder of communism, which called for traditional Christian values (love, care, mutual assistance, friendship, etc.) [17]. In fact, the Soviet government made an attempt to secularize the Orthodox teaching on morality. It is this ploy that seems to have contributed to the short-term success of communist ideology.

In the post-Soviet years, the government did not abandon the search for a national idea. In the early 1990s, a course was taken for the de-ideologization and liberalization of Russian society, which threw off the shackles of communism. According to E.T. Gaidar, Deputy Chairman of the Government of those years, the Russian state needed to "change its social, economic, and ultimately historical orientation, to become a republic of the "Western" type" [18]. In the mid-1990s, the President of Russia Yeltsin B.N. an attempt was made to search for a new national idea. On his initiative, a group was formed under the leadership of G.A. Satarov, who was instructed to conduct a media study on the most common variants of the national idea. The result of this study was the work "Russia in search of an idea" [19] which, however, did not find practical application. By the end of the 90s, there was a reorientation towards a conservative direction and the beginning of the era of the current President Putin V.V., who indicated the need for a national idea, understood as: "patriotism, sovereignty, statehood and social solidarity" [20].

Modern ideas about the Russian national idea

It must be said that in recent decades, the topic of the need to implement the national idea has increasingly become a subject of discussion not only in political circles, but also within civil society.

So, in 2012, a team of authors led by the General Director of the Center for Problem Analysis and State Management Design Sulakshin S.S. formulated the Russian national idea as follows: " My country must be, and must always be [21] " The six-volume collective work, which reveals the concept of implementing this idea, proposes measures for social and economic restructuring, and also substantiates the need to change the model of government in order to improve the success and viability of the state. As a result of the study, the authors came to the conclusion that the viability of Russia is directly related to the implementation of the national idea and the 20 highest values, including: the eternal existence of the country of Russia itself, the service of the state to the people of Russia, the rejection of discrimination, the public good in harmony with the good of every person, love and family, social justice, altruism and empathy, etc. At the same time, the authors called for fixing the national ideas in the Constitution.

In 2017, the participants of the Leaders of Russia project took part in the discussion of the national idea of Russia [22]. The first four places among the proposed options were occupied by the following formulations of national ideas: "UNITING WITH LOVE, COLLECTING THE BEST, REVEALING EVERYONE!", "SOCIAL JUSTICE", "CITIZEN IS THE MASTER OF HIS COUNTRY" AND "CATHOLICITY, POWERFULNESS, NATIONALITY!".

The theme of the national idea is also relevant and in demand in the modern scientific community. The studies of M.I. Bogachev [23], Mchedlova M.M. [24, 25], Panarin A.S. [26, 27, 28], Pinkevich V.K. [29], Drunk E.P. [30], Stepin V.S. [31, 32], Shchipkov A.V. [33] and others are

devoted to it. In the works of these authors, there are diametrically opposed points of view on the significance of Orthodoxy in the concept of the modern national idea, however, the authors agree that the historically national self-consciousness of Russians is rooted in spiritual and moral values. At the same time, there are very few works concerning the Orthodox implications of the modern national idea. Among the studies of recent years, one can note the works of Eremenko Yu.E. [34], Ivashchenko Ya.S. [35], Tkach N.N. [36,37,38], Jiawen Q. [39]. There are also a number of dissertations on the topic of the national idea [40-46], but none of them examines the Orthodox factor as a determining factor in the formation of the national idea.

Consequently, in modern scientific discourse, the question of the role of Orthodoxy in the formation of the national identity of Russians, in the formation of the national identity of the Russian people, in the evolution of the national idea is poorly developed. Meanwhile, in the context of the actualization of interest in this issue in society and the state, such studies can significantly facilitate the task of developing a high-quality and effective national idea based on enduring Orthodox spiritual and moral values.

Conclusion

Given the above, we can state that the history of the Russian state convincingly proves the key mobilizing role of the idea in the turning points in the life of the state. "The country was then successful, significant and attractive to its people and other peoples and countries of the world, when she understood what the meaning of her "life" was, when she had an idea and a project, her life, like the life of individuals, was ideological and soulful. Not self-interest, consumption and prosperity have always been and remain the driving force of Russia in history, but the idea [4]. And vice versa, the absence of a national idea is disastrous for the social and state forms of Russian civilization. The nation loses its identity and becomes a conductor of foreign national interests and an easy target for political exploitation.

For centuries, it was under the influence of the Russian Orthodox Church that the formation of the national identity of the Russian people took place, Orthodoxy was the key semantic element of the proposed historical national ideas. And even during the period of atheistic power, spiritual and moral values remained on the pedestal of the ideological policy of the state. These factors indicate that centuries of being under the spiritual patronage of the Orthodox Church determined the national identity of the Russian people, shaped its identity and rooted spiritual and moral values. Based on the foregoing, the developers of the national idea of modern Russia need to take into account the historical context of the problem and pay special attention to Orthodox values that have determined the vector of the national policy of the Russian state from time immemorial.

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СОЦИАЛЬНО-ЭКОНОМИЧЕСКОЕ И ПОЛИТИЧЕСКОЕ ПРОСТРАНСТВО РОССИЙСКОЙ АГЛОМЕРАЦИИ

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THE SOCIO-ECONOMIC AND POLITICAL SPACE OF RUSSIAN AGGLOMERATION

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Аннотация

В Российской Федерации до настоящего времени отсутствуют законодательные нормы, определяющие понятие «агломерация» и «городская агломерация», порядок и процедуры их формирования, критерии отнесения территорий муниципальных образований к городским агломерациям, полномочия органов государственной власти и местного самоуправления, а также системы и формы управления такими агломерациями, ответственности за реализацию проектов.

Материалы и методы, результаты и заключение

Социально-экономическое и политическое пространство, представленное городскими агломерациями, как особого феномена инновационного развития, отличается разнообразием организационных форм управления, национальными особенностями и традициями. На основе отечественной практики агломерационных процессов рассмотрен комплекс накопившихся проблем в этой бизнес-сфере. Их устранение будет способствовать формированию современной модели пространственной организации и развития экономики страны, достижению агломерационных эффектов.

Ключевые слова: агломерация, городская агломерация, регион, стратегия, бизнес-процессы, пространственное развитие, социально-экономическая система

Abstract

To date, there are no legislative norms in the Russian Federation defining the concept of "agglomeration" and "urban agglomeration", the procedure and procedures for their formation, criteria for assigning territories of municipalities to urban agglomerations, the powers of state authorities and local self-government, as well as systems and forms of management of such agglomerations, responsibilities for the implementation of projects.

Materials and methods, results and conclusion.

The socio-economic and political space, represented by urban agglomerations, as a special phenomenon of innovative development, is distinguished by a variety of organizational forms of management, national characteristics and traditions. Based on domestic practice of agglomeration processes, a complex of accumulated problems in this business area is considered. Their elimination will contribute to the formation of a modern model of the spatial organization and development of the country's economy, the achievement of agglomeration effects.

Key words: agglomeration, urban agglomeration, region, strategy, business processes, spatial development, socio-economic system

Introduction

In the Russian Federation, there are still no legislative norms that define the concept of "agglomeration" and "urban agglomeration", the procedure and procedures for their formation, the criteria for classifying the territories of municipalities as urban agglomerations, the powers of state

authorities and local self-government, as well as systems and forms management of such agglomerations, responsibility for the implementation of projects. In modern scientific research, agglomerations are considered as engines of the country's development, territories of advanced growth, centers of regional settlement systems, and catalysts for regional development. They perform a dual role, on the one hand - a spatial model of the organization and development of the economy, on the other - it is a form of ensuring "human life" [27, p. 13]. Thus, about 30% of the country's population lives on the territory of the 9 largest agglomerations of Russia, more than 40% of the RF GDP is produced, ensuring high efficiency of the functioning of enterprises, which increases by 1.5–2 times relative to traditional forms of management [13, p. 28].

Multi-vector processes of a theoretical and applied nature contribute to the development of research areas for various models of urban agglomerations. Therefore, the issues of the formation of modern approaches and concepts of spatial organization and management of the post-industrial economy for the sustainable development of the country are the most relevant.

Materials and methods of research

A review of modern theoretical and practical approaches to the study of the processes of "urban agglomeration", as well as to the evolution of the concept of "agglomeration" as a socio-economic and political space, is made. Legislative restrictions and obstacles are identified that hinder the implementation of the country's spatial development strategy and the formation of the supporting frame of large agglomerations and the transport network.

Results and discussion

In the scientific literature, the concept of "city" as a special phenomenon has a wide range of interdisciplinary research and is often considered in a specific historical context. According to A.S. Senyavsky, it contains "fundamentally different social phenomena" [41, p. 34]. Playing important socio-economic functions, cities become a place of "concentration and distribution of surplus product" [35, p. 155], having “the ability of self-reproduction and expanded development” [15, p. 25]. Professor R.A. Romashov explores the city as a socio-cultural and economic-legal phenomenon that forms urban space and a “market settlement”, ensuring the functioning of communication systems and an independent urban culture [40, p.59; 61]. Cities are also viewed as a political institution in which political contradictions between the objective need for the development of the state and limited resources have become aggravated [25, p. 152].

According to UN estimates, if in 1950 about a third of the world's population lived in cities, in 2019 - 56%, then in 2030 their share will be 60%, and by 2050 - about two thirds of the world's population [28]. According to the Federal State Statistics Service, the share of the urban population in Russia as of January 1, 2021 reached 74.8%, and by 2035 it will increase to 75.8%. At the same time, about 40 large and largest urban agglomerations with a population of over 73 million people are distinguished on the territory of Russia [43].

The concepts of agglomeration and urban agglomeration appeared at the beginning of the last century in the field of interdisciplinary research in geography, economics, sociology, politics and other sciences. Since the 1980s, agglomeration has been understood as a form of functioning of a large city [6, p.4]. However, a unified theory of their study has not yet been formed, although new types of such formations have appeared - conurbation (less dense agglomerative formation) and hypercities (hyperclusters) [13. c. 32].

Depending on scientific views and the scope of research, there are a significant number of definitions of these concepts (Table 1).

Table 1

Characteristics of the concepts "agglomeration" and "urban agglomeration"

Animitsa E.G. [2]	Integration of settlements and new urban forms (p. 39)
Bose E. [5]	One of the tools for managing the development of socio-economic processes in Russia
Volchkova I.V., Eliseev A.M. [7]	An integral set of urban and rural cooperating territories, which is characterized by common patterns of development, as well as sustainable infrastructure interactions aimed at achieving socio-economic effects

Vilner M.Ya. [8]	Self-developing, giving a synergistic effect of stimulating socio-economic development, a group form of population resettlement - the concentration of cities and other populated areas (p. 27)
Galinovskaya E.A., Kichigin N.V. [nine]	The totality of urban or urban and rural settlements united by stable economic, transport, cultural and other ties, which has territorial integrity (p. 146)
Goryachenko E.E., Mosienko N.L., Demchuk N.V. [10]	Production system or settlement system, a naturally formed special socio-territorial object
Dubrovin P.I. [14]	Close cluster of urban-type settlements
Kuznetsova O. [26]	An objectively existing territorial entity, not necessarily an official unit of territorial division with unified governing bodies. There is a core of the agglomeration - the central city (C.10)
Lappo G.M. [17]	A compact territorial grouping of urban and rural settlements, united in a complex dynamic local system by diverse intensive ties of communal, economic, labor, cultural, recreational, as well as the joint use of this area and its resources
Lappo G.M. [19]	Urban and rural settlements united in a dynamic local system by diverse intensive ties: industrial, business, labor, cultural, recreational and others, as well as the joint use of resources of the agglomeration area (p. 48)
Lyubovny V.Ya. [20]	The supporting frame of settlement and one of the main directions for improving the spatial organization of the country (P. 7)
Pertsik E.N. [32]	A group of closely located cities, towns and other populated areas with close labor, cultural, community and industrial ties
Pertsik E.N. [33]	A system of geographically close and economically interconnected settlements united by stable labor, cultural, domestic and industrial ties, a common social and technical infrastructure (p. 32)
Novoselov A.S. [39]	Settlement system, a naturally formed special socio-territorial object (p. 112)
Kharchenko K.V. [44]	A territory that includes a core city (several such cities) and a set of foci of the urban environment united by a common economic and social ties

Analytical assessments of the concepts of "agglomeration" and "urban agglomeration" indicate a wide range of their interpretations, which is explained by an interdisciplinary approach to the objects of study. For example, urban agglomerations are presented as the economic space of the region, the effect of their functioning is expressed in the reduction of transaction costs, the enlargement of the labor market and the development of infrastructure [4]. From another point of view, agglomeration is assessed as a production system and a settlement system, forming a special socio-territorial object [11]. The median position characterizes this macro-object not from the point of view of the integrity of the production and settlement systems, but from the point of view of the integrity and connectedness of markets: labor, real estate, land [5].

Probably, theoretical models for the study of urban agglomerations [31], which are represented by national characteristics and traditions, are associated with a similar approach:

- European, in which agglomerations are based on the spatial diversification of production, while the center uses production facilities and the population of the periphery;
- American, when the center uses the periphery (territory, infrastructure, recreational areas) to prevent the process of overpopulation (agglomerations based on the diversification of settlement);
- Russian agglomeration based on the integration and joint use of recreational, informational, educational and other types of potentials that ensure the accelerated growth of production, economic and human capital.

In the Russian scientific literature, three levels of development of the urban environment (urban planning systems) are also distinguished: 1) spatially isolated sections of the urban environment (elements of the complex - microspace); 2) separate town-planning complexes of the social needs of the population, represented by a closed cycle of relations "work - life - rest" (as an urban organism); 3) urban agglomerations - the level of urban clusters (urban organisms), includ-

ing settlements that form autonomous territorial production complexes and economic systems [12, p. 217-220].

According to the Constitution of the Russian Federation, the federal structure of the country is based on the state integrity and unity of the system of state power, consisting of subjects of the Federation - regions (republics, territories, regions, etc.) [24, art. five]. Accordingly, the region should be considered the most stable and manageable economic system.

Carrying out certain comparisons of the concepts of "region" and "agglomeration" it is possible to reveal some unity and differences. In particular, according to the complex definition of a "region", which includes the physical environment, the socioeconomic , political and cultural environment, as well as the spatial structure [45, p. 17], one can agree with the conclusions of M.D. Rakhmaninova that the reorganization of urban spaces is a powerful diffuse political process [38, p. 138] development of agglomerations of various levels. This approach ensures the unity of the socio-economic and political space of the subject of the Federation and the urban agglomeration. In the context of the consolidated combination of these conclusions and the spatial organization of management functions, in fact, a natural process of the formation of urban agglomerations takes place, which, as a rule, covers the entire space of a subject of the Federation (for example, Moscow) or the most important territorial production complexes, including the administrative center of the region (Astrakhanskaya region).

In case of discrepancy between the boundaries of agglomerations and administrative-territorial boundaries, it is proposed to use the concept of "urbanized region" or "territorial-spatial system", within the boundaries of which the design and management of the urban agglomeration is carried out [34, p. 127].

In numerous scientific studies, the types and stages of development of various urban agglomerations are distinguished: industrial agglomeration; agglomeration of the transformation period; dynamic agglomeration; developed post-industrial agglomeration [5]. The concept of "innovative agglomeration" is introduced, represented by a complex spatial grouping of settlements that have objects of innovative production, social, environmental, transport and engineering infrastructure, united by pendulum functional and compositional links [23, p.15].

Despite the different interpretations of the concept of agglomeration, their common features are distinguished in the form of the presence of: urban clusters around a pronounced center-core; sustainable pendulum migration of the population; stable and developing industrial, social, labor and cultural and household ties [34, p. 127], the need to form a supporting framework that combines large centers, the interconnectedness of the economic, political and cultural life of the country (region), united by main transport networks [18, p. 113].

Thus, modern trends in the development of agglomerative processes are associated with the peculiarities of the state and maturity of national economic systems, cultural and historical values and traditions of states and peoples, the evolutionary development of which is carried out evolutionarily from simple to complex, as an ascending process of development.

The initial stage is associated with the emergence of cities and the subsequent transformation of large cities into major centers and megacities, classified as urban agglomerations. According to Professor A.A. Neshchadin, such formations must meet certain criteria [31]: 1) maintaining a stable pendulum migration of the population from suburban areas to the city and back; 2) providing the population and business with high transport accessibility in time (total travel time is about 1.5 hours per day); 3) achievement of multimodality - balance of different types of transport in transport corridors; the presence of unified transport hubs (airport, railway and river terminal hubs. M.E. Monastyrskaya and O.A. Peslyak propose to detail the level of accessibility by setting a threshold value depending on the size of the agglomeration core: for the largest cities - 120 minutes; for large cities - 90 minutes, for large cities - 60 minutes [29, p. 114].

Considering that the urban agglomeration is a multidisciplinary object of study, it is characterized by the conjugation of five scientific approaches: economic, economic-geographical, architectural-planning, demographic, organizational and managerial aspects [21, p. 15].

The process of agglomeration as an object of the spatial development of the state was described by chroniclers, studied by historians, geographers, urban planners and other fields of science, and was also based both on the natural course of events - the integration of settlements, and was considered as a whole [2, p . 39; 47]. Accordingly, business processes have acquired natural procedures for managing these spaces and urban agglomerations. This development is accompanied by the impact of positive and negative factors, which are also described in the theoretical literature as factors that expand and narrow the multifunctionality of development, in particular, rural areas [1; thirty]. The most important of them are: economic, social, demographic, environmental, managerial, market, spatial and others.

It is no coincidence that the current stage of the development of civilization by individual experts is defined as the "era of agglomerations" [6, p. 6]. In the history of agglomeration thought, there has been a transition from the urban planning concept to managerial aspects [21]. At the same time, special attention in the agglomeration theory is paid to the so-called "pulling factors", through which the urban center of the agglomeration redistributes regional resources (labor, financial) in its own interests, exacerbating the relationship "center - periphery" [21, p. 39; 65]. The territorial expansion of settlement systems stimulates the development of transport infrastructure systems [22, p. one]. On the other hand, the development of high-speed transport infrastructure is accompanied by a contraction of the space of the region and the country as a whole [21, p. 40].

According to Professor O. Kuznetsova, in the next 30 years, the existing system of settlement in developed countries will not undergo fundamental changes [26, p. fourteen]. At the same time, some forecast trends in settlement for the next twenty years are provided for by [31]: 1) the transition from a point to an agglomerative system of settlement; 2) exacerbation of the demographic problems of economic development (infrastructural development of agglomerations; development of medium and small towns, as well as rural areas; population aging and rising costs of social services; reduction of own sources of filling local budgets and the potential for their development).

Under these conditions, the problems of development of transport and modern infrastructure are of particular importance. During the discussion at the meeting of the Presidium of the State Council of the transport strategy of the Russian Federation until 2030 and the forecast until 2035, the key principle of the strategy was formulated: customer-centricity, manufacturability, the introduction of the mechanism of the Unified Basic Transport Network, accelerated digitalization and the implementation of the concept of sustainable development [42].

As the most important tasks of the transport strategy, the need to increase: 1) spatial connectivity and transport accessibility of territories; 2) population mobility and the development of domestic tourism [42]. These approaches are objectively interconnected with the provisions of the Spatial Development Strategy of the Russian Federation for the period up to 2025, which singles out “largest urban agglomeration” and “large urban agglomeration”, which differ in population size. Thus, “large urban agglomeration”, as the main (most common) form of agglomeration, is a set of compactly located settlements and territories between them with a total population of 500 thousand people or more. up to 1000 thousand people These spaces are connected by the joint use of infrastructure facilities and are united by intensive economic ties (labor, social, etc.) [43].

The Ministry of Economic Development of Russia has developed a draft federal law "On urban agglomerations" dated September 4, 2020, in which the concept of an urban agglomeration is presented as "the territory of an urban district or an urban district with an intracity division, or a city of federal significance, combined with the territories of other municipalities sustainable social, economic and economic ties” [37].

These norms, presented in the documents [43] and [37], to a certain extent are in mutual exclusion of certain provisions. Thus, the wording of the last document is quite abstract, since according to the current Constitution of the Russian Federation on the unity and integrity of "sustainable ties" enshrined in Article 5, fully applies to the subjects of the Federation and does not characterize the exclusive features of agglomerations as a phenomenon of innovative spatial development .

This draft law also received a significant number of comments from legislators, in terms of the lack of clear criteria for distinguishing agglomerations, giving the term "agglomeration" the status of a territorial entity that has not a legal, but an economic character, etc. [16].

Specialists of the Institute for Urban Economics Foundation conducted a study of the practice of institutionalizing the management of the development of urban agglomerations in 32 constituent entities of the Russian Federation, the results of which showed the low efficiency of the implementation of these business projects (Table 2).

Table 2

Barriers preventing agglomeration processes

Factors Restraining Agglomeration Processes	% of respondents
Imperfection of federal legislation	71.2
Fears of municipalities to lose independence	69.9
Legal and regulatory framework for inter-municipal interactions	68.5
Inconsistency in development strategies of municipalities	46.6
Undeveloped mechanisms for coordinating management decisions	46.6
Low density road network, poor quality	37.0
Insufficiently active actions of the administration of the subject of the federation	27.4
Differences in the quality of life of the population of the center and the periphery	26.0
Other	11.1
No barriers or obstacles	3.2

Source: data [11, p. 105]

Analytical results of surveys of heads of municipalities show: 1) the dominant negative impact (from 68.5% to 71.2%) is exerted by three fundamental factors (imperfection of federal legislation, fear of municipalities of losing independence and imperfection of the regulatory framework for intermunicipal interactions); 2) a significant negative impact (from 26.0% to 46.6%) is occupied by the following factors (inconsistency in development strategies of municipalities, undeveloped mechanisms for coordinating management decisions; low density and poor quality of the road transport network, as well as differences in the quality of life of the population center and periphery); 3) other factors have an adverse effect (about 11.1%).

These barriers that hinder agglomeration processes (see Table 2) are aggravated by the problems of developing the road transport network and modern infrastructure, which are noted by 67.1% to 78.5% of respondents [36, p. 106].

The structure of the results of sociological surveys allows us to conclude that the strategy of spatial and agglomeration development is focused on more active participation in these processes of federal and regional government bodies, whose consolidated policy is able to achieve a high agglomeration effect based on an innovative approach to the implementation of the country's spatial development strategy.

Conclusions

In the modern post-industrial economy, the concepts of agglomeration and urban agglomeration are being transformed, which are most actively carried out in the field of scientific and theoretical research. However, the existing practice and legislative framework for the institutionalization of management of the development of urban agglomerations lag far behind the needs of the development of Russian society.

Numerous problems of state "construction" have not yet made it possible to form the supporting frameworks of large agglomerations and a transport network that ensure the socio-economic and political interconnectedness of the country's regions, united by a single backbone transport network.

Developed business projects for the creation of urban agglomerations often do not take into account the diversity of infrastructural and institutional factors of spatial development. The declarative nature of individual decisions, the lack of a proper regulatory, legal and regulatory frame-

work, scientific, methodological and conceptual developments do not ensure the achievement of the expected agglomeration and socio-economic effects.

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СОЦИАЛЬНО-ПОЛИТИЧЕСКИЕ И ЭКОНОМИЧЕСКИЕ ИЗМЕНЕНИЯ И ТЕНДЕНЦИИ, ОБУСЛОВЛЕННЫЕ РАСПРОСТРАНЕНИЕМ COVID-19

SOCIO-POLITICAL AND ECONOMIC CHANGES AND TRENDS DRIVEN BY THE SPREAD OF COVID-19

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Аннотация

В статье рассматриваются последствия распространения коронавирусной инфекции COVID-19. Обобщены и систематизированы социально-политические и экономические изменения и тенденции. Наряду с аспектами, общими для всего мирового сообщества, освещены специфические подходы и меры противодействия распространению пандемии, принимаемые в Российской Федерации, затронуты особенности ситуации на Юге России.

Материалы и методы, результаты

В исследовании использован сравнительный метод при анализе различных реакций политических систем и сообществ на риски и угрозы безопасности, порожденные либо усиленные пандемией. Социологический метод применен при выяснении социальной обусловленности целевых установок, реакций и проявлений различных страт общества на процессы, порожденные пандемией. Количественный и сравнительный методы использованы при анализе данных периодической печати и социальных сетей, переполненных полемикой по изучаемому вопросу.

Наибольший объем информации по исследуемой теме почерпнут из плановых и отчетных материалов административно-управленческих структур, органов здравоохранения, научно-исследовательских учреждений, аналитических разработок специализированных организаций, также учтена полемика в средствах массовой информации, социальных сетях.

Заключение *Автор обосновывает, что особенности экономики России смягчили негативное воздействие COVID-19. Наиболее значимыми последствиями стали изменение характера производственных отношений, расширение цифровизации. Пандемия способствовала усилению протестной активности и размежеванию «прививочников» и «антиваксеров», проявила дисбаланс между деятельностью государственных структур и угрозами безопасности, выявила проблемы здравоохранения, породила изменения на рынке труда, изменив структуру занятости, перевела образование в онлайн, увеличила количество психических расстройств. Экстремальные условия меняют социальную действительность, дополняя ее виртуальной реальностью и реорганизуя нормативные ограничения, вводя новые смыслы и цели. Масштабные изменения, порожденные экстремальными воздействиями, наряду с негативными имеют и позитивные последствия, привносят новые возможности развития экономики, проявляют слабые места в различных социально-политических сферах.*

Ключевые слова: коронавирус, COVID-19, пандемия, рынок труда, онлайн-образование, социально-политические изменения, экономическая устойчивость, антиваксеры, протестный потенциал, психическое здоровье.

Abstract. *The article examines the consequences of the spread of the coronavirus infection COVID-19. Socio-political and economic changes and trends are generalized and systematized. Along with the aspects common to the entire world community, specific approaches and measures to counter the spread of the pandemic taken in the Russian Federation are highlighted, the specifics of the situation in the South of Russia are touched upon.*

Materials and methods, results. *The study used a comparative method when analyzing various reactions of political systems and communities to risks and security threats generated or intensified by the pandemic. The sociological method was applied to clarify the social conditioning of target attitudes, reactions and manifestations of various strata of society to the processes generated by the pandemic. Quantitative and comparative methods were used in the analysis of data from periodicals and social networks, overflowing with polemics on the issue under study. The largest amount of information on the topic under study was gleaned from the planned and reporting materials of administrative and managerial structures, health authorities, research institutions, analytical developments of specialized organizations, and controversy in the media and social networks was also taken into account.*

Conclusion. *The author proves that the peculiarities of the Russian economy have mitigated the negative impact of COVID-19. The most significant consequences were the change in the nature of industrial relations, the expansion of digitalization. The pandemic has contributed to an increase in protest activity and delimitation of "vaccinators" and "anti-vaxers", showed an imbalance between the activities of state structures and security threats, identified health problems, generated changes in the labor market, changed the structure of employment, transferred education to online, increased the number of mental disorders. Extreme conditions change social reality, supplementing it with virtual reality and reorganizing normative restrictions, introducing new meanings and goals. Large-scale changes generated by extreme impacts, along with negative ones, also have positive consequences, bring new opportunities for economic development, and show weaknesses in various socio-political spheres.*

Keywords: coronavirus, COVID-19, pandemic, labor market, online education, socio-political changes, economic resilience, anti-axers, protest potential, mental health.

Introduction. The situation with the spread of COVID-19 and the organization of countermeasures has become a powerful factor influencing most areas of human life, has no analogues in terms of the breadth of planetary coverage and strength of influence over the past few decades, and is one of the most relevant areas of research in modern science. The pandemic hit the world economy, accelerated the crisis in the economy and the foundations of the liberal world order, showed national selfishness to the detriment of international cooperation, increased conflict at all levels - from confrontation between blocs of states to intra-municipal contradictions and interpersonal disagreements.

The purpose of the article is to search for and study the most objective data on the issues under study, to separate sound assessments from unfounded statements aimed at achieving opportunistic and counterproductive goals. The key task in this case is to fix the existing contradictions and analyze the prerequisites for strengthening social confrontation. Political science should contribute to resolving one of the most difficult problems of the last two years, namely, finding a balance between the need for restrictive measures aimed at saving many lives, and the preservation of existing freedoms and rights of citizens.

Materials and methods, results. Since the pandemic has affected almost the entire population of the planet, has become the subject of discussions and conflicts at all levels of the scientific community, the political leadership of countries and block associations, various organizations and citizens, the volume of sources and studies at various levels on this topic seems redundant. This includes publications of health organizations, legalization of government and

administration, decisions of governments and international organizations, discussions on social networks and much more. Since the beginning of the pandemic, many institutions and organizations have been summarizing and systematizing the relevant security risks and threats, and providing forecasts of the possible development of the situation. Despite the great interest in this issue, there are few generally accepted conclusions and assessments, the reliability of the existing messages is subject to constant doubt and refutation. Therefore, the greatest interest in the context of the issues under study are generalized analytical calculations of large structures, "thought factories" and other organizations that have material and organizational resources and have access to diverse information.

Thus, in expert assessments of the long-term consequences of the pandemic, published in December 2020 by the research institute of the financial conglomerate Credit Suisse group AG", discusses the negative consequences of COVID-19. At the same time, the collective opinion of specialists is built on an optimistic message about the transformative effect of crises. They note that "throughout history, health crises have helped propel scientific and social innovations that shape the paths of future economic recovery." [1]. Having become a catalyst for emerging trends, the pandemic contributed to the expansion of states and the digitalization of life. The stagnation of the economy can contribute to the strengthening of regional ties and the revival of small towns, the development of scientific and social technologies and practices.

Credit Experts Suisse identified ten major trends to watch. Among them are the growth of deflationary risks, the increase in the power of states, the development of regional ties, the slowdown in globalization and the strengthening of regional diversification. It also noted the expansion of the practice of monitoring the population and the collection of personal data, which creates the preconditions for violations in the field of protecting privacy and individual rights. The specialists outlined the prospects for the development of the practice of remote work, which contributes to the expansion of flexibility and new standards of labor relations. In the field of education, continuous learning is becoming the norm, an adaptable workforce is being formed, and the prerequisites are being laid for increasing the competitive superiority of man in machine production. A set of problems caused by social and property inequality is named, in response to which Credit specialists Suisse offer greater tax redistribution, workforce incentives and targeted capital investment. In addition, in their opinion, the increased risks of infection of crowds in large cities should lead to regional decentralization and the revival of small settlements.

The World Bank, in a preliminary assessment of the consequences of COVID-19, identified "four shocks" that the global economy has experienced. Experts attributed to them: a sharp increase in unemployment, a drop in international trade by more than 25%, a significant decline in tourism, a change in the structure of household demand and ways of purchasing goods, which led to a reduction in consumption through ordinary stores by 15% [2].

In March 2021, the US National Intelligence Council published a report on world development trends, where it summarized and systematized the dangers generated by COVID-19 [3]. Among the main problems, experts of the American intelligence community name the imbalance and destruction of the structures and organizations of international systems, primarily healthcare, the complication of the realization of the desires of the majority of people, which gives rise to mass demonstrations. The pandemic has accelerated and exacerbated social differentiation, deepened nationalism and inequality, destabilized global supply chains, caused public debt to rise, and stepped up government intervention in the economy. The complication of governance has reduced public confidence in government institutions, including medical ones. During the pandemic, the role of non-state actors has increased, while at the same time, the ability and readiness of states for multilateral cooperation in solving common problems is increasingly doubtful.

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The strengthening of social polarization in almost all countries, not excluding Russia, is due to a decrease in the confidence of a certain part of the population in the statements and ac-

tions of authorities and administration, the lack of reliable information about the development of the disease and the effectiveness of countermeasures. This was reflected in skepticism and protest manifestations, up to mass clashes. At the same time, under the influence of COVID-19 , quite certain processes developed in the socio-political and economic sphere.

These include, first of all, the growing global imbalance, including the lag and inconsistency of international, state, public and other structures with the risks, challenges and threats to security generated by the pandemic. The weakness of coordination measures contributes to the growth of protest moods, doubts about the effectiveness and viability of social structures and management principles. Shifts in lifestyle, employment and other areas are growing and giving rise to new trends that have consequences that are difficult to predict.

Since the beginning of the spread of the disease, two poles of its perception have developed: people who recognize the high danger of the threat and the need for vaccinations, as well as other countermeasures, and their opponents - " crown-skeptics", COVID-dissidents, anti-vaxers who question the actions of authorities and medical institutions on control and reduce the risk of disease. Between these poles, there are different perceptions and interpretations of the impact of the coronavirus , which is reflected in different attitudes towards compliance with or denial of restrictions. The confrontation between vaccine supporters and their opponents (“anti-vaxers”) in many countries, including Russia, has given rise to significant social disengagement and confrontation, up to mass actions and clashes.

of public health and medicine were most noticeable Social inequality was reflected in differences in access to health care, and the lack of medical resources forced the systemic work to combat many other diseases to be actually interrupted. Moreover, the economic impact of COVID-19 has particularly affected the poor and deepened inequalities.

The response to the pandemic was the rise of isolationism and nationalism in many countries building various barriers and obstacles to protect their citizens and interests. No less significant changes are taking place within states: in different countries, processes of internal delimitation are taking place with varying intensity based on the attitude to the perception and assessment of the danger of COVID-19 and the countermeasures taken. Social polarization leads to the formation of groups of supporters and opponents of anti-COVID measures taken by authorities and administration. At the same time, opponents are distinguished by increased activity in the search for and identification of the perpetrators, promotion of their views in social networks and the media, and holding various actions.

The movement of anti-vaccinators (or “anti-vaxers”) appeared long before the COVID-19 pandemic , at the beginning of the 19th century, and is characterized by a lack of scientific justification for the positions of its supporters, their increased emotionality, and a penchant for conspiracy theories [4]. However, it should be taken into account that there are rational arguments in the arguments of anti-vaccinators, they should be taken into account, since in some cases they reveal real shortcomings and contradictions in the actions of the authorities.

Thus, one of the acute issues discussed in the context of anti-COVID measures is the prospect of strengthening totalitarianism based on a system for tracking the movements of citizens using a QR code, and connecting electronic cards to this system. And the famous journalist Giulietto Chiesa , in his last interview in April 2020, expressed concern that some people with serious power, under the guise of a pandemic, are trying to radically change the behavior and lives of people in order to achieve total control over humanity [5]. He believed that an attempt to change the social system is a new form of globalization, the essence of which is the organization of universal control over the actions of people. Those who do not want to obey the new rules run the risk of being isolated from society and may become the object of massive pressure.

The natural desire of people to protect themselves, relatives and friends from a dangerous disease, including through vaccination and following restrictive measures, encounters doubts and objections. They can be grouped into two main blocks based on the difference between the main objects of mistrust:

1. Distrust of the authorities gives rise to various fears and manifests itself in statements about the lack of systematic and effective steps taken by the government. Anti-vaxxers pointed to the lack of clear statistical data, the incompleteness of formal vaccine testing procedures, the chaotic nature and weak effectiveness of the measures taken. The main reason for such manifestations is believed to be the desire of a certain part of officials to plunder the budget funds allocated for the fight against the pandemic.

2. Distrust of the medical community, primarily large pharmaceutical companies ("big-pharma"), manifests itself in fears that they massively deceive ordinary consumers in pursuit of profit, sell ineffective drugs that cause harmful side effects, falsify data on diseases with to increase drug sales [6]. Anti-vaxxers note that such activities involve the reliance of "big pharma" on corrupt politicians, officials and scientists, as well as pressure on doctors who seek to objectively assess the risks of vaccination, attempts to discredit such specialists.

These attitudes, present in the public mind, exacerbate social differences. Antivaxers point to elements of the compulsory nature of vaccination and the increasing aggressiveness of the opposing side. At the same time, anti-vaccinators are also accused of using violence, including against officials - police officers, prison staff and bailiffs, teachers and employees of social institutions [7]. The growth of aggression forms one of the most serious threats to social stability, undermines the authority and trust in state institutions, complicates interaction and deepens social polarization. Aggressive actions of even one of the parties rule out controversy on a rational basis, impede the objective perception of arguments.

Problems of governance and cooperation in countering global risks arose and escalated long before the pandemic [8]. The dominance of the interests of individual states and the growth of conflict prevented constructive interaction and expanded the zones of instability, the processes of atomization and state paternalism deepened, the value of individual rights and freedoms decreased in exchange for the security and "guardianship" of the state. But it was COVID-19 that most acutely manifested negative trends, making it difficult to implement measures to reduce poverty and disease.

Liberal societies in a pandemic are forced to resolve the contradiction between the need for restrictive measures and existing freedoms: "The state has stalled and is faced with the difficult task of finding an appropriate balance between freedom and protecting the lives of its citizens" [9]. Many countries had to solve this dilemma during the pandemic, and they demonstrated different approaches - from the almost complete elimination of any restrictive actions (Sweden, Belarus) to the adoption of tough measures (China, etc.), including curtailing the freedoms of the population and severe penalties for violation of accepted regulations.

Under these conditions, the political leadership and responsible departments of Russia sought to implement a balanced set of measures. Since the beginning of the pandemic, deliberate steps have been taken to sanitary protection of the country's territory, the implementation of the national plan for prevention of the importation and spread of coronavirus infection, as well as unprecedented quarantine measures [10]. In August 2020, the Ministry of Health of the Russian Federation was the first in the world to register a vaccine for the prevention of COVID-19, developed by the N.N. Gamaleya, which greatly contributed to strengthening the international prestige of Russia.

The restriction of civil liberties was accompanied by monitoring the attitude of citizens to anti-COVID measures, assessing the protest potential and the likelihood of mass demonstrations. The scale of the silent rejection of the actions of the authorities was also assessed. A change in the opinions of Russian citizens regarding the fight against COVID-19 has been recorded . Thus, a study conducted in May 2020 did not yet allow us to assert that any of the possible positions dominates: 36% of respondents believed the coronavirus to be very dangerous, 38% considered this danger exaggerated, and 26% found it difficult to answer [11]. Note that at that time, only every seventh respondent had friends and relatives who had COVID-19. But by the end of 2021, the given ratio had changed, which was facilitated by an increase in the inci-

dence. Most citizens were convinced of the danger of infection. Currently, many periodicals are conducting express surveys demonstrating that approximately two-thirds of the population of the Russian Federation perceive the anti-COVID measures with understanding, weakening phobias in front of various digital identifiers [12]. The number of vaccinated citizens is increasing, and at the end of 2021 it exceeded half of the adult population [13].

In general, the perception and attitude towards the disease is determined by sociocultural circumstances and the availability of reliable information. An analysis of the socio-economic and political factors of the region made it possible to single out the most significant points. Among them: population density, its number, degree of urbanization; mobility of the population within the region and country, the development of international tourism, as well as the degree of transport and other connectivity with centers of infection; the level of development of the health care system and its impact on reducing the mortality of infected people; lifestyle, sociocultural attitudes and traditions of the population [14].

Most of these factors seem obvious. Thus, the city of Rostov-on-Don, which is the largest transport hub in the South of Russia, has also become the main focus of the disease in the region. However, specific factors, which were previously practically not taken into account, also have a significant influence. For example, the influence of sociocultural attitudes and traditions requires explanation. The situation can be illustrated by the example of Dagestan, where an outbreak of COVID-19 was observed in mid-2020 , affecting not only the capital of the republic, but also remote mountain villages [15]. It was found that the level of " COVID -skepticism" was initially high in this republic. When the epidemic caused the first victims, according to customs, the whole village gathered for the funeral, relatives from neighboring areas came, condolences traditionally included bodily contacts (handshakes, hugs), which contributed to the spread of infection. Accordingly, the republic soon became one of the leaders in terms of the proportion of infected people, which gave the authorities reason to strengthen regime measures.

It should be noted that the South of Russia, like many southern regions of the world, is characterized by a minimum distance between people, a large number of tactile contacts in the communication process, a significant share of small-scale commerce in the structure of the economy, and other factors that contribute to the spread of infectious diseases. However, " COVID-dissidents" point to relatively low incidence rates compared to other diseases present in the region. Nevertheless, according to immunologists, the number of people who recover from an infectious disease in practice, as a rule, is ten times higher than the number of officially confirmed diseases [16].

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The events and measures related to countering the coronavirus have generated a number of economic and socio-political effects. The most noticeable changes have taken place in the labor market. The mass transition to remote work has allowed employers to hire employees not only in large cities, but also in the provinces, in remote regions. This allows promising specialists, especially in the technological field, to find a job in large corporations. Relations between employers and employees are changing, many enterprises are expanding the geography of hiring, creating virtual centers in the regions, including in the South of Russia [17].

In general, the formation of a new structure of the economy, dominated by the digital sector, is accelerating. Manufacturers' attention is shifting to social issues and the service sector. Digital technologies are fundamentally changing the needs and habits of the population, ways to meet them, and form new patterns of behavior.

It should be noted that quarantine measures have led to a drastic reduction in economic activity in almost all areas of activity. The IT industry was among the few sectors of the economy that have grown significantly during the rise of COVID-19. We can say that the coronavirus has activated the progress of digital technologies. New requirements due to the spread of the epidemic forced almost all organizations to switch to remote work in order to stay afloat in the changed conditions. Information technologies are being intensively introduced into the practice of Russian companies. It

can be stated that force majeure accelerated the development and decision-making in the field of IT , set the digital vector for the development of the economy and business, making the digital economy the basis for the growth of prosperity. Russia has risen to seventh place in the world in terms of the involvement of people in the digital economy [18], however, security threats remain due to the fact that it is built on foreign operating systems.

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The growth of anxiety in society, especially among young people, was facilitated by falling incomes, limited mobility, the flow of unverified information and uncertainty about the future. Experts identify negative psychological consequences. A retrospective study showed that more than a third of coronavirus patients suffer from long-term mental disorders [19]. However, optimists argue that at the same time, social isolation gives a chance to strengthen the family: parents began to spend more time at home, and the “digital generation” got a chance for personal communication. Let's see how true this is.

The spread of coronavirus infection creates very serious consequences in the field of mental health. Among the first mass measures to counteract the spread of the pandemic, the announcement of mass self-isolation stands out, which created a crisis situation. According to experts, in 2020, 3.4 billion people were in self-isolation and quarantine, which is 43% of the world's population [20]. Obviously, in developed countries, the proportion of the population in self-isolation is much higher.

This often contributes to the development of severe stress and various psychological dysfunctions, which are characterized by the disorganization of public consciousness, the destruction of rational behavioral standards, increased anxiety and the emergence of "corona panic" [21]. The most common psychological reactions to the COVID-19 pandemic are symptoms of anxiety and depression, which were identified in 28% of the examined patients [20].

There is also a deterioration in the condition of people classified as borderline mental disorders who do not have a clearly expressed pathology . In the ordinary state, they practically do not manifest themselves, but in a situation of prolonged stress, breakdowns and outbreaks of unmotivated violence are possible. According to experts, the number of people with an unstable mentality has approximately doubled, and there is also a worsening and exacerbation of mild mental disorders [22].

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Coronavirus restrictions have given a certain acceleration to "cloud services" and new technologies. Companies specializing in the delivery of food, electronics and consumer goods made a powerful rise, and the turnover of e-commerce increased.

Remote communication technologies, in particular, telemedicine, have been developed. The issues of maintaining and promoting health have become almost a cult, many countries are moving towards total medicalization, and physicians are gaining unprecedented power in the field of social control. A completely different status is acquired not only by healthcare, but also by the social sphere as a whole, which becomes the main object of investment, the recipient of grants [23].

Experts are not so positive about the forced transition of education to online. Employees of institutions of secondary and higher education note that a significant part of teachers failed to switch to distance teaching, to master new teaching technologies. Most of the students were also not ready to fully work remotely, and parental control turned out to be ineffective in most cases.

Initially, online learning was introduced into the Russian educational space in order to increase the accessibility and convenience of learning, as well as to transfer some of the routine functions of a teacher to machines. However, rather quickly, online learning began to be seen "as a way to commercialize the activities of higher education institutions" [24]. Among the risks of its implementation, we note the high probability of the expansion of e-learning from the capitals to the regions and the subsequent displacement of the regional teaching elite from the educational services market. A likely consequence of such a development of events may be the monopolization of such an important public institution in the hands of a rather

narrow circle of people, which is fraught with a decrease in the diversity and versatility of the educational process.

The traditional form of contact education in classrooms has certain advantages in terms of subject development of students' intellect, emotional contact and live energy of communication with a teacher. At the same time, the opportunities and strengths of online education should not be underestimated. In the context of the COVID-19 pandemic, its indisputable advantage has come to the fore, namely, accessibility for any participant with the necessary device. Online education allows you to use a variety of educational resources, including inviting (or using lecture notes) highly qualified scientists, specialists in various fields of practical activity. However, the same conditions of self-isolation contribute to a decrease in the educational and social activity of students. Violation of the habitual way of life of young people prevents the realization of their basic needs in communication, the achievement of visible signs of social self-realization. At the same time, young people are required to perform an increased amount of homework, which creates a shortage of time, there is a lack of physical activity, and a lack of movement outside the premises. It is noteworthy that the crisis conditions during the COVID-19 period are not perceived by all young people as unambiguously negative. The survey showed that an approximately equal number of young people consider the conditions of self-isolation conducive to both degradation and creative activity [25].

In general, the lifestyle of young people during the coronavirus pandemic contributed to a decrease in their social and educational activity, the development of social deprivation, had a negative impact on social health, and reduced the opportunities for constructive activity and self-realization in society [26].

Returning to the assessment of online education during the pandemic, we note that most of the teachers familiar to the author note the low effectiveness of online classes and, at the same time, higher fatigue than with a regular classroom lesson. They talk about psychological problems, lack of contact with students, the inability to see the reaction to the material provided during the lesson, and also that the lack of feedback significantly complicates the filling and control of the teaching process. In addition, the use of free services often leads to a disruption of the lesson due to intermittent technical problems. Online labs proved to be ineffective. Practice has shown that not only a medical surgeon cannot be taught a complex profession online, but also an archaeologist, teacher and students of many other specialties.

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Agricultural producers in the context of the pandemic were forced to quickly optimize management and management processes, which allowed the domestic agro-industrial sector to gradually regain its position in production.

The situation is complicated by the presence of restrictive barriers to the export of products of Russian agricultural enterprises, which is due to the sanctions adopted by the United States and the countries of the European Union. The global quarantine imposed in connection with the COVID-19 pandemic has caused a new global recession. The danger of such a development is due to the fact that agriculture is one of the most vulnerable sectors, since it is largely dependent on government subsidies. Under the conditions of COVID-19, significant changes had to be made quickly in this area. The structure and culture of consumption has changed, supply chains have been rebuilt [23]. The speed and convenience of consumption are becoming a key direction for the development of the agro-industrial industry. As a result, agricultural production was among the few industries that, along with the IT sector, showed relatively stable growth in difficult conditions. At the end of 2020, the increase in production amounted to almost 2% compared to the previous year and, against the background of stagnant imports, exceeded the target indicator of the federal project "Export of agricultural products" for 2020 [27]. It should be noted that the devaluation of the ruble and rising prices on world markets played a certain role in stimulating the export of agricultural products, the same factor contributed to the growth of domestic prices. Given the fall in incomes of the population, the government was

forced to turn to new tools for regulating food prices; at the end of 2020, a number of relevant government decrees were adopted.

The goal of developing agricultural production in a pandemic requires innovative and investment activity of agricultural producers with constant and multifaceted support from the state, as well as the widespread use of digital technologies. The unconditional importance of this direction is dictated by the interests of ensuring the country's food security.

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Summing up, we note that in the process of adopting and strengthening anti-COVID measures, many citizens expressed concerns about the increased risks and security threats. In particular, measures to maintain quarantine were seen as a revival of totalitarianism - first through a system for tracking the movements of citizens using a QR code, and then by extending the tracking system to electronic cards, making them mandatory for any transaction in government institutions. Similar restrictions are envisaged for the acquisition of travel documents and transportation.

Concern is often expressed on social media that the tightened control measures taken temporarily during the quarantine period may become permanent. Obviously, the historical memory of Russians recorded that the centralized measures of state structures aimed at improving the situation of the majority of citizens and implemented through coercive actions often led to negative results. Apparently, this is why the authorities in the course of a large-scale vaccination campaign periodically emphasize its voluntary nature and distance themselves from proposals regarding discrimination against Russians who have not been vaccinated against the coronavirus [28]. Such an expression of position is necessary, since, according to a number of researchers, in the face of the coronavirus, human rights and their guarantees from state institutions are in the greatest danger [29].

The greatest number of complaints arises about the proportionality of the actions taken by the authorities to the threats of a pandemic. Human rights activists and experts see attacks on law, freedom and institutional principles in acts of transferring emergency powers to executive authorities, violations of the principle of separation of powers into legislative, executive and judicial, empowering unconstitutional institutions with powers on a wide range of issues, as well as violations of the system of law, the hierarchy of legal documents [30].

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Drawing conclusions, we note that the indicators of the global recession due to COVID-19 in Russia turned out to be not so large due to the peculiarities of its economy. Among these features, high monopolization of industries, a low share of small and medium-sized businesses with a significant share of the public sector, a small share of the service sector in the sectoral structure of the economy, and relatively low competition are distinguished. Also, the regulatory functions of the state made it possible to mitigate the consequences of the coronavirus. In addition, the dominance of large state-owned enterprises in the economy, which had sufficient resources to pay salaries on non-working days and provide targeted state assistance, and support in debt restructuring, played a role.

The nature of industrial relations is radically changing and the productive forces in the digital environment are reaching a new level. In the context of accelerating digitalization, which is changing the structure of the economy, it is especially important to direct state support to the sectors of the real sector of the economy that have confirmed their demand, including agriculture, the food industry, and pharmaceuticals.

The pandemic has undermined the confidence of part of the population in the government and caused an increase in protest activity. The imbalance between the activities of state structures and the security threats generated by the pandemic has become visible . The changes that have taken place in the way of life and work activity have initiated new trends in the development of society. The confrontation between representatives from the poles of the perception

of the disease, conventionally referred to as "vaccinators" and " anti- vaccinators", contributes to social disengagement, often in an acute form.

COVID-19 has revealed health problems exacerbated by social inequality, limited access for a significant number of people to medical care.

Isolationism and nationalism have increased in many countries, and disengagement is growing based on different assessments of the danger of COVID-19 and countermeasures. Ideas about artificially inflating the risk of infection in order to return to totalitarianism, achieve complete control over humanity, and start the "great reset" [31] were widely spread . The main doubts are built on distrust of the authorities, "big pharma", the world of financial capital . Social divisions are escalating, outbreaks of violence and an increase in aggression have been recorded . On the other hand, constructive steps, such as US support for the proposals of India and South Africa to abandon the protection of intellectual property related to COVID-19 vaccines , which should strengthen production capacity and make the drug more affordable [32], are cause for cautious optimism.

Liberal societies do a poor job of resolving the tension between the need for restrictions and freedoms. Different countries have taken different paths - from eliminating restrictive actions to taking tough measures. There are also intermediate options. Thus, in Russia, where the world's first vaccine for the prevention of COVID-19 has been developed , a balanced set of measures is being implemented. An increase in the number of people wishing to be vaccinated is recorded; they make up the majority of the country's population.

The fight against coronavirus has generated changes in the labor market, remote work is becoming the norm, the employment structure has changed, the geography of hiring has expanded, and virtual production centers are being created . A new structure of the economy is being formed with the dominance of the digital sector. Significantly reduced economic activity in most areas of activity, with the exception of the IT industry and agriculture.

At the same time, anxiety in society has increased, and the number of mental disorders has increased. Mass self-isolation has exacerbated the manifestations of the crisis, “coronapanic” is recorded.

Education was forced to move online, which contributed to a decrease in the educational and social activity of students, a drop in the quality of the educational process.

In general, despite the difficult situation, restrictive measures in Russia are being reduced. Probably, the authorities have decided that the ups and downs of COVID-19 activity , its mutations can be long-term in nature, but restrictive measures that have an indefinite duration cause too serious damage to the economy and socio-political stability of society, undermine the education system. There is a phasing out of the "medicine that is worse than the disease." At the same time, the easing of restrictive measures is accompanied by an intensification of the vaccination campaign with an emphasis on the fact that people bear the main responsibility for the health of themselves and those around them.

Conclusion. Practice has demonstrated a change in social reality under stressful conditions. Virtual reality is being dynamically formed, normative restrictions are being destroyed, traditional and modernist patterns of behavior are shifting and mixing, new meanings and goals are emerging. The need for reunification and consolidation of Russian society requires increased attention from state structures to the development of measures to strengthen social interaction, social activity, and integration of the population at all levels.

We note the opinion, which is confirmed by historical experience and a number of studies, that epidemics and other diseases have not only negative, but also positive consequences, primarily in the economy, and also show the real state of affairs in healthcare, various socio-political spheres.

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ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ КОМПЛЕКСНОГО ПОДХОДА БЕРЕЖЛИВОГО УПРАВЛЕНИЯ НА ПРЕДПРИЯТИЯХ

PROSPECTS FOR USING THE INTEGRATED APPROACH OF LEAN MANAGEMENT IN ENTERPRISES

Экономический факультет Каракалпакского государственного университета

«Создавайте среду для изменения мышления сотрудников»
А.А. ЯГОФАРОВ

"Create an environment to change the mindset of employees"
A.A. YAGOFAROV

Аннотация

Статья посвящена принципам и инструментам бережливого управления, а также результатам применения концепции бережливого управления на предприятиях. Авторами подробно описан процесс внедрения комплексных подходов бережливых технологий на предприятиях, который может стать основой эффективного управления крупными проектами и программами во многих областях деятельности.

Ключевые слова: бережливое производство, управление производством, улучшение бизнес-процессов, комплексный подход, методика бережливого производства.

Abstract. *The article is devoted to the principles and tools of lean management, as well as the results of applying the concept of lean management in enterprises. The authors describe in detail the process of implementing integrated approaches of lean technologies at enterprises, which can become the basis for effective management of large projects and programs in many areas of activity.*

Key words: lean manufacturing, production management, business process improvement, integrated approach, lean manufacturing methodology.

Introduction

In modern economic conditions, ensuring the stability of the production process, timely implementation of production volumes with high market saturation and progressive competition is one of the important points at enterprises [14]. The introduction of lean manufacturing at industrial enterprises is one of the trends in domestic economic development. However, all developments related to lean manufacturing relate mainly to the main production shops and management structures of the enterprise [1]. This is due to the fact that it is in the subsystems of the main production that value is created, for which consumers are willing to pay money [7]. At the same time, some enterprises decide to introduce lean production tools first into the main production, and then into auxiliary subsystems [2]. However, in a saturated market with a large number of similar products and companies with strong, recognizable brands in such an environment, a price cut by one of the competitors will provoke a price war that reduces the profitability of all participants. Thus, the

original goal of increasing or maintaining competitiveness will be leveled [11]. It follows that an innovating enterprise can use the reputational factor created by lean management for marketing purposes (creating value for the client, producing quality products, etc.).

1. Theoretical and methodological aspects of the study

The lean production methodology is a process of continuous improvement, every day and every hour, allowing you to evaluate the existing processes in the enterprise and analyze why the existing processes do not allow you to achieve the company's goals to reduce costs [18]. Tools and methods of lean manufacturing allow you to consider and see the full chain of movement in the company. Such a vision allows you to find losses and realize why the goals set were not achieved [14].

To improve the efficiency of the company, the productivity of the enterprise [4], to improve and maintain the quality of products and increase the competitiveness of the organization, we will consider the tools and methods of lean production. This methodology allows companies to achieve continuous and continuous improvement. For practical implementation at enterprises, various methods can be used [14]:

1.Total system productive Maintenance ;
2. Product value stream map;
3. 5S-systems ;
4. Kaizen - FI / QFI teams ;
5. Visualization;
6. SMED analysis;
7. Error prevention method;
8. Just in time on time);
nine. Overall equipment efficiency (operational, production efficiency, CUTE system);
10. Kanban;
11. System meetings (Factory Driving System);
12. 5 Why.

The entire production potential, the entire infrastructure of the enterprise should be based on line operators, workers [10]. Lean production involves the involvement of each employee in the optimization process and maximum customer orientation [13]. The personnel of the enterprise is the main wealth, and only with the help of it the enterprise can achieve the intended results [9]. Based on this, it can be argued that the main task of lean production systems is to improve, improve all production processes at the level of line personnel [12]. And only taking this into account, the company's management should set new tasks for subordinates, since for effective management of the production process, it is necessary to analyze all existing processes in the workplace, and not just analyze indicators. The management of the company must understand and know the problem areas and losses in the enterprise.

Materials and methods of research

Lean manufacturing originated during the time of the samurai in Japan. The question of the location of the samurai sword for its more efficient use was considered. At the moment, Toyota [6] is a leader in the implementation of lean manufacturing methods, which allowed it to become a leader in its industry and increase the competitiveness of the enterprise. This company was in a ruined state after the Second World War [13]. For the company, and for the entire industry as a whole, one goal was set - to catch up and overtake the United States in car production. And only having conquered the US automobile market, the Americans began to study the industry in the field of organizing production in Japan. To achieve high results, each employee must follow at least 3 principles in their [14]:

1. Organize the workplace in such a way that everything is in its place in the absence of unnecessary items. All this helps to improve ergonomics and eliminate the risk of injury, to protect slippery and dangerous places, to reduce defects and time for search and movement. This methodology is called 5 S. 5 steps: Sort - Create - Maintain - Standardize Follow.

2. To reduce the number of breakdowns, improve equipment maintenance and operation. Operators are assisted by FI (focused improvement) teams that focus on solving a specific problem.

3. Improve processes using lean manufacturing techniques to reduce waste and increase efficiency.

In order to involve each employee in this process, it is necessary that everyone clearly and specifically understand what requirements are presented to him and how the company's management operates, how it is connected with the need to survive in a highly competitive environment [5] , then create a desire for worker in a lean manufacturing environment is quite realistic. An important point is that each employee understands what losses are and how they are related to his work. Also, to involve employees, it is possible to introduce, create and use key target indicators (KPI – key performance indicator) [2]. But in order to use them more effectively and get more out of them, it is necessary that each employee understands how he can influence the goals. It is also important to convey to employees that the increase in work efficiency will not affect their hourly wage rate and layoffs in any way.

Research results and proposals

Our studies have shown that as a result of the development of the organization of production as a science, from mechanized to lean production, the following principles of production organization can be distinguished, which formed the basis of all modern production systems:

1. Unconditionally, there is a trend towards a constant decrease in the resources used, while improving the quality of products.

2. Human resource is one of the key factors in the development of modern industrial enterprises, for the effective management of which it is necessary to sharply improve the quality of the use of scientific methods of organizing production. First of all, it is necessary to organize continuous training and retraining of personnel (mainly in practical methods) in order to increase the efficiency of using their creative potential [8]. It follows from this that it is necessary to develop the creative abilities of workers by offering them the latest modern production tools.

3. Creating favorable opportunities for innovative transformations of the production system and maintaining a high level of trust and trust between workers and administration ensures the effectiveness of their business interaction and is the key to the success of any production system by liberating the creative potential of workers.

4. The idea of frugality should become a kind of “medicine” for enterprises against wastefulness, reducing the share of processes that do not add value to the production of products. The key should be the principle of " Just - in - Time ", which allows you to "cure" production processes from excessive resource intensity by producing a strictly necessary amount of products.

5. The rational organization of the use of flexible and quickly changeable equipment allows not only to quickly respond to innovative market demands, but also to effectively use the resources of the production system used.

6. Today, when not material, but information resources are becoming the decisive sources for the development of production systems, the observance of ethical standards, which apply, in particular, to technological information (sufficiency, reliability, timeliness, etc.), and controlled not as much by the management of the firm as by the workers themselves, or rather their community.

Conclusions

Thus, the prospects for using an integrated approach to lean management in enterprises allows more flexible changes in the process of implementing lean production. The practical significance lies in facilitating the process of implementing lean management in enterprises, as well as the simplicity and efficiency of links between mesoprocesses due to procedures. Team building in the proposed scheme of work deserves a more detailed study, since developers, in fact, should be not only change leaders, but also specialists capable of development. In relation to the rest of the pool of employees, the main problem is usually the resistance of the staff, which can be reduced through training.

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ИССЛЕДОВАНИЕ ВЛИЯНИЯ ПАРАМЕТРОВ ПРОЦЕССА НА ВЫХОД БИОДИЗЕЛЯ В РЕАКЦИИ ПЕРЕЭТЕРИФИКАЦИИ

THE INVESTIGATION OF THE EFFECT OF PROCESS PARAMETERS ON THE YIELD OF BIODIESEL IN THE TRANSESTERIFICATION REACTION

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Аннотация

Процесс получения качественного биодизеля из растительных масел изучен не полностью. Биодизель является экологически чистым продуктом, что делает его конкурентоспособным с классическим топливом из нефтепродуктов. На процесс производства биодизеля влияет множество факторов, основные из которых рассмотрены в данной работе.

Материалы и методы

Оптимальные условия реакции переэтерификации заключаются в изучении температурного режима, длительности процесса, типа и концентрации применяемых катализаторов и физических условия процесса. Также главным условием является применяемое сырье на основании которого протекает рассматриваемая реакция.

Результаты и обсуждения

Выявлен оптимальный катализатор для реакции переэтерификации. Представлена схема получения биодизеля на основании существующих схем производства. Проведен анализ длительности реакции от применяемых температурных режимов. Представлено обоснование использованию центрифугирования в процессе производства биодизеля.

Заключение

В связи с ростом экологически чистых продуктов, которым является биодизель, популярность рассматриваемого продукта будет возрастать. Таким образом в данной работе рассмотрены, проанализированы и представлены главные факторы, влияющие на качество готового продукта. Также представлены показатели выхода биодизеля из различных масел.

Ключевые слова: *переэтерификация, биодизель, сложные эфиры.*

Abstract

The process of obtaining high-quality biodiesel from vegetable oils is not fully understood. Biodiesel is an environmentally friendly product, which makes it competitive with classic petroleum fuels. The biodiesel production process is influenced by many factors, the main of which are considered in this work.

Materials and methods

The optimal conditions for the transesterification reaction are to study the temperature regime, the duration of the process, the type and concentration of the catalysts used and the physical

conditions of the process. Also, the main condition is the raw material used on the basis of which the considered reaction proceeds.

Results and discussions

The optimal catalyst for the transesterification reaction has been identified. The scheme for producing biodiesel based on existing production schemes is presented. The analysis of the duration of the reaction from the applied temperature conditions is carried out. The rationale for the use of centrifugation in the biodiesel production process is presented.

Conclusion

Due to the growth of environmentally friendly products, which is biodiesel, the popularity of the product in question will increase. Thus, in this work, the main factors affecting the quality of the finished product are considered, analyzed and presented. Indicators of the yield of biodiesel from various oils are also presented.

Key words: *transesterification, biodiesel, esters.*

Introduction

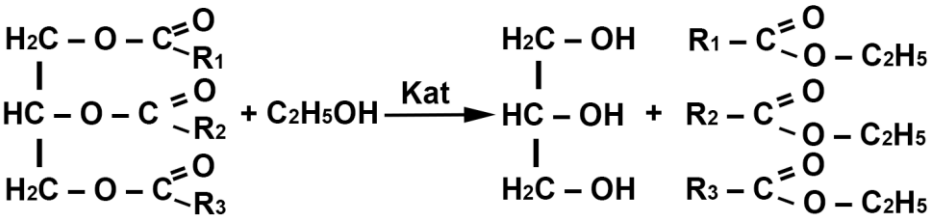
The trends of recent years are the rational, economical and efficient use of non-renewable energy resources, with the gradual abandonment of their use in favor of environmentally friendly energy sources. This movement is associated with existing environmental and economic problems. At the moment, there are several ways to obtain and use renewable energy sources. One of which is the transesterification reaction, which results in biodiesel.

The aim of the work was to determine the optimal conditions for the reaction to obtain biodiesel from raw materials, which are considered vegetable oils. As reaction conditions, the temperature regime, the duration of the process, the type and concentration of catalysts, as well as the physical conditions of the process are studied.

Materials and methods

Interesterification is a chemical reaction that results in the exchange of structural elements of triacylglycerides and alcohols. As a result of the reaction, alkylated ethers (biodiesel) and glycerol are formed.

The scheme shows the reaction of the transesterification of triglycerides, where R_1, R_2, R_3 are triglyceride fatty acid radicals.



Oil Ethanol Glycerin Ethyl ether

From the presented mechanism of the transesterification reaction, it can be concluded that 3 mol of fatty acid ethyl esters (biodiesel) and 1 mol of glycerol are formed.

According to the literature, this reaction proceeds in the presence of such catalysts as KOH , NaOH , $NaOCH_3$ and $KOCH_3$. This catalytic process can be either homogeneous or heterogeneous [8].

It should be noted that when mixing homogeneous Brønsted basic catalysts, namely KOH , NaOH , and NaOCH3 with alcohol, an alkoxide ion is formed, which attacks the carbonyl carbon atom of the triglyceride molecule [2] .

During the study, 2% and 10% NaOH solution were considered as a catalyst. As a result of using the catalyst in a homogeneous form, the reaction did not proceed. Which highlights a number of disadvantages of homogeneous mixtures.

The disadvantages inherent in the use of homogeneous catalysts can be overcome by using solid catalysts. Heterogeneous catalysts are more easily separated from the reaction products; soap, which is a salt of free fatty acids, also does not form.

On the surface of solid catalysts, there are a large number of strong acidic and basic sites, which explains their activity. Also, heterogeneous acidic and basic catalysts have not only Brönsted, but also Lewis active sites [7].

As a source of triacylglycerides for the transesterification reaction, vegetable oils were considered: sunflower refined (1) and unrefined premium grade oil (2), refined corn oil (3) of a deodorized brand, and refined linseed oil (4) of first grade bleached oil. Deep frying of used refined sunflower oil has also been investigated (5).

Ethanol was used as alcohol, since the production of biodiesel is aimed at obtaining energy from renewable components. Sodium hydroxide was used as a catalyst. One of the advantages of ethanol is the rate of reaction with triacylglycerides; it also easily dissolves the catalyst used [6].

The experimental procedure was as follows: initially, 9 ml of the studied oil and 1 ml of ethanol are mixed, with the addition of 0.1 g of sodium hydroxide as a catalyst. This is followed by the process of heating the resulting mixture to a temperature of 60ºC, with further holding for 2 hours. The next step is settling and centrifuging the mixture.

This scheme of the experiment duplicates the existing schemes for the production of biodiesel [9].

One of the factors affecting the reaction rate is temperature. The experiment was carried out at different temperature conditions. So, at room temperature at 20ºC, no signs of the reaction were observed for several days. A further increase in temperature in increments of 10°C accelerated the reaction by about a factor of two.

Glycerol is formed in the reaction products of the target biodiesel. In view of the close values of the densities of the components of the mixture, complete separation does not occur. Solving this problem was one of the objectives of the study.

KOH /g) has a special effect on the yield of ethyl ethers. Thus, the recommended level of the acid number of oil for sending it to the synthesis of biodiesel is less than 1.0 mg KOH/g [8]. Table 1 shows the values of the acid number and the mass fraction of moisture in%, which in turn also affects the final yield of biodiesel.

Table 1

The value of the acid number and the mass fraction of moisture in the studied oils according to GOST 1129-2013.

Research oil	Acid number, mg KOH/g, no more	Mass fraction of moisture, %, no more
one	2	3
Sunflower refined	0.30	0.10
Sunflower unrefined	4.00	0.20
one	2	3
corn	0.35	0.10
Linen	0.7	0.10

To determine the qualitative composition of the product mixture, a qualitative reaction was carried out for glycerin with Fehling's reagent, the signs of which are the formation of a dark blue solution of copper (II) glycerate.

Results and discussions

The results of the catalyst selection experiment showed that the use of crystalline NaOH is the most optimal. This catalyst greatly speeds up the process. In a number of works, it was noted that the conduct of heterogeneous processes in this case is more efficient [6].

The optimal temperature for the process was established by experimental method, it is equal to 60 ºC; in this case, the interesterification reaction proceeds for two hours. It should be noted that with a further increase in temperature, alcohol boils, which leads to a number of explosive consequences. Figure 1 shows the dependence of the reaction time on the temperature regime.

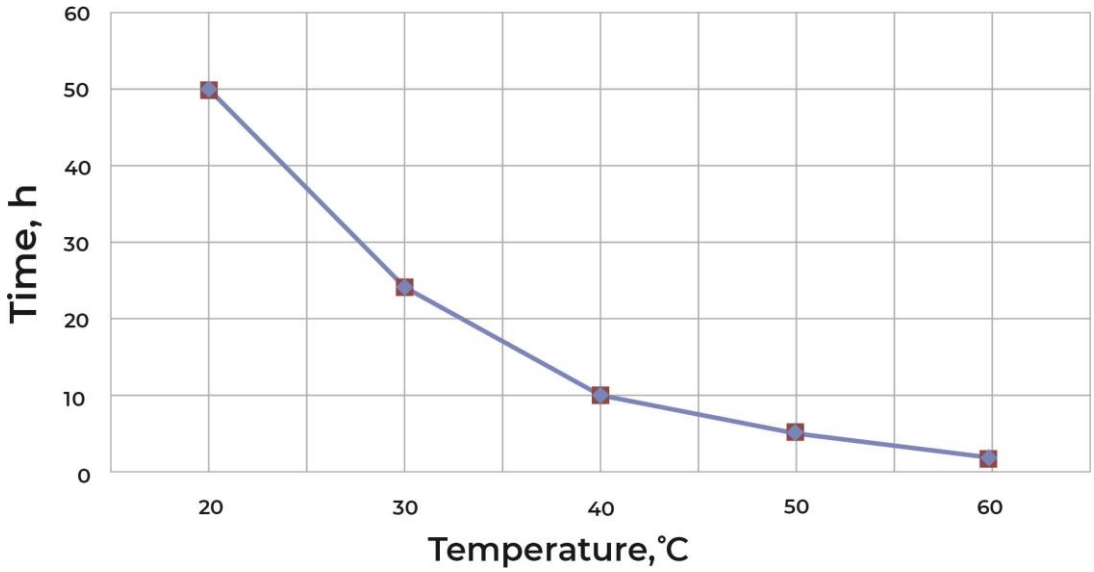


Figure 1. Graph of the duration of the reaction at various temperature conditions

To resolve the issue of decomposition of the reaction products into fractions, centrifugation was used on a laboratory centrifuge TsLMN-R10-01-Elekon.

As a result of the experiments, the mixture was separated in a laboratory centrifuge for 3 minutes, with a rotation speed of 3000 rpm. As a result, the separation of the mixture into two fractions was observed, with a clearly defined boundary, which indicates the complete separation of the components.

For the purpose of a comparative analysis of the yield of biodiesel, the ratio of glycerol and biodiesel to the total volume of the studied oils, presented in the graph (Figure 2), was determined.

After analyzing the obtained results, the percentage of biodiesel in the studied oils was calculated. Table 2 shows the percentage yield of biodiesel.

Also in the course of the study, organoleptic indicators of the obtained biodiesel based on the oils used were revealed. Table 3 presents the organoleptic characteristics of biodiesel.

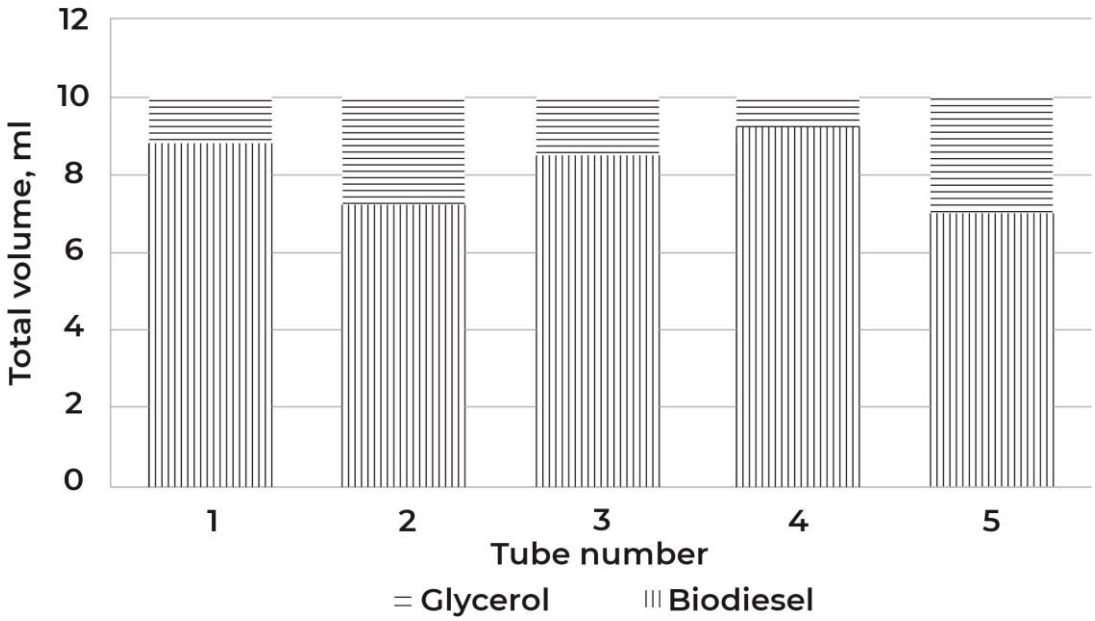


Figure 2. Volumetric yield of biodiesel

Table 2

Biodiesel output

Research oil	Biodiesel yield, %
Sunflower refined	88.0%
Sunflower unrefined	72.4%
Corn	85.7%
Linseed	92.7%
Deep frying fat	70.0%

Table 3

Organoleptic indicators of biodiesel

Oil based biodiesel	Color	Smell
Sunflower refined	Transparent	Blunted
Sunflower unrefined	Light lemon	Weakly perceptible
Corn	Pale yellow	Weak
Linseed	Light brown (with impurities)	Imperceptible
Deep frying fat	Pale yellow	Weak

In the course of the study, the staining intensity of the qualitative reaction to glycerol, which is a by-product of the esterification reaction, was evaluated. According to this indicator, it is possible to draw a conclusion about the quality of the obtained biodiesel. Because a qualitative reaction should have a dark blue color. The linseed oil sample showed the brightest and most intense indigo staining. Other samples, in turn, had a dirty blue with a hint of green. What can indicate the inadequate quality of the products received.

Also, as a result of the study, another qualitative indicator of the resulting biodiesel was analyzed. This indicator is the acidity of the medium, which should be in the neutral zone. As a

result of the determination of acidity, a neutral environment was found in biodiesel from linseed oil and deep frying fat. At the same time, other studied samples had an acidity of 4-5 pH .

High acidity indicates the content of free fatty acids, as well as technical acids. The presence of a high acid content leads to an increase in deposits in the fuel system and increases corrosivity [1].

Conclusion

The yield of biodiesel is affected by a complex of factors, which includes such indicators as the acid number of the initial product, the amount of water content, the reaction conditions, and other indirect factors.

According to the results of the work, the optimal temperature was revealed, at which the reaction lasts 2 hours. The minimum values of the centrifuge speed at which the mixture is completely separated into fractions are presented. Analyzed the quality indicators of the obtained biodiesel, as well as indirect factors that affect the final quality of the product.

Data on the percentage of biodiesel output are presented. So the highest yield of 92.7% was recorded in biodiesel based on linseed oil. Also in this sample, optimal acidity was revealed, which indicates the proper quality of the finished biodiesel. At the same time, this sample had a large amount of impurities, which were identified during the organoleptic analysis. It should be noted that the lowest yield of biodiesel was observed in the deep-fried sample, this figure was 70.0%. In this sample, the acidity of the medium and organoleptic indicators were of good quality.

It should be noted that one of the main criteria for the raw material from which biodiesel will be produced is its cost. Thus, after analyzing all of the above, we can conclude that the most suitable for the manufacture of biodiesel in all factors, except for its percentage yield, is deep fat. As a result, the considered raw material can be used as a secondary one.

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СРАВНЕНИЕ СПОСОБОВ ТЕПЛОВОЙ ОБРАБОТКИ НА ПРИМЕРЕ БЛИНОВ С МЯСОМ

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THE COMPARISON OF HEAT TREATMENT METHODS ON THE EXAMPLE OF PANCAKES WITH MEAT

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Аннотация

В статье рассказывается о способах тепловой обработки продукта, особенностях каждого способа, их преимуществах и отличиях друг от друга на примере блинчиков с мясом. В качестве тепловой обработки были выбраны следующие способы: жарка на сковороде, жарка в аэрогриле, запекание в духовом шкафу, приготовление в СВЧ-печи.

Материалы и методы

В статье использовались способы тепловой обработки блинов с мясом.

В качестве объектов исследования выступали: жарка блинов на сковороде, жарка блинов в аэрогриле, запекание блинов, СВЧ-нагрев блинов.

При жарке блинов – полуфабрикатов четырьмя разными способами был посчитан процент потерь для каждого изделия, а также проведен органолептический анализ всех четырех видов готовых изделий.

Результаты исследования

В работе проведено исследования сравнения тепловой обработки на примере блинов с мясом. Сравнительное исследование способов термического воздействия, такие как: жарка на сковороде, жарка в аэрогриле, запекание в духовом шкафу, приготовление в СВЧ-печи.

Обсуждение и заключение

Самым оптимальным вариантом тепловой обработки блинов с мясом является жарка блинов на сковороде.

По органолептическим показателям блины имеют привлекательный внешний вид, ярко выраженный аромат и вкус, свойственный данному виду продукта, а также мягкую, однородную консистенцию

Ключевые слова: *блины, тепловая обработка, жарка, аэрогриль, запекание, потери, способ.*

Abstract

The article describes the methods of heat treatment of the product, the features of each method, their advantages and differences from each other using the example of pancakes with meat. The following methods were chosen as heat treatment: frying in a pan, frying in an airfryer, baking in an oven, cooking in a microwave oven.

Materials and methods

The article used methods of heat treatment of pancakes with meat.

Research results

The study carried out a comparison of heat treatment on the example of pancakes with meat.

Discussion and conclusion

The best way to heat pancakes with meat is to fry the pancakes in a pan.

Key words: *pancakes, heat treatment, frying, airfryer, roasting, losses, method.*

Introduction

Heat treatment of a product is a process of softening a product by heating it, resulting in an improvement in organoleptic characteristics (color, aroma, taste, texture) and further better absorption of food by the human body. Moreover, at high temperatures, food is disinfected as a result of the death of microorganisms, so heat treatment is of great importance in the food industry [1].

Methods of heat treatment of the product are divided into basic (boiling, frying), auxiliary (sauteing, blanching) and combined (stewing, baking, braising).

COOKING - this is the heating of products in water, broth, milk or steam. Cook vegetables for soups, appetizers, main courses and side dishes. They are boiled in a large amount of liquid (the main method), steamed, as well as in a small amount of water or in their own juice.

FRYING - heating food in a hot pan with fat (most often vegetable oils are used as fat). As a result of frying, a crust forms on the product. Vegetables are fried raw or boiled.

EXTINGUISHING - combined method of heat treatment. When stewing, the products are first fried, and then poured with sauce or broth, spices are added and stewed until tender.

Cooking in a microwave oven consists in exposing the product to microwave radiation. Under the influence of high-frequency electromagnetic oscillations, the products are heated to a high temperature, which makes it possible to reheat or even cook dishes without the use of classic thermal heaters.

grill is a convection oven that cooks food using hot air. Thanks to this preparation, the food retains all its beneficial properties.

For frying pancakes, the Mystery -1501 air grill was used. The main characteristics of the equipment: adjustable temperature 100-250 ° C, power 1200 W, timer for 60 minutes, bowl capacity - 12 liters.

Baking - heating the dish in the oven until golden brown. It is divided into three types: open (grilling), closed and short. Closed baking can be under the lid and in foil. Short baking is that the finished or almost ready dish is placed in the oven for 20-40 seconds to acquire a crispy crust and readiness to the end [2].

The same dish can be prepared in different ways, and as a result, dishes with different appearance, color, aroma, taste and texture can be obtained [3]. For example, flour products can be fried in an air grill or in a frying pan using a large amount of fat, or you can bake in an oven or a combi steamer and get dishes with different crusts and flavors [4].

Speaking of flour products, it is important to note that these are products that use flour. All flour products are divided into two main groups: culinary and confectionery. The first group includes dumplings, pancakes, pasties, pizza, khachapuri, belyashi. These are products of a given shape from a semi-finished dough product. Produced from fat, eggs, flour with a high sugar content. These are high-calorie, easily digestible foods. These include: cake, waffles, cookies, pies, gingerbread, cakes.

Flour products occupy a special place in the food industry. The products included in the formulation of dough products have a high energy value and are an important source of carbohydrates (starch and sugars), B vitamins, valuable minerals and dietary fiber (flour). The role of flour dishes and products is especially great in Russian cuisine, a feature of which is a wide range and a large proportion of flour dishes. Their nutritional value is determined primarily by the chemical composition of the flour [3].

Pancakes are a culinary product made from batter, the classic composition of which includes flour, milk, chicken eggs, sugar and soda. In the classical form, pancakes are round and can

be used as an independent dish or together with fillings, which can be completely different: minced meat, cheese with ham, cottage cheese, jam, condensed milk, etc.

During heat treatment, many foods decrease in weight (meat, fish, most vegetables, etc.), while some, on the contrary, increase (cereals, pasta). It depends mainly on the loss or absorption of water by the product [5].

Materials and methods of research

The purpose of this study is to compare the methods of heat treatment using the example of pancakes with meat.

The objects of the study were: frying pancakes in a pan, frying pancakes in an air grill, baking pancakes, microwave heating of pancakes.

When frying pancakes - semi-finished products in four different ways, the percentage of losses for each product was calculated, and an organoleptic analysis of all four types of finished products was carried out (Table 1).

Research results

To conduct research and determine which method of heat treatment is the most convenient and optimal, frozen semi-finished pancakes were chosen, which included the following ingredients: premium wheat flour, drinking water, chicken meat , soy flour, bacon, vegetable oil, sugar, milk dry skim, salt.

Table 1

Table for calculating losses after heat treatment of semi-finished pancakes

Indicator	Type of heat treatment of the product			
	Frying in a pan	Air frying	baking	microwave heating
Appearance	Pancakes with a flat surface, folded into an envelope with a golden crust	Pancakes with a flat surface, folded in an envelope	Pancakes with a flat surface, folded in an envelope, there are burnt	Pancakes with a flat surface, folded in an envelope
Color	golden brown	Brown	Brown	Light brown
Aroma	Pronounced, pancake dough and minced chicken	Pancake dough and minced chicken	Pancake dough and minced chicken	Pancake dough and minced chicken
Taste	Pancake dough and minced chicken	Pancake dough and minced chicken	Burnt dough and minced chicken	Pancake dough and minced chicken
Consistency	soft, with a fried crust, the filling is homogeneous	solid, the filling is homogeneous	Solid the filling is homogeneous	Soft, homogeneous filling
Weight before cooking, g	208.4	214.3	219	210.3
Weight after preparation, g	192.8	169.5	167	160.6
Losses, %	8	21	23	24

As a result of the study, it was found that the most optimal results were for pancakes cooked in a pan with sunflower oil (see Fig. 1). They have the most preferred organoleptic characteristics, namely, a more attractive appearance, a pronounced aroma and taste characteristic of this type of product, as well as a soft, uniform texture [6-8]. In addition to these indicators, pan-fried pancakes have minimal weight loss, three times less than pancakes cooked in a different way. Also, pancakes cooked in an air grill have an attractive appearance, but their texture turned out to be too hard and crunchy [9-11].

During cooking, denaturation of proteins is most often caused by heating. Heat treatment significantly changes the quality of food proteins.

With proper heat treatment, protein-like substances of the connective tissue of meat in pancakes, consisting of a substance that is not absorbed by the body, insoluble in water - collagen - turn into a glue that is digestible by the body, soluble in water - glutin; at the same time, the true protein of the muscles is made more available for the action of digestive juices.

When frying pancakes with meat, aromatic substances are formed that increase the taste properties of the product and their absorption.

Fig.1. Pancakes with chicken cooked in a pan (left) and cooked in an air fryer (right)

Discussion and conclusion

Products that were baked in the oven and heated in the microwave oven have a less attractive appearance. Microwave pancakes are very pale in color and have no crust [12–14]. The consistency of these pancakes is very soft, homogeneous and sprawling. But at the products from the oven, under the given mode, the edges were slightly burnt, which in turn affected the taste of pancakes, it became bitter from the burnt edges of the dough. The consistency of baked pancakes is very similar to the consistency of pancakes from an air grill. Also, pancakes prepared in these two ways have the largest weight loss after heat treatment. The appearance of pancakes is shown in Figure 2.

Fig.2. Oven-cooked chicken pancakes (left) and microwave-cooked pancakes (right)

At a public catering enterprise, it is necessary to be highly responsible in choosing the heat treatment of a particular product so that the sold product is in high demand and evokes positive emotions in the consumer [11]. It is important to do all the technological operations repeatedly to identify any reasons why the dish is not recommended to be sold and to choose the most optimal and high-quality method of preparing the dish.

In the course of laboratory work, the method of heat treatment was compared using the example of pancakes with meat. The best option was obtained by frying pancakes in a pan.

When frying pancakes, the formation of carcinogens occurs.

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