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ARTICLES

DETERMINATION OF WATER POLLUTION IN THE CHUI VALLEY WITH HEAVY METALS

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In the modern world, environmental pollution: water, air and various chemicals is a global problem. We propose research work to lead the pollution of the water of the rivers of the Chui Valley, the Ala-Archa, Alamedin and BCHK rivers with various chemicals (heavy metals), sources of heavy metals, and what consequences will these pollution lead to when it enters the human body. Why did we choose the waters of the Chui Valley rivers: Ala-Archa, Alamedin and BCHK? Because, the Chui Valley, the city of Bishkek are densely populated areas, where there are many flows of various transport, large and small markets are located, and many enterprises. Also in this area there are sewage treatment plants and a landfill, which additionally pollute the water with various chemicals, including heavy metals. Lead, mercury, and cadmium were determined from heavy metals. The analysis was carried out spectrometrically using an atomic absorption spectrometer, AAS-7000. This method is a modern, convenient, fast, accurate, safe method and by this method very small concentrations of heavy metals can be determined. At the beginning of the article, we briefly dwelt on some of the properties of heavy metals (Pb, Hg, Cd).

Keywords: Chui, Ala-Archa, Alamedin, heavy metals, plumbum, hydrargyrum, cadmium

The growth of cities, the rapid development of industry, the intensification of agriculture, the improvement of the cultural and living conditions of people and a number of other factors have led to the pollution of water resources.

This is especially the case in densely populated areas, cities where there are large traffic flows, large and small markets are located, there are many gas stations and other enterprises [1].

The purpose of this work is to study the pollution of the water of the Chui Valley rivers: Ala-Archa, Alamedin, BCHK with heavy metals.

Lead, mercury, cadmium were taken from heavy metals.

Water is a valuable human product, because our body consists of 60-70% water. Water is present in all tissues of our body. For example: brain contains 70%, heart 75%, lungs 85%, liver 86%, kidneys 83%, muscles 75%, blood 83%. Therefore, the lack of water is difficult for the body to tolerate. Dehydration contributes to the development of many diseases [2].

The purpose of this work is to study the pollution of the water of the Chui Valley rivers: Ala-Archa, Alamedin, Big Chui river with heavy metals. Lead, mercury, cadmium were taken from heavy metals. Water is very necessary product for human because our body consists of 60-70% water. There is present in all parts of body. For example: brain contains 70%, heart 75%, lungs 85%, liver 86%, kidneys 83%, muscles 75%, blood 83%. Therefore, the lack of water brings difficulty for the body to tolerate. Dehydration contributes to the development of many diseases [1].

The danger of lead for humans is that it is highly toxic and can accumulate in the body. Lead gets in to the human body with food (40-

70%), drinking water, dust from contaminated soils, etc. Lead enters the environment, that is, soil, water, atmosphere with salts of inorganic acids (lead chloride, lead sulphate) from transport, where highly toxic alkylated compounds tetraethyl lead, tetramethyl lead are used, from lead paints, batteries

Mercury kills the nervous system of humans and other animals. When exposed to mercury on the human body, memory gets worse (Alzheimer's disease), and we get anxiety and self-doubt, irritability and headaches, bleeding gums, heart disease, urination problems, etc [3].

Mercury comes to the environment from mercury lamps, medical waste, also from industry (vinyl chloride, etc.), mercury batteries.

Cadmium is dangerous with its any form. A dose of 30-40 mg is lethal. When cadmium enters the body, it damages the kidneys and the nervous system, disrupts the functions of the genitals, and causes acute bone pain in the back and legs. In addition, cadmium causes impairment of lung function and has a carcinogenic effect, accumulates in the kidneys, and people get poisoning.

Cadmium is easily absorbed by plants from the soil, also we can find it in tobacco leaves, and therefore tobacco smoke has a high cadmium content.

Excessive intake of cadmium into the body will bring anemia, pulmonary emphysema, osteoporosis, hypertension, can damage liver, etc [4].

To determine the content of the above heavy metals, we have chosen a spectrometric method using an AAS-7000 atomic absorption spectrometer.

The essence of this method is in the resonant absorption of electromagnetic (visible)

radiation of a certain wavelength through a layer of atomic vapors of the element being determined [5].

Sampling for chemical analysis is carried out in accordance with GOST 17.1.5.05-85. Water is taken in containers with a volume of 500 ml, 1 liter from a polymer material, which should not enter into a reaction with the sample, so as not to change the composition of the water.

Samples were taken from the waters of the Ala-Archa, Alamedin rivers and from the water of the Big Chui river. Samples were taken from each of these waters at three locations. From the Ala-Archa river, near the Osh market and in the village of Maevka.

From the Alamedin River – to the villages of Kok-Zhar, Tash-Moinok and Alamedin. From Big Chui river – railway station Ak-Bos-

ogo, in the village of Gidrostroytel and near the Alamedin market.

The experimentation data came out from the spectrometric analysis of the water of the Ala-Archa, Alamedin and big chui rivers are given in tables 1, 2, 3. Using these datas of these tables, we have constructed diagrams 1, 2, 3 and gradient-level plots 1, 2, 3.

Table 1 shows the experimental data obtained in the study of the water of the Ala-Archa River.

To compare the content of heavy metals in water, the tables give the maximum concentration.

Table 1 shows that the lead content at all points does not exceed the Maximum concentration, on the contrary, it is 5 times lower than A-Ar-1; 1.42 times lower than A-Ar-2; 2 times lower at point A-Ar-3.

Table 1

The content of heavy metals in the water of the Ala-Archa river

№	Heavy metals	Sample points			Unit of measurement	Maximum permissible concentration
		A-Ar-1	A-Ar-2	A-Ar-3		
1	Pb 283,3	0.002	0.007	0.005	mg/dm ³	0.01 mg/dm ³
2	Hg 253,3	0.001	0.005	0.003	mg/dm ³	0.005 mg/dm ³
3	Cd 228,8	0.005	0.003	0.002	mg/dm ³	0.003 mg/dm ³

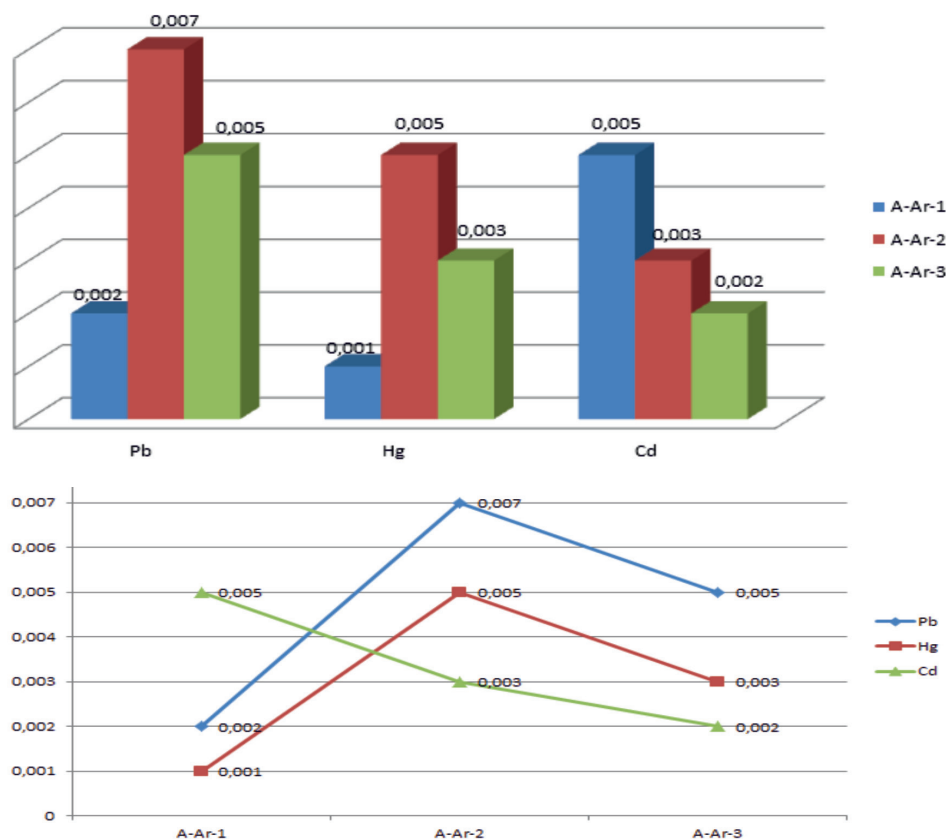


Fig. 1. Diagram and calibration graph of the content of heavy metals in the water of the Ala-Archa river

Mercury at points 1 and 3 is less than the maximum concentration, at point 2 it is equal to the MC.

Cadmium A-Ar-1 is 1.66 times more, at the second point it corresponds to the MC, at the third point it is 1.34 times lower than the norm.

Using the data in Table 1, we built diagrams and calibration graphs.

Experimental data on the study of the water of the Alamedin River, we showed in table 2, in diagram 2 and calibration graph 2.

As we can see from Table 2, the lead content of the Alamedin River at all three points exceeds the MPC 200 times. In our opinion, this is due to the fact that the Alamedin River flows in those places where there are large traf-

fic flows, densely populated areas, and many different enterprises.

Mercury in the Alamedin River is contained below the MPC, and at the Ala-2 point it corresponds to the maximum permissible concentration, below the norm.

Cadmium at all three points exceeds the maximum permissible concentration by about 6 times. The data on the determination of heavy metals in the water of the Big Chui River we presented in table 3.

In the water of the Big chui river, a high content of lead is seen at all points and it is 232; 229; 226 times higher than MPC.

On the contrary, mercury does not exceed at points 1 and 3, at the second point the content of mercury is equal to the MPC.

Table 2

Content of heavy metals in the Alamedin River

№	Heavy metals	Sample points			Unit of measurement	Maximum permissible concentration
		Ala-1	Ala-2	Ala-3		
1	Pb 283.3	2.28	2.17	2.21	mg/dm ³	0.01 mg/dm ³
2	Hg 2530000.3	0.001	0.005	0.003	mg/dm ³	0.005 mg/dm ³
3	Cd 228.3	0.18	0.15	0.13	mg/dm ³	0.003 mg/dm ³

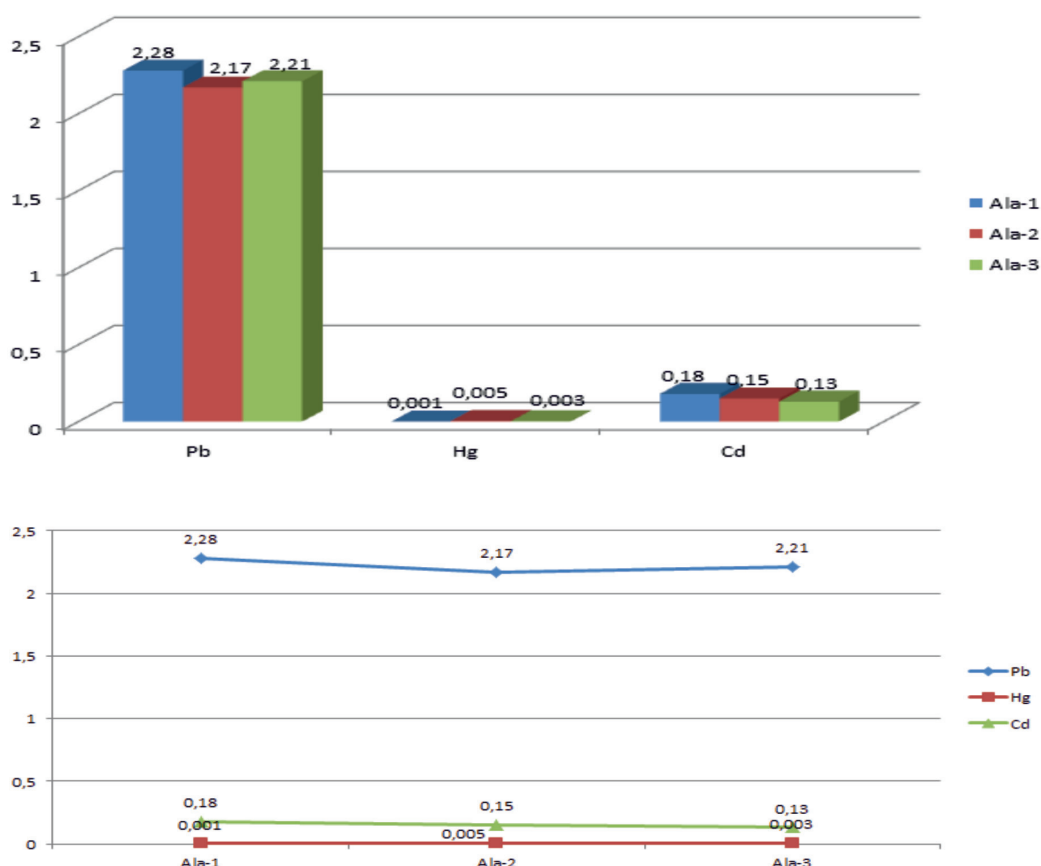


Fig. 2. Diagram and calibration graph of the content of heavy metals in the water of the Alamedin River

Table 3

The content of heavy metals in the water of the Big chui river

№	Heavy metals	Sample points			Unit of measurement	Maximum permissible concentration
		BCHK-1	BCHK-2	BCHK-3		
1	Pb 283.3	2.32	2.29	2.26	mg/dm ³	0.01 mg/dm ³
2	Hg 253.3	0.003	0.005	0.001	mg/dm ³	0.005 mg/dm ³
3	Cd 228.8	0.23	0.17	0.19	mg/dm ³	0.003 mg/dm ³

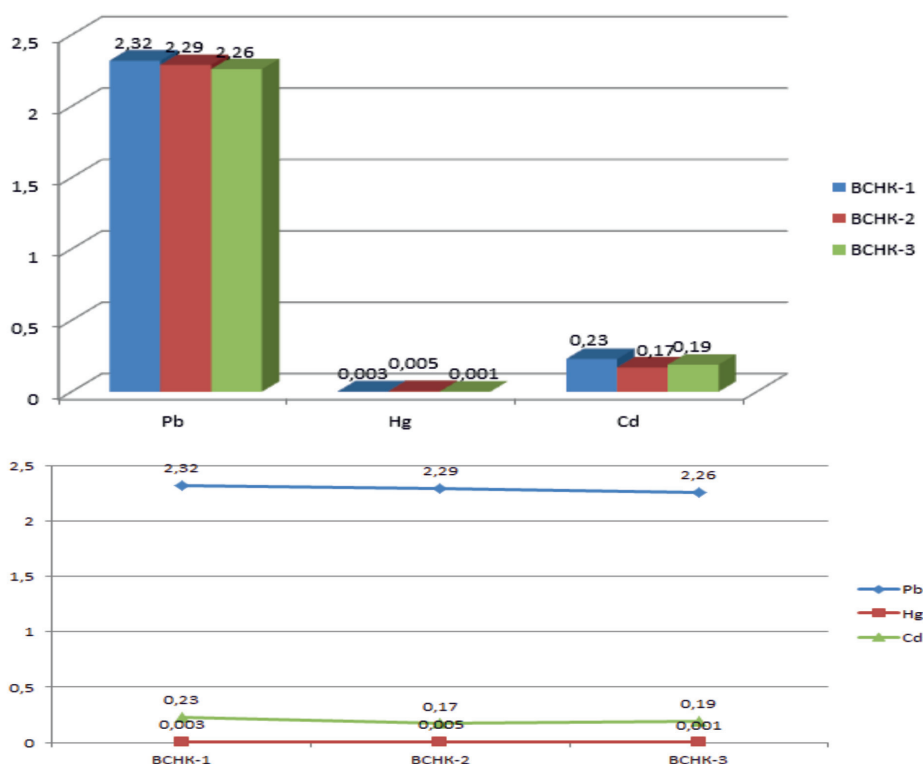


Fig. 3. Diagram and calibration graph of the content of heavy metals in the water of the Big chui river

Cadmium, like lead, is contained in all three points above the maximum permissible concentration. At the first point the maximum concentration limit is 76 times higher. At the second and third points, it exceeds the maximum permissible concentration by 63 times. This is explained by the fact that the Big chui river flows through agricultural fields where farmers grow tobacco.

As mentioned above, cadmium is found most of all in tobacco and tobacco smoke. Using the data in Table 3, diagram 3 and calibration curve 3 are constructed.

Thus, we have determined the content of heavy metals (Pb, Hg, Cd) in the waters of the Ala-Archa, Alamedin and Big chui rivers, which flow through the city of Bishkek. As we expected, the dense population of the city, a large flow and resulting traffic jams, the discharge of untreated industrial and domestic wastewater and many other reasons will lead to water pollution in the Ala-Archa, Alamedin and Big chui rivers.

The use of a universal, accurate, modern atomic absorption method made it possible to determine the trace amount of these heavy metals in the water of these rivers.

References

1. Shakhonov B.M. Influence of the industrial zone of the Ak-Tyuz field on the composition of water bodies of the river. Kichi-Kemin / B. M. Shakhonov, V. P. Solodukhin, V. L. Poznyak // Modern problems of geochemical ecology and conservation of biodiversity: materials of the conference dedicated to the 70th anniversary of the BPI NAS KR, the year of ecological culture and environmental protection (CIS) and the 150th anniversary of the birth of V.I. Vernadsky (Bishkek, September 17-27, 2013). Bishkek, 2013. – pp. 103-106.
2. Shiklomanov I. A. Research of water resources / I.A. Shiklomanov. – M.: Book on demand, 2014. – 154 p.
3. Motuzova, G.V. Chemical pollution of the biosphere and its ecological consequences. Publishing house of Moscow University, 2013. – P. 95-124.
4. Boobekova S.B. Ailana choyronyn khimiyalyk zattardan bulganuuu zhana anyn kesepetteri / S.B. Bobekova. – Bishkek: 2017. – P. 65-73, 91-95.
5. Chegrintsev S.N. Atomic absorption analysis: guidelines for laboratory work in the course «Physicochemical methods of analysis» for IV year students / S.N. Chegrintsev. – Tomsk: Tomsk Polytechnic University Publishing House, 2014. – 44 p.

VOLUNTARY HEALTH INSURANCE: CORPORATE FOCUS

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Medical insurance is a form of social protection of the interests of the population in health protection, the purpose of which is, in the event of an insured event, guaranteed receipt of medical care by citizens at the expense of accumulated funds, as well as financing of preventive measures. Medical insurance is carried out in two types: mandatory and voluntary and is an important part of the social protection of the population. The relevance of the study is due to the fact that voluntary medical insurance, especially its corporate component, is a growing segment of the insurance market and is the most popular type of insurance in Russia, which is confirmed by statistical data and scientific publications. The purpose of this work is an analytical review of statistical data reflecting the indicators of voluntary medical insurance according to various criteria, as well as identifying the positive and negative aspects of this type of insurance. According to the results of the study, it was determined that the main part of the VMI market falls on corporate clients, the reasons for this fact are reflected in the course of work. The main advantage of corporate voluntary medical insurance for all participants of the scheme is the benefit expressed in different ways and it is this benefit that is the main factor in the dynamic development of this type of insurance.

Keywords: Insurance, voluntary health insurance, VHI, corporate insurance, insurance companies

Introduction

Insurance is a system of economic relations that includes a set of forms and methods of forming trust funds of funds used to protect the property and other interests of individuals, legal entities and the state in the event of certain events [1].

Medical insurance is a form of social protection of the interests of the population in health protection, the purpose of which is, in the event of an insured event, guaranteed receipt of medical care by citizens at the expense of accumulated funds, as well as financing of preventive measures. Medical insurance is carried out in two types: mandatory and voluntary and is an important part of the social protection of the population.

Voluntary medical insurance (VMI) includes additional services that are not included in the mandatory medical insurance programs, can be individual and intended for legal entities – corporate. Voluntary medical insurance appeared in Russia in 1991 after the adoption of the Law of the RSFSR of 28.06.1991 No. 1499-1 “On medical insurance of citizens in the RSFSR” [2] and continues to exist to this day, adjacent to mandatory medical insurance. The main reason for the emergence and

existence of VMI is the demand of policyholders and insured persons for an expanded and high-quality volume of medical services, and the provision of tax benefits to both individuals and legal entities who have sent their funds to health funds by purchasing policies of this type of insurance is a significant fiscal support [3].

The purpose of the study, materials and methods

The purpose of this work is an analytical review of statistical data reflecting the indicators of voluntary medical insurance according to various criteria, as well as using the expert assessment method to identify the positive and negative aspects of this type of insurance. The relevance of the study is due to the fact that voluntary medical insurance, especially its corporate component, is a growing segment of the insurance market and is the most popular type of insurance in Russia, which is confirmed by statistical data and scientific publications.

Results and discussions

If we consider the official statistics, the top five leaders in voluntary health insurance among the regions, presented in *Table 1*, looks like this:

Table 1

Distribution of LCA receipts by cumulative total by regions for 12 months of 2020

No	Dynamics from 2019.	Region	Cumulative total receipts	
			thousand rubles	% of the total market
1.	→	Moscow	99 636 228	56,3 %
2.	→	Saint-Petersburg	39 244 365	22,18 %
3.	→	Khanty-Mansi Autonomous Okrug – Yugra	4 584 370	2,59 %
4.	→	Sverdlovsk region	2 774 854	1,57 %
5.	→	Republic of Tatarstan	2 221 118	1,26 %
	→	Other regions	28 503 793	16,1 %

Source: Compiled by the author on the basis of data [4].

Moscow leads by a significant margin with revenues of 56.3 % of the entire market, followed by St. Petersburg – 22.18 %, the other regions are significantly behind. Thus, the provision of VMI services is concentrated in two capitals of Russia. This fact is due to the low income of the population living in the regions, since it is in the regions that for many years there has been an increase in the share of the population whose income is below the subsistence minimum, and the cost of a voluntary health insurance policy is quite high. Also, all the leading insurance companies are concentrated in Moscow, due to the convenience of doing business and the availability of sol-

vent customers, that is, the emphasis is on making a profit by insurers.

Table 2 shows the dynamics of fees and payments under the VMI for 2011-2020, indicating percentages from previous periods and payment coefficients.

Figure 1 clearly demonstrates the increase in fees and payments for VMI for 2011-2019. Thus, there is a constant increase in cash receipts for programs, as well as an increase in payments for insurance cases. However, the 2020 pandemic made adjustments in all spheres of society, and voluntary health insurance was no exception – the indicators decreased. In this regard, it will be interesting to analyze the data for 2021-2022 in the future.

Table 2

Dynamics of VMI fees and payments for 2011-2020

Year	➡ Receipts		➡ Payouts		Payout coefficient %
	Receipts (thousand rubles)	% of the previous year's indicator	Payments (thousand rubles)	% of the previous year's indicator	
2020	176 964 713	97,96	118 206 690	93,45	66,80
2019	180 654 783	118,97	126 495 453	113,01	70,02
2018	151 843 113	108,45	111 930 614	105,78	73,71
2017	140 007 952	101,59	105 811 237	105,14	75,58
2016	137 816 419	106,87	100 634 322	101,00	73,02
2015	128 956 970	103,94	99 641 322	104,64	77,27
2014	124 074 582	107,92	95 219 627	105,87	76,74
2013	114 965 640	105,81	89 941 540	110,29	78,23
2012	108 653 999	111,80	81 551 462	111,01	75,06
2011	97 183 789	113,32	73 463 178	111,84	75,59

Source: [4].

Dynamics of VMI fees and payments for 2011-2020

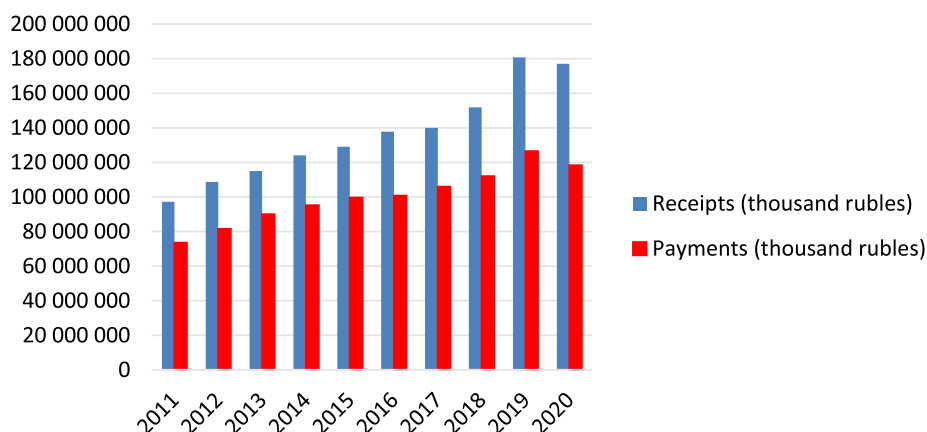


Fig. 1. Dynamics of VMI fees and payments for 2011-2020

Source: Compiled by the author on the basis of data from Table 2

Figure 2 shows the coefficient of payments under the VMI for 2011-2020.

It should be noted that the variation of the indicators presented in Figure 2 cannot be associated with external factors, but only with internal factors that directly affect this coefficient: the number of requests for medical care, the type of medical care and the cost of services provided.

The growth in the number of contracts concluded and the steady volume of the VMI market in monetary terms indicate a continued increase in the volume of this

type of insurance. Both receipts and payments are growing. This conclusion is made without taking into account the consequences caused by the pandemic, since positive dynamics was demonstrated throughout the entire study period before its occurrence. And we are confident that after overcoming the difficulties caused by the pandemic, the VMI market will continue its intensive development.

In accordance with the statistical data, we will conduct an analysis of the leading LCA insurers in the insurance market (Table 3).

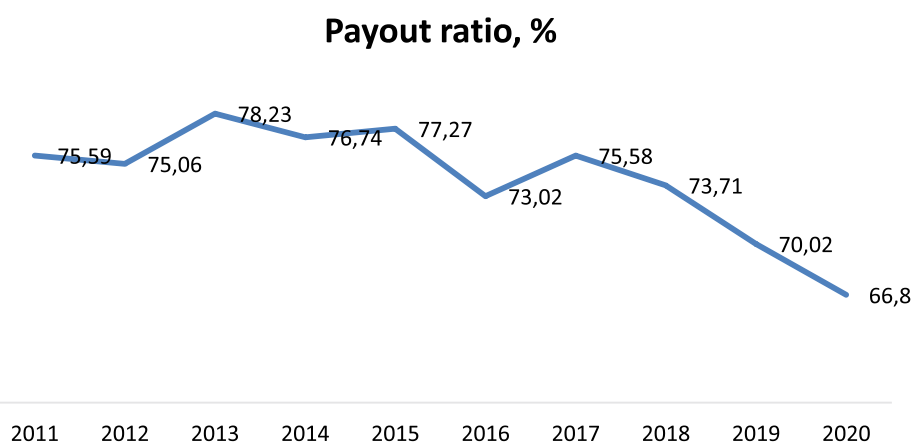


Fig. 2. The coefficient of payments under the VMI for 2011-2020.

Source: Compiled by the author on the basis of data from Table 2

Table 3

Dynamics of VMI fees and payments for 12 months of 2020: TOP-5 insurance companies

No	Name, city	➡ Receipts			➡ Payouts			Payout ratio
		Place in the ranking	Receipts (thousand rubles)	% of the previous year's indicators	Place in the ranking	Payments (thousand rubles)	% of the previous year's indicators	
1.	JSC "SOGAZ" Moscow	1	64 352 886	106,82	1	48 575 248	92,30	75,48
2.	Insurance PJSC "RESO-Garantia" Moscow	2 ↑	20 062 545	114,29	2	14 422 341	106,07	71,89
3.	JSC "AlfaStrakhovanie" Moscow	3 ↑	17 857 463	116,28	3	11 887 131	106,10	66,57
4.	PJSC IC "Rosgos-strakh" Moscow	4 ↓	12 187 276	61,88	5	5 752 583	94,55	47,20
5.	Insurance PJSC "Ingosstrakh" Moscow	5	9 556 485	87,75	4	6 802 557	81,22	71,18

Source: Compiled by the author on the basis of data [4].

The undisputed leader in the market of insurance services for voluntary medical insurance is JSC "SOGAZ", its indisputable advantages are presented in the figures of cash receipts, as well as payments for insured events. Thus, the insurance PJSC "RESO-Garantia" Moscow, which occupies the second place in the ranking in terms of receipts and payments, lags behind JSC "SOGAZ" by more than three times.

So, after considering some statistical indicators, we can conclude that, basically, the advantages that the VMI policy gives are enjoyed by residents of large cities working in prestigious companies, there is an increase in the number of contracts concluded, there is a constant increase in cash receipts for programs, and payments for insurance cases are also increasing. The leading insurance company providing services for voluntary medical insurance is JSC "SOGAZ". The intensive development of the market, increased competition between insurance companies, medical institutions due to the improvement of the quality of service, the complication of the service component of insurance products leads to further concentration on the VMI market [5].

However, with the identified positive trends in the development of voluntary medical insurance, it is impossible not to mention the

problems in this sector of insurance services, which can be divided into external and internal. We will not focus on the pandemic, since the problems caused by it are unconditional and have affected every sector of the economy. *Figure 3* shows the classification of problems of voluntary health insurance by internal and external components.

The main clients of insurance companies in terms of voluntary health insurance are corporate clients, they account for about 90% of the contributions collected under these programs, this happens for a number of reasons, the main of which include the following:

- In recent years, the level of business involvement in solving social problems has significantly increased, including the provision of medical services to its employees and their family members.

- In addition to the growth of social responsibility of business, there is also an interest of insurance companies to work with corporate clients, due to the uniform distribution of risks among all insured employees and a high percentage of negative selection when concluding VHI contracts with individuals.

- Also, the low financial situation of the population does not make it possible to purchase a VMI policy privately, due to its high cost.

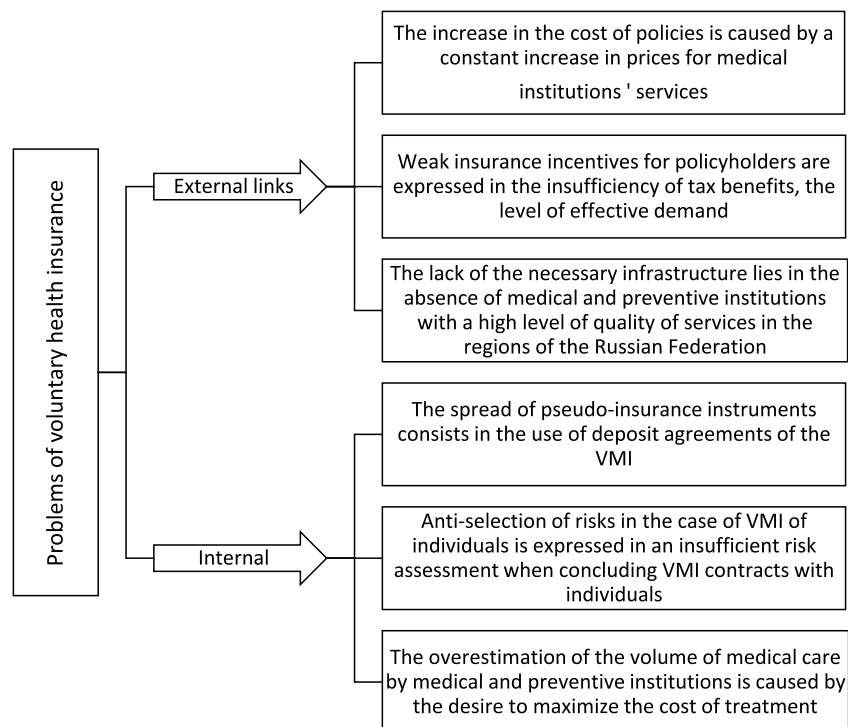


Fig. 3. Problems of voluntary health insurance
Source: [6]

Thus, the main part of the VMI market falls on corporate clients and, for example, in Moscow and St. Petersburg, according to experts, 95 % is corporate. In the regions, companies that insure their employees prefer depository insurance and the use of VMI to finance their own medical unit or organize the treatment of employees in sanatoriums and dispensaries [1].

Investments in human capital are one of the crucial conditions for increasing the efficiency of any company, and VMI is one of the directions of such investments. The social package is understood as additional social benefits and guarantees to employees, and each employer provides it on its own initiative and on a voluntary basis, and it serves as a competitive advantage of the company. The social package may include medical care for employees, that is, a program of corporate voluntary medical insurance. Corporate VMI is a program of social guarantees in the medical field, including compensation for the costs of treatment, examination and hospitalization of the organization's personnel.

Figure 4 shows the scheme of interaction of VMI subjects.

In accordance with Article 157 of the Civil Code of the Russian Federation, the VMI agreement is one of the conditional transactions. The policyholder has the right to demand payment of the insured amount from the insurer only from the moment of occurrence of the insured event. The insured event also has a feature inherent in a conditional transaction: the condition and the insured event are equally obligations with respect to which it is unknown whether they will occur or not [8].

The absolute advantages of voluntary health insurance for employees are:

- Additional free social guarantees;
- Getting medical care in the best medical institutions;
- The possibility of choosing a medical institution from the list offered by the insurance company;
- Full compensation of medical care costs;
- Qualified medical staff, polite and attentive;
- Individual approach;
- Reception by appointment at a convenient time, no queues;
- The possibility of calling a doctor at home or at work;
- Registration of sick leaves, certificates and other documents;
- Spa treatment (subject to inclusion in the program);
- The possibility of insuring family members.

The advantages for legal entities that insure their employees are:

- Getting tax benefits:
 - In accordance with paragraph 16 of Article 255 of the Tax Code of the Russian Federation, the maximum amount of contributions not exceeding 6% of the total cost of salary payments under a VMI agreement concluded for at least 1 year can reduce the tax base for income tax [9];
 - According to paragraph 1 of Article 238 of the Tax Code of the Russian Federation, the amounts of insurance premiums under the VMI contract, which was concluded for at least 1 year, are not subject to a single social tax [9];

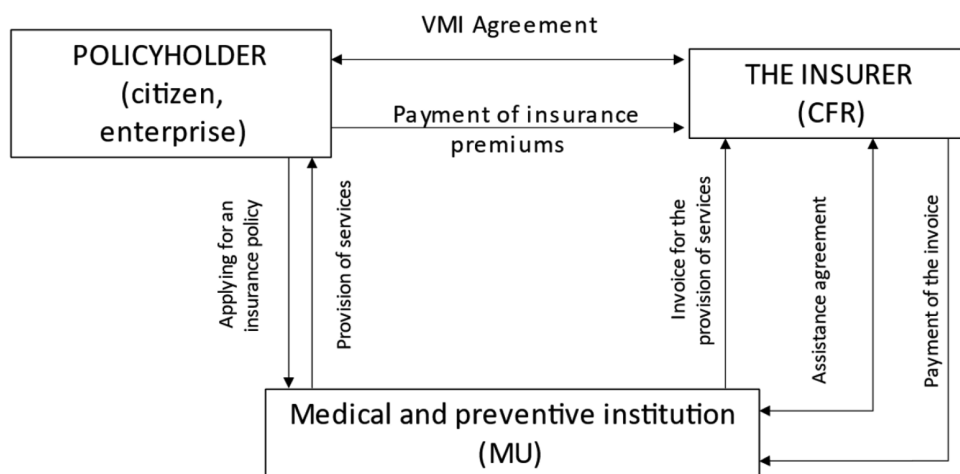


Fig. 4. Scheme of interaction of VMI subjects
Source: [7]

○ In accordance with paragraph 3 of Article 213 of the Tax Code of the Russian Federation, when calculating the tax base of an individual, the income that he receives as an insurance payment upon the occurrence of an insured event is not taken into account [9].

- Increasing the prestige of the organization and the loyalty of employees;
 - Attracting qualified employees;
 - Reducing the turnover of qualified personnel;
 - Reducing the loss of working time and, accordingly, increasing labor productivity.
- And others.

Thus, in addition to the main function of voluntary medical insurance – receiving highly qualified volume medical care, there are additional bonuses that confirm the benefits for both insured and insured persons, and it is this that is the main factor in the dynamic development of this type of insurance.

VMI programs include various types of medical care:

- Outpatient clinic;
- Stationary;
- Comprehensive;
- Special programs

In case of illness, you can seek help in two ways:

- Direct access (applying to a medical institution from the list provided by the insurance company);
- Access through the insurance company (round-the-clock phone number of the insur-

ance company, confirmation of payment for the necessary service).

For corporate VMI, there are various schemes that are applied depending on the personnel belonging to different grades (Fig. 5).

The employer's choice of a VMI program is influenced by many factors: the position of the employee, the length of service, the value of the employee for the company. For example, employees belonging to grade 3 can be insured under the standard VMI program, and elective options with the inclusion of shared co-financing can also be applied to this program. All the years of using VMI, the possibility of insuring relatives of employees of the company – grade 1 has become very popular. As a rule, the standard and extended VMI program does not include aesthetic medicine and cosmetology. The full VMI program, costing from 100,000 rubles, includes, in addition to the list included in the standard (basic) and extended programs, the following:

- Access to expensive private and public high-tech clinics;
 - Expensive high-tech research;
 - Hospitalization for emergency and planned indications in separate wards of Luxury clinics;
 - Dental care, includes prosthetics and implantation;
 - Pregnancy management and maternity care;
 - Psychotherapy services;
 - Diagnostics and treatment in foreign medical institutions
- And so on.

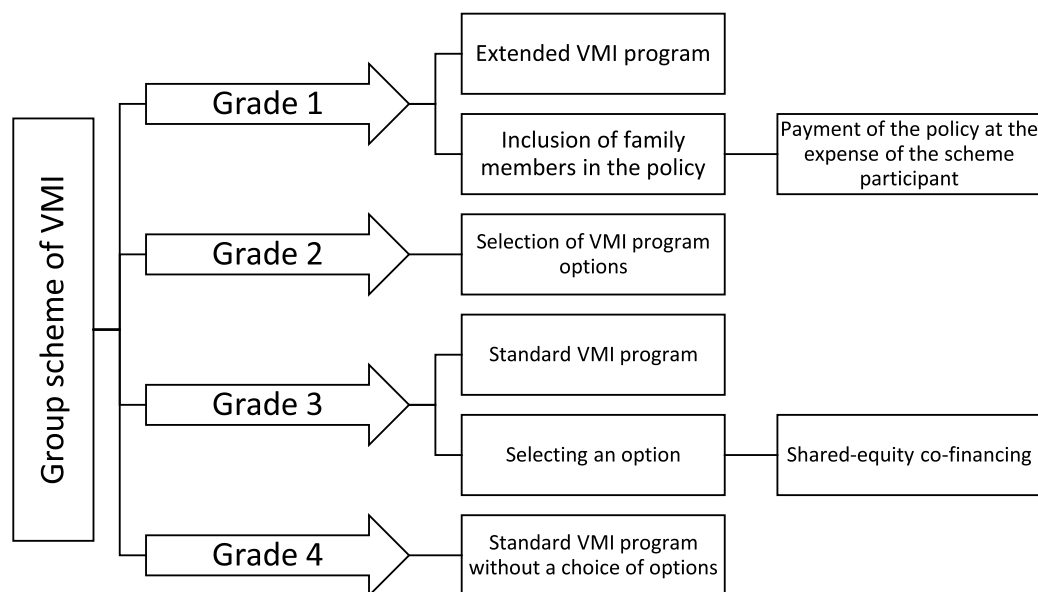


Fig. 5. Scheme of group insurance of VMI
Source: [10]

If there are a large number of advantages of corporate voluntary medical insurance, the main disadvantage for employees is that the insurance program is chosen directly by the employer, the conditions are dictated by him. So, if the insured amount is exceeded per person under the collective insurance contract, the insured will have to pay for treatment independently. And with an extended VMI program, the employer may ask the employee to pay part of the insurance premium. However, with the existing disadvantages, a significant plus is that the cost of a corporate voluntary health insurance policy is significantly lower than a policy for an individual.

An important point for both corporate and private VMI is that unpaid medical services are mandatory prescribed in the insurance contract. It should be noted that if the client of the insurance company already has some serious diseases, such as:

- Oncological diseases;
- Dangerous infectious diseases;
- Venereal diseases;
- AIDS;
- Hepatitis;
- Tuberculosis;
- Diabetes mellitus;
- Mental disorders;
- Congenital chronic diseases;
- Complicated pregnancy;
- Infertility

and the patient will have a long-term treatment and rehabilitation, in this case, the insurance company may not conclude a VMI contract. If the concealment of the presence of a serious illness is detected, the insurance company has the right to terminate the insurance contract. Within the framework of VMI, chronic diseases are treated only in the acute stage if there is a threat to the patient's life. If the above-mentioned diseases are detected during the examination of the patient, the insurance company will pay for all studies and procedures until the diagnosis is made.

In accordance with the analytical review of the voluntary health insurance market prepared by AST Company:

- This type of corporate insurance is most in demand in raw materials companies and IT sector companies and accounts for 27.6% (Fig. 6);
- The most popular options are outpatient consultations and inpatient care (Fig. 7);
- There is an increased popularity of options related to telemedicine, as well as a growing demand for coinage (Fig. 8);
- The success factors of the clinics are:
 - Professional team;
 - Modern methods of diagnosis and examination;
 - Convenient location;
 - Service;
 - High places in the quality ratings compiled by the media.

VMI by industry

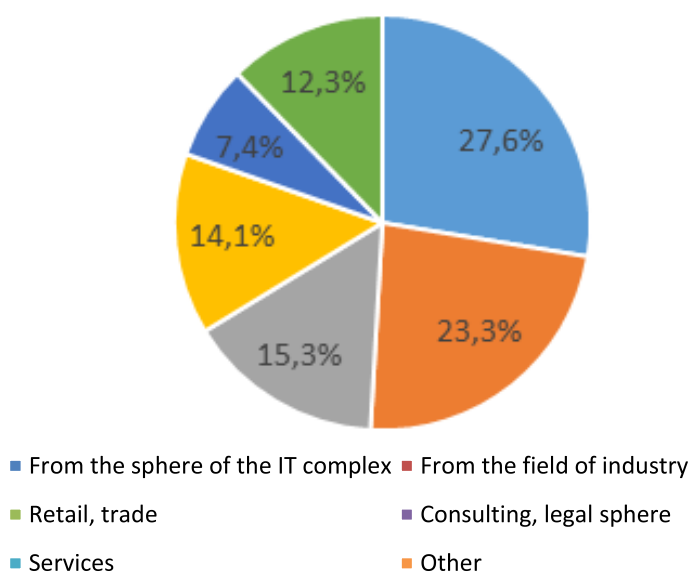


Fig. 6. VMI by industry
Source: [11]

A set of basic VMI services, %

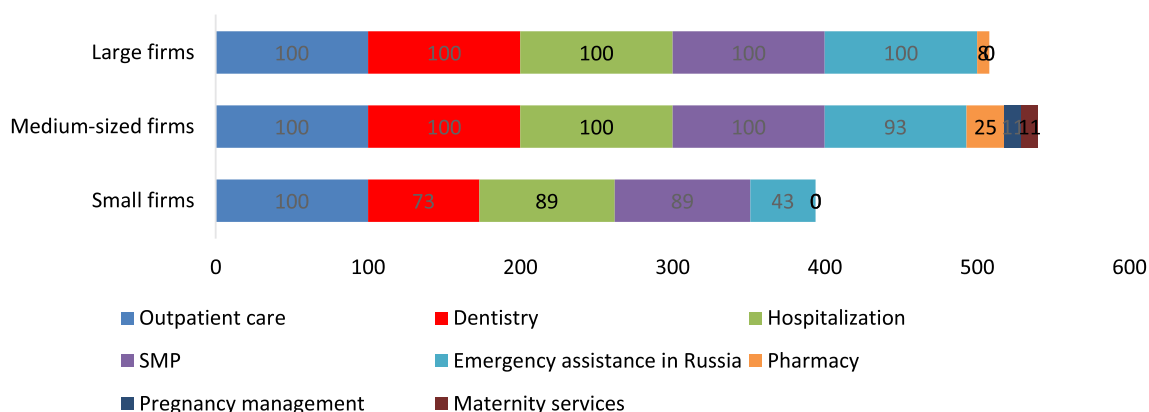


Fig. 7. A set of basic VMI services
Source: [11]

Additional VMI options, %

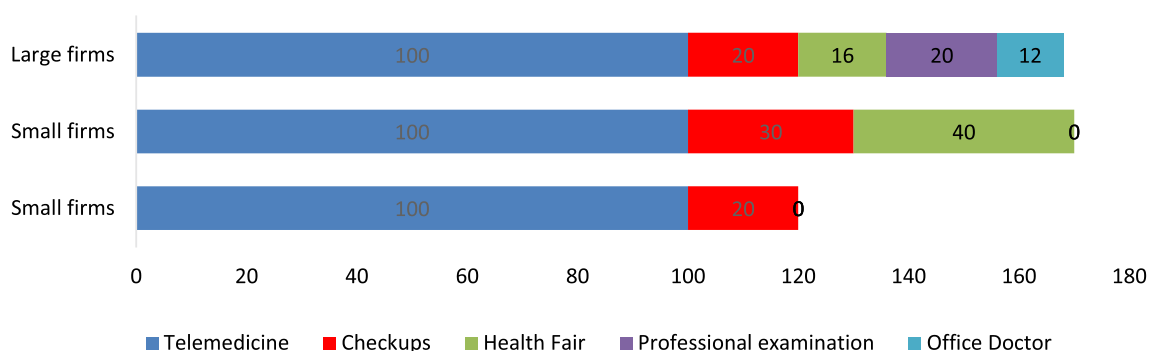


Fig. 8. Additional VMI options
Source: [11]

Conclusion

Thus, voluntary medical insurance, especially its corporate component – is a growing segment of the insurance market and is the most popular type of insurance in Russia, which is confirmed by statistical data and scientific publications analyzed in the course of this study. The main part of the VMI market is accounted for by corporate clients, and in Moscow and St. Petersburg, 95% is corporate. Investments in human capital are one of the crucial conditions for increasing the efficiency of any company, and VMI is one of the directions of such investments. This type of corporate insurance is most in demand in raw materials companies and companies in the IT sector, which is natural, since companies in these areas of activity are large businesses and are the most financially stable. And the cost of a corporate voluntary health insurance policy is significantly lower than the cost of a policy for an individual. The

study identified the positive and negative aspects of the analyzed type of insurance.

In conclusion, it should be noted that the main advantage of corporate voluntary medical insurance for all participants of the scheme is the benefit expressed in different ways and it is this benefit that is the main factor in the dynamic development of this type of insurance.

References

1. Geraskina, O. A. Problems and prospects of compulsory medical insurance and voluntary medical insurance in Russia / O. A. Geraskina // Politics, economics and innovations. – 2016. – № 7(9). – P. 3.
2. The Law of the Russian Federation of 28.06.1991 No. 1499-1 (ed. of 24.07.2009) "On medical insurance of citizens in the Russian Federation".
3. Aistov, A.V. Post-contract opportunism in the market of voluntary medical insurance / A.V. Aistov, E. A. Alexandrova // Economic policy. – 2018. – Vol. 13. – No. 3. – pp. 148-181. DOI: 10.18288/1994-5124-2018-3-07.
4. Professional insurance portal "Insurance today" / Market dynamics. [Electronic resource] // URL: <http://www.insur-info.ru/statistics/analytics/> (accessed 20.07.2021).

5. Suslyakova O. N. Prospects for the development of the voluntary medical insurance market in Russia / O. N. Suslyakova // Scientific and methodological electronic journal Concept. – 2018. – No. 9. – pp. 331-338. DOI: 10.24422/MCITO. 2018. 9. 16684.
6. Bondar, Yu. V. On the content of internal and external problems in the development of voluntary medical insurance in Russia / Yu. V. Bondar // Izvestiya Irkutsk State Economic Academy (Baikal State University of Economics and Law). – 2015. – Vol. 6. – No. 3. – p. 9. DOI: 10.17150/2072-0904.2015.6(3).9.
7. Studbooks.net / Home / Banking / Comparative analysis of compulsory medical insurance (CHI) and voluntary medical insurance (VMI) in Russia. [Electronic resource] // URL: https://studbooks.net/586141/bankovskoe_delo/sistema_dobrovolnogo_meditsinskogo_strahovaniya (accessed: 20.07.2021).
8. Gerasimenko, L. V. The concept and features of a voluntary medical insurance contract / L. V. Gerasimenko // Society and law. – 2010. – № 2(29). – Pp. 81-85.
9. “The Tax Code of the Russian Federation (Part two)” dated 05.08.2000 No. 177-FZ (as amended on 02.07.2021) (and amendments and additions, intro. Effective from 02.08.2021).
10. Bstudy.net / Home / Economics / Group risk insurance schemes. [Electronic resource]. URL: https://bstudy.net/683079/ekonomika/shemy_gruppovogo_strahovaniya_riskov_personala (accessed: 20.07.2021).
11. Professional insurance portal “Insurance today” / Analysis [Electronic resource]. URL: <https://www.insur-info.ru/analysis/1308/> (accessed 20.07.2021).

FORMATION OF FUNCTIONAL LITERACY AS A BASIS FOR IMPROVING THE QUALITY OF THE EDUCATIONAL PROCESS

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The modern world requires from a young specialist not only academic knowledge in his specialty, but also many other qualities, skills, skills that allow him to navigate the modern powerful information flow. Today, students have to learn a huge amount of complex, often incomprehensible material in all academic subjects. And even complete mastery of this material does not guarantee a young specialist competitiveness in the modern economic market. The formation of functional literacy among students allows not only to master theoretical knowledge, but also to apply the acquired knowledge in practice, to form skills and abilities, to build meta-subject connections. They must acquire the necessary knowledge and comprehend it, develop skills for applying the acquired knowledge in real life situations. In connection with the increasing globalization of the economies of most countries of the world, the problem of training specialists capable of adequately competing in the modern world economic market becomes urgent. The article gives the concept of natural science literacy as a necessary component of the development of students' functional literacy. The components of natural science literacy are revealed and an example of the formation of its competencies when passing the topic "Discovery of viruses" is given.

Keywords: functional literacy, meta-subject knowledge, science literacy, International Program for Student Assessment (PISA)

A distinctive feature of the life of modern society is the rapidly increasing variability of the surrounding world of things, ideas and technologies are replaced than generations of people. Such changes affect almost all aspects of human life, but first of all, the education system, since entering a post-industrial society has given rise to the problem of timely preparation of people for new conditions of life and professional activity. The modern world requires from a young specialist not only academic knowledge in his specialty, but also many other qualities, abilities, skills that allow him to navigate in the modern powerful information flow [1]. In the 21st century, a person is surrounded by an information field, in which it is not easy to navigate not only for young specialists, but also for the older generation [2, 3]. Today, students have to learn a huge amount of complex, often incomprehensible material in all academic subjects. And even a complete mastery of this material does not guarantee young specialist competitiveness in the modern economic market, which has intensified in connection with the globalization of the economies of most countries of the world. Modern education allows students not only to master theoretical knowledge, but also to apply the acquired knowledge in practice, to form skills and abilities, and to build Meta subject connections. They must acquire the necessary knowledge and comprehend it, develop the skills of applying the knowledge gained in real life situations. The term «functional literacy» is currently used to define this complex competence.

The term «functional literacy» was introduced back in 1957 by UNESCO, which was understood as «a set of reading and writing skills for use in everyday life and to satisfy everyday problems» and was applied mainly to the adult population.

In our country, according to a number of international experts, from 25 to 40% of the total population, due to functional illiteracy, experience significant difficulties in writing, reading and working with numbers [4].

Nowadays, modern education has an essential question: «Do 15-year-old students who have received compulsory general education have the knowledge and skills they need for full functioning in modern society, i.e. to solve a wide range of tasks in various spheres of human activity, communication and social relations.

Materials and research methods

To monitor educational achievements, functional literacy among students in 1997, the Organization for Economic Cooperation and Development (OECD) developed a test that allows assessing the level of functional literacy among students. The result of this work is the Program for International Student Assessment (PISA).

PISA was first tested in 2000 and is conducted by the OECD every 3 years among adolescents aged 15 years. International research on monitoring functional literacy using the PISA test is carried out with the participation of leading international scientific organizations such as the Australian Council for Educa-

tional Research (ACER), the Netherlands National Institute for Educational Measurements (CITO), the United States Educational Testing Service (ETS), and the National Institute for Educational Research (NIER) in Japan, US Westat (WESTAT) and others. The study involves OECD countries, as well as those countries that interact with the OECD. The number of such countries is increasing every year.

The results of the PISA study allow us to determine the state of Russian education from the standpoint of international standards, as well as in what direction Russian education should be improved to increase the competitiveness of our graduates.

Research results and discussion

To determine functional literacy, several indicators are used, the main of them are mathematical literacy, reading literacy and natural science literacy. The results of PISA-2018 among students of OECD countries, as well as those countries that interact with the OECD we see from Russia ranks 30th in functional literacy among the OECD countries. According to the results of the study conducted in 2018, students from Russia showed a slight decline in all three areas in comparison with 2015. As can be seen from the data in Table 1, the average score of Russians in 2018 was: in reading literacy 479 points against 495 in 2015; in natural science literacy – 478 points against 487 in 2015; in mathematical literacy – 488 points against 494 in 2015.

As a result, compared to the 2015 survey, Russia dropped from 26th to 31st in reading literacy, from 23rd to 30th in mathematics, and from 32nd to 33rd in science literacy. The data are presented in Table 2.

In the international report for 2000-2012 the place of the country is indicated taking into account the standard deviation. To date, the largest researchers in assessing the quality of education, in addition to PISA, are several recognized organizations – IEA, TIMSS. About 50 – 70 countries of the world take part in such studies, where the educational level of the younger generation is assessed.

International studies TIMSS (Trends in Mathematics and Science Study) in the field of mathematical and natural science knowledge showed that subject knowledge in these areas meets international requirements (in the studies conducted in 2015 and 2019, Russia takes 3-4 places in science literacy among 4 grades and 5-7 places among 8 grades, and in mathematical literacy 6-7 places in grades 4 and 8), and functional literacy remains below international standards.

If earlier there were debates about what is more important, academic knowledge or the competence of the student, now the need for deep academic knowledge and the importance of basing the competencies of students on them, allowing to apply this knowledge in real life, are obvious. The research, carried out according to the PISA program standards, focuses not so much on determining the formation of subject knowledge and skills, but on identifying the ability to solve practice-oriented problems based on information presented in different forms, identifying those knowledge and skills that will be useful to students in the future. According to the results of the study, Russian students occupy lagging positions in the ability to analyse life situations in order to identify and formulate modelling problems, and suggest ways to solve them.

Table 1

Research direction	The number of Russian points (on a 1000-point scale)						
	PISA-2000	PISA-2003	PISA-2006	PISA-2009	PISA-2012	PISA-2015	PISA-2018
Science literacy	460	489	479	478	486	487	478
Mathematical literacy	478	468	476	468	482	494	488
Reading literacy	462	442	440	459	475	495	479

Table 2

Research direction	Place of the Russian Federation among other participating countries						
	PISA-2000	PISA-2003	PISA-2006	PISA-2009	PISA-2012	PISA-2015	PISA-2018
Science literacy	26-29	20-30	33-38	38-40	34-38	32	33
Mathematical literacy	21-25	29-31	32-36	38-39	31-39	23	30
Reading literacy	27-29	32-34	37-40	41-43	38-42	26	31

In this regard, before the education of Russia there is a task to change the trajectory of students so as to apply knowledge to practice. In accordance with the May decree of President Vladimir Putin, Russia by 2024 should become one of the ten leading countries in the world in terms of the quality of general education. To do this, it is necessary to maintain the level of academic knowledge in TIMSS and increase functional literacy in PISA. In the tasks of the Unified State Examination and the OGE of recent years, practice-oriented tasks aimed at identifying functional literacy in children have already been included.

How can this goal of our functional literacy education be implemented? First of all, you need to know the requirements that are presented to teachers in PISA tests. Currently, a 6-level assessment system has been developed and used in PISA tests to assess the results of educational achievements (pic. 1).

According to the data from Table 3 and pic. 1, Russia is between the 3rd and 4th levels in functional literacy, occupying an average value on the international scale.

What problems need to be solved to increase the level of functional literacy?

First, we are used to building a model of education based on one single correct answer. With this approach, students do not develop creative thinking skills. Without mastering this,

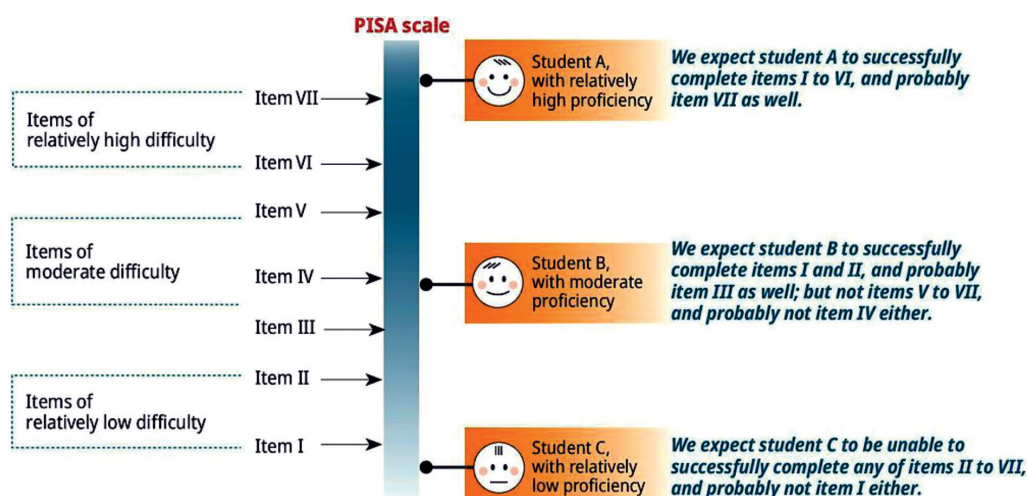
it is difficult for a modern person to navigate and develop in the rapidly changing conditions of the modern world. Accordingly, expanding the skills of solving problems with multiple solutions is a priority for the teacher.

Secondly, at the moment, the problem with education is that often academic knowledge is given in isolation from real life. And when students face real life, they often cannot determine in which area of knowledge the solution to a particular problem is located. The students do not have the integrity of the perception of the picture of the worldview. An important role in this is played by the formation of Meta subject knowledge. To form this competence in the educational process, it is necessary to give atypical tasks, real life situations, tasks where there is no obvious solution and requiring creative activity.

Thirdly, when building the trajectory of students' education, it is necessary to develop not only mathematical, reading and natural science literacy, but also global competencies of students, such as creative thinking and metacognitive abilities, which allow students to solve multiple life and professional tasks based on the acquired knowledge, skills and skills. Only such an integrated approach to the development of competencies will allow our students in the future to compete with dignity in the specialist market.

Table 3

	Reading literacy	Mathematical literacy	Science literacy
Russia	479	488	478
All OECD countries	487	489	489
Top ten countries with the best results	526	541	534



Levels of functional literacy of PISA research

In order to form the functional literacy of students, it is necessary to use new systems of teaching and learning situations. Introduce tasks, the main meaning of which is to translate passive knowledge into active knowledge. To do this, set multivariate tasks, tasks in which there are no explicit indications of the mode of action. To pose problems requiring the search for an answer outside the subject area, close to life situations and affecting the personality of students [5, 6]. And in this case, the basis of functional literacy is the formation of natural scientific literacy. What is natural science literacy and what does it consist of?

There are three main competencies, three groups of skills that characterize natural science literacy in PISA

- Explaining or describing natural science phenomena based on available scientific knowledge, as well as predicting changes.
- Recognition of scientific questions and application of scientific research methods.
- Interpreting data and using scientific evidence to draw conclusions.

For the formation of relevant competencies, it is necessary to introduce tasks aimed at the development of natural science literacy in the learning process [7]. There are basic requirements for such tasks. These tasks should be aimed at testing the skills that characterize science literacy, but at the same time should be based on situations that can be called life, real, or simply interesting for the children. These tasks are usually based on problematic material, including text, graphs, tables and related questions.

For example, consider the tasks for the formation of natural science literacy in the study of the topic "Discovery of viruses". In connection with the developing COVID-19 epidemic, the topic is relevant and the competencies acquired by students in the study of this topic are necessary for any person.

Tasks for the formation of natural science literacy in the study of the topic "Discovery of viruses". Read the text and complete tasks 1-5.

Task 1. Discovery of viruses

Viruses have existed on earth for about 3 billion years. They are the most multiply biological form and are present in every ecosystem. Meanwhile, people have only recently learned about the existence of viruses.

This happened at the end of the 19th century, when a young Russian scientist Dmitry Ivanovsky studied the so-called mosaic disease of tobacco plants. He rubbed sickly tobacco leaves in a porcelain mortar and passed the re-

sulting juice through a bacterial filter. The filter had tiny pores through which bacteria did not pass. The resulting filtrate was applied to healthy tobacco plants, and after a while, discoloured areas appeared on these leaves. There were no bacteria, but the mosaic disease affected the plant. The leaves were examined under a light microscope, as a result, D. Ivanovsky suggested that the causative agents of diseases are still unknown particles, which he called non-bacterial pathogens or "filtering" bacteria. Subsequently, these particles were called viruses. D. Ivanovsky became their discoverer.

1. What research methods made it possible for D. Ivanovsky to make an assumption about the existence of viruses?

- 1) Observation
- 2) Modelling
- 3) Experiment
- 4) Filtration
- 5) Monitoring

Mark all correct answers.

As we can see from Task 1, students are offered to determine the research methods used by the scientists. This requires an analysis of the text read, updating knowledge on the topics studied. At the same time, the competencies of students are formed and consolidated in the application of various methods of natural science research to solve the assigned tasks.

Task 2. *Continuing the study, D.I. Ivanovsky conducted the following experiment. In a Petri dish on media with nutrients, he placed excretions from plants with a known bacterial disease and excretions from plants with "filtering" bacteria. It turned out that only in case 1, colonies grew on nutrient media, and in case 2 there were no colonies. What conclusions did Ivanovsky make after he had studied his experiments on the study of mosaicism of tobacco leaves?*

Mark all correct answers.

- 1) Tobacco leaves are contaminated with bacteria.
- 2) There is genetic material inside the viral particle.
- 3) The smallest particles pass through the bacteria filters.
- 4) Viruses develop in any cells (plants, animals, humans).
- 5) Cancer viruses infect only animal and bacterial cells.
- 6) "Filterable" bacteria are not cultivated on artificial nutrient environment.

In task 2, students are given the scientist's research and the data obtained by them. Students need to draw their own conclusions from the research results. Competencies of analysis

and interpretation of the received research information are formed

Task 3. *Can we assume that the experiments carried out by D.I. Ivanovsky gave the final confirmation of his hypothesis about the existence of viruses?*

Mark "Yes" or "No" and then write down an explanation of your answer.

YES – ☐ NO – ☐

Explain your answer.

If in tasks 1 and 2 students are asked to establish research methods, to understand the essence of the experiment, to determine its purpose, to guess that the scientist acted at the level of an assumption, that is, to put forward a hypothesis, then in task 3 they are asked to explain whether D.I. Ivanovsky confirm his hypothesis about the existence of a non-bacterial pathogen of tobacco disease.

Task 4. *Much later, using an electron microscope, viral particles of the TMV tobacco mosaic virus and other viruses were detected and studied. It revealed that a viral particle is a DNA or RNA molecule enclosed in a protein coat. For example, the TMV virus contains an RNA molecule, and its protein coat consists of 2130 identical polypeptide subunits. Currently viruses are believed to be non-cellular life forms. When viruses enter a cell, they rebuild the metabolism of the host cell, and it begins to produce (due to the building material of the cell and energy) new viral particles identical to the first virus.*

What is the role of the genetic material (the DNA or RNA molecules) contained within the viral particle? Write down your answer.

To complete this task, students need to explain the function of DNA and RNA as an integral part of a viral particle, indicating the important properties of nucleic acids: the presence of genetic information that determines all the signs of a viral particle, and the participation of nucleic acids in the reproduction of viruses.

Task 5. *Viruses live exclusively in living organisms: people, animals, plants, fungi and bacteria. Without viruses, the evolution of life on earth would be impossible, but at the same time, viruses are capable of causing disease in any living organism. Humanity knows massive viral diseases, epidemics and pandemics that claim hundreds of thousands, and sometimes millions of lives. The danger of an epidemic diminished sharply after the invention of the vaccine. For example, such a deadly viral disease as smallpox has almost completely disappeared from the earth thanks to mass vaccinations. However, the composition of vaccines*

against some viral diseases must be changed frequently. For example, vaccines to prevent common seasonal flu are changed every year.

What property of viruses explains the need to be vaccinated against influenza every year? Please check one correct answer.

- 1) Very small dimension
- 2) Ability to adapt to environmental conditions
- 3) The ability to penetrate the cells of a living organism
- 4) The ability to reproduce inside a living organism

When completing assignment 5, students need to explain the information that they know from life experience, competencies are formed to apply the knowledge gained in a life situation, the possibility to get vaccinated against influenza every year.

As we can see in these tasks, various competencies of natural science literacy are laid. Practice shows that the most difficult tasks for the students turned out to be tasks 3 and 4, which required detailed answers from the students. Not everyone succeeds in expressing their judgments, giving reasons, making generalizations.

So, in this example, we see that students develop such skills and abilities of natural science literacy as:

- use of natural science knowledge in life situations;
- identification of the features of natural science research;
- the ability to draw conclusions based on the data obtained;
- formulating the answer in a form that is understandable to all;
- an understanding of research methods;
- Identifying questions and issues that can be solved using scientific methods, etc.

No doubt it is not easy to set aside dedicated time to implement tasks aimed at developing functional literacy. The main study time in the modern curriculum is aimed at mastering the subject tasks of the discipline. But without linking the acquired academic knowledge to the realities of the life situations of students, the educational process loses its topicality. The effectiveness of the educational process is sharply reduced and at the end we have specialists who are often unable to apply their knowledge in personal and professional activities.

Therefore, our task is to develop and implement in practice as many tasks as possible aimed at the development of natural science literacy, as an integral part of the formation of functional literacy, which allows future spe-

cialists to effectively solve personal and professional problems.

Conclusion

To improve the quality of education and the level of functional literacy, it is necessary, through the joint efforts of the state, methodological workers and teachers, to form a modern educational environment for students. It is necessary to have a practical base for the implementation of design tasks, allowing you to apply the knowledge gained in practice.

An important and basic role in improving the quality of education belongs to a teacher who owns not only subject, but also meta-subject knowledge and a methodological system capable of gradually forming functional literacy in children. In this case, an important role is played by raising the qualifications of the teachers. After all only they determine the level of students, build an educational trajectory for the sequential formation of levels of functional literacy.

To accomplish these tasks, the teacher needs to master the basic concepts of functional literacy, master the technologies of their formation and be able to select and develop educational tasks aimed at applying theoretical knowledge in practice. In countries where functional literacy is well developed (Singapore, Finland, etc.), there are specialists in the field of the formation of functional literacy who help to expand the educational and meth-

odological resources of the teacher, analyse how to restructure the methodological work of the teacher.

Observing these conditions, it is possible to eliminate the main problems of training our students identified by international studies PISA and TIMSS and to increase the competitiveness of our specialists in the international market.

References

1. Adieva A.A., Medzhidova M.G., Djamalova S.A., Izrailova G.M. General scientific research methods as a theoretical basis for improving the quality of the educational process. – European journal of natural history. 2015. No. 6. P. 41-42.
2. Medzhidov M.A., Medzhidova M.G., Adieva A.A. Formation of functional and natural science literacy when studying the topic: "Discovery of viruses" // Innovative scientific research. 2021. No. 4-2 (6). P. 119-136.
3. Natural science literacy. Collection of reference tasks. Issue 1;2: textbook. manual for educational organizations / [G.S. Kovaleva, A.Yu. Pentin, E.A. Nikishova, G.G. Nikiforov]; ed. G.S. Kovaleva, A.Yu. Pentina. – SPb.: Education. 2020. 95 p.
4. Innovative project of the Ministry of Education "monitoring the formation of functional literacy" main directions and first results Basyuk V.S. Kovaleva G.S. // Domestic and foreign pedagogy. 2019. T. 1. No. 4 (61). P. 13-33.
5. Kolosova O.N., Elovenko N.A. Open type tasks as a tool for the formation of functional literacy. // In the collection: New science: history of formation, current state, development prospects. Collection of articles of the International Scientific and Practical Conference. Ufa. 2021. P. 139-141.
6. The network complex of information interaction of the constituent entities of the Russian Federation in the project "Monitoring the formation of students' functional literacy". <http://skiv.instrao.ru>.
7. Results of the PISA study: www.oecd.org/edu/pisa, www.fioco.ru.

МАТЕРИАЛЫ XIII МЕЖДУНАРОДНОЙ СТУДЕНЧЕСКОЙ НАУЧНОЙ
КОНФЕРЕНЦИИ «СТУДЕНЧЕСКИЙ НАУЧНЫЙ ФОРУМ 2021»РОЛЬ ВОСПАЛИТЕЛЬНОГО ПРОЦЕССА
В ПАТОГЕНЕЗЕ РЯДА ЗАБОЛЕВАНИЙ

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Известно, что за свободнорадикальными (СР) процессами стоит немаловажная роль, отражающаяся на жизнедеятельности клеток и заключающаяся в обеспечении различных метаболических процессов всего организма. Как скорость образования свободных радикалов (СР), так и их количество, вне патологических состояний, поддерживает организм на определенном уровне, контролируемом системой саморегуляции. Однако усиление процессов свободнорадикального окисления является предпосылкой развития клеточной патологии, где выступает в качестве ведущего механизма. Рассматривая конкретную область медицины, стоматологию, где одними из самых многочисленных и актуальных проблем являются воспалительные заболевания полости рта, влекущие за собой и социальную значимость, ведь в настоящее время поражению тканей пародонта, зубов подвержены лица более молодого возраста, актуализация данной проблемы не вызывает сомнений. Исследование СР процессов в слюне легкодоступно, забор слюны исключает инфицирование больного. Проведена оценка содержания в слюне малонового диальдегида (МДА) при ряде воспалительных заболеваний в полости рта. Установлено повышение содержания МДА при гингивите, стоматите, пародонтите и кариесе, что свидетельствует о развитии окислительного стресса. МДА легко диффундирует внутрь клеток, реагирует и повреждает разнообразные биомолекулярные структуры. Наиболее выраженный окислительный стресс наблюдался при гингивите и кариесе.

Ключевые слова: воспаление, свободнорадикальное окисление, свободные радикалы, антиоксидантные системы, стоматологические заболевания, малоновый диальдегид

THE ROLE OF THE INFLAMMATORY PROCESS
IN THE PATHOGENESIS OF CERTAIN DISEASES

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It is known that free radical (FR) processes have an important role that affects the vital activity of cells and consists in providing various metabolic processes of the whole organism. Both the rate of formation of free radicals (FR) and their number, outside of pathological conditions, are maintained by the body at a certain level, controlled by the self-regulation system. However, the intensification of free radical oxidation processes is a prerequisite for the development of cellular pathology, where it acts as a leading mechanism. Considering a specific area of medicine, dentistry, where one of the most numerous and urgent problems are inflammatory diseases of the oral cavity, which entail social significance, because at present, younger people are susceptible to damage to periodontal tissues and teeth, the actualization of this problem is beyond doubt. The study of FR processes in saliva is easily accessible, saliva sampling excludes infection of the patient. The content of malondialdehyde (MDA) in saliva was evaluated in a number of inflammatory diseases in the oral cavity. An increase in the content of MDA in saliva was found in gingivitis, stomatitis, periodontitis and caries, which indicates the development of oxidative stress. MDA easily diffuses into cells, reacts and damages a variety of biomolecular structures. The most pronounced oxidative stress was observed in gingivitis and caries.

Keywords: inflammation, free radical oxidation, free radicals, antioxidant systems, stomatological diseases, malondialdehyde

Воспаление является одной из сложных реакций, направленной, в первую очередь, на защиту организма и возникающей в ответ на местное действие флогогенного фактора. Данная защитная реакция выявляет локализацию внедрения патологического фактора, уничтожает и удаляет его из организма, снижает риск развития и проявления его патогенных эффектов.

При внедрении патологического фактора в организм возникает ступенчатое повреждение, начинающееся от малых структур (клеток, внеклеточных структур) и переходящее на более обширные участки: ткани, органы, и, как следствие, возникает нарушение жизнедеятельности организма в целом.

Особое значение воспалению уделяется в челюстно-лицевой хирургии. Важно обо-

значить принципиальную необходимость данной проблемы не только в медицинской отрасли, но и в социуме. Усугубляет ситуацию прямая корреляция между степенью тяжести течения и повышением смертности больных, что в среднем составляет около 0,2%. Упоминая временную нетрудоспособность граждан с воспалительными процессами в челюстно-лицевой области, необходимо указать на чрезвычайно большие цифры, составляющие порядка 87,46% стоматологических болезней [1]. Воспалительные процессы часто сопровождаются гипоксией и активацией процессов свободно-радикального окисления. Процессы, протекающие в организме при нормальных и патологических состояниях, основываются на молекулярных механизмах патогенеза,

исследование которых, в настоящее время, является одним из преимущественных направлений медицины [2]. Исследование показателей пероксидного окисления липидов (ПОЛ) в слюне при различных стоматологических заболеваниях способствует обоснованию роли СРО в патогенезе. В связи с этим актуальность выбранной темы не вызывает сомнения.

Цель исследования: изучить научную литературу последних лет об этиологии и механизмах развития воспалительного процесса. Описать особенности воспалительного процесса в челюстно-лицевой области, показать роль процессов СРО в механизмах развития патологий.

Материалы и методы исследования

Исследования были проведены на базе НИИ экспериментальной биологии и медицины ВГМУ им. Н.Н. Бурденко Минздрава России.

Материал (ротовая жидкость) получали без стимуляции, сплевыванием в стерильные пробирки. Ротовую жидкость центрифугировали 15 минут при 6000 об/мин. Надосадочную часть использовали для анализа. Исследования проводили на биохимическом анализаторе ClimaMC-15 (Испания). Определение малонового диальдегида (МДА) проводили с 2-тиобарбитуровой кислотой). Опыты проводили в 4-кратной биологической и 2-кратной аналитической повторностях. Результаты опытов сравнивали с контролем. Статистическая обработка полученных результатов проводилась с использованием стандартных методов вариационной статистики: расчета средних значений, стандартного отклонения, ошибки средних значений, t-критерия Стьюдента, программы Excel для построения графиков, пакета прикладных программ Statistica 6,0. Также проведен анализ литературных данных, на базе которого сформулированы основные выводы.

Результаты исследования и их обсуждение

Воспаление можно рассматривать как взаимодействие организма с патогенными факторами различного происхождения. Флоготенный фактор может быть как экзогенного, так и эндогенного происхождения. Немаловажным является принадлежность патологического фактора к инфекционным агентам. Значительная роль принадлежит длительности и интенсивности воздействия флоготенного фактора на организм: здесь прослеживается прямая зависимость – чем больше и выше, тем острее протекает воспалительная реакция. Нельзя не сказать

о состоянии организма на момент внедрения патологического фактора и способности противостоять его разрушительным действиям, т.е. его реактивности и местных особенностей тканей или органов. Большое значение имеет и состояние организма, которое зависит от реактивности организма (нормальная, повышенная или качественно измененная и пониженная реактивность) и регионарных особенностей тканей или органов, подвергшихся воздействию флоготенного фактора.

Говоря о последовательности процессов, возникающих во время воспалительной реакции, необходимо заметить три неотъемлемых составляющих: альтерацию, или повреждение клеток и тканей; расстройство микроциркуляции с экссудацией и эмиграцией; пролиферацию – размножение клеток и восстановление целостности ткани.

В результате действия флоготенного фактора непосредственно на ткань, возникает первичное нарушение структур клетки и межклеточного вещества, запускающее последовательный каскад биохимических реакций свободнорадикального окисления. Образование свободных липидов и кетокислот вызывают расстройства энергетического и пластического обмена в конкретном участке поврежденной ткани. Нарушается соотношение ионов в клетке и межклеточной среде, в результате чего в клетке увеличивается количество ионов кальция и натрия, а вне клетки – ионов калия и магния.

При нарушении клеточной структуры, повреждении органелл, во внеклеточную среду попадают лизосомальные ферменты. Большая роль стоит и за активными метаболитами кислорода, источниками которых могут служить активированные и иммигрировавшие фагоциты, в меньшей степени – резидентные клетки. Оба фактора, лизосомальные ферменты и активные метаболиты кислорода воздействуют на соединительную ткань, микрососуды и кровь, вызывая вторичную альтерацию. Так как в клетке увеличивается количество высших жирных кислот и ионов кальция, как следствие первичной альтерации, нарушается функция митохондрий, происходит разобщение окислительного фосфорилирования, в результате чего глюкоза окисляется по анаэробному пути, что приводит к накоплению недоокисленных веществ, возникает метаболический ацидоз.

Снижение pH среды создает благоприятные условия для высвобождения гидролаз лизосом, причем их каталитическая активность в данном случае будет только расти. Под действием различных гидролаз (протеазы, липазы) происходит усиление проте-

олиза и липолиза. Стоит отметить, что денатурация белков приводит к разрушению мембран клеток, распаду белковых структур и клеток флогенного агента, когда им являются микроорганизмы, паразиты или белоксодержащие факторы, активации иммунных реакций и включение клеточных и гуморальных механизмов иммунитета.

К настоящему времени доказана существенная роль процессов СРО в патогенезе ряда заболеваний. Установлено, что воспалительные процессы сопровождаются снижением активности антиоксидантных систем и увеличением содержания прооксидантных агентов.

Кислород является самым значимым источником свободных радикалов, активными формами которого являются пероксид водорода, супероксидный анион-радикал, гидроксильный радикал, иногда в состав этой группы входит синглетный кислород.

Доказано, что гидроксильный радикал, будучи самым активным инициатором СРО из известных, атакует соединения различной природы и структуры, не исключением становятся и биомакромолекулы, в результате чего он «перетягивает» на себя ион водорода, образуя воду и соответствующий радикал пораженной молекулы [3, 4]. Гидроксирадикал, оказывая разрушительное влияние на группы аминокислот, цистеиновые, гистидиновые и другие, и остатки белков, вызывает необратимое их разрушение, т.е. денатурацию. В результате чего возникают инактивация ферментов, необратимый распад углеводных мостиков, располагающихся между нуклеотидами, что сопровождается грубыми разрывами цепей ДНК и РНК, инициирует процессы липопероксидации, вызывает мутации и гибель клеток [5].

Следом за альтерацией возникают сосудистые реакции, в состав которых входят следующие компоненты:

1. кратковременный спазм артериол, проявляющийся побледнением ткани, возникающий как следствие воздействия флогенного агента и возбуждения вазоконстрикторов;

2. артериальная гиперемия, объясняющаяся расширением артериол и базирующаяся в проявлении местных признаков воспалительной реакции – повышении температуры и покраснения (однако, в образовании жара участвует и усиленная теплопродукция в очаге из-за повышенного метаболизма);

3. венозная гиперемия, являющаяся истинной воспалительной гиперемией и сопровождающая весь воспалительный процесс.

Стоит отметить особенности воспалительной гиперемии, отличающейся от других видов гиперемии извращением сосудистых реакций поврежденной ткани на действие сосудосуживающих агентов, такими являются адреналин и кофеин, и на раздражение симпатических нервов. Данное явление связано со снижением или качественным изменением их чувствительности к действию вазоконстрикторных стимулов, или «десенсибилизацией» сосудов, что обуславливается блокадой рецепторов. Другой отличительной чертой данного вида гиперемии является более сильное кровенаполнение пораженного участка ткани или органа, в результате чего количество функционирующих капилляров значительно увеличивается, их просвет расширяется, интенсивность микроциркуляции нарастает, линейная скорость кровотока снижается. Таким образом, воспалительную гиперемию можно рассматривать как самостоятельный вид нарушения микроциркуляции.

Еще одним компонентом воспалительной реакции является стаз. Как правило, нарушение кровотока при воспалительном стазе является преходящим, однако при возникновении повреждений сосудистой стенки и тромбов во многих микрососудах стаз становится необратимым.

Расстройства микроциркуляции во время воспалительной реакции сопровождаются такими явлениями, как экссудация и эмиграция.

Пролиферация возникает с первых этапов начала воспаления, вместе с альтерацией и экссудацией, но значительное ее преобладание начинается в более поздний период воспалительного процесса, по мере уменьшения экссудативно-инфильтративных явлений. Пролиферация нарастает от периферии очага к центру, причем она имеет прямую зависимость от степени очищения очага воспаления от флогенного фактора. Значимая роль в этом отводится моноцитам и гистиоцитам.

Как известно, челюстно-лицевая область имеет ряд анатомо-топографических особенностей, обуславливающих распространение одонтогенной инфекции. Обильное кровоснабжение, наличие венозных сплетений, а также вен без клапанов, несомненно, способствует быстрому распространению воспалительного процесса по сосудистой системе. Помимо этого, данная область имеет сильно выраженную иннервацию, в результате чего при возникновении гнойно-воспалительных процессов присутствует чрезмерная болезненность. Особенно болезненны процессы, располагающиеся в зоне локализации чувствительных нервов,

в такой как область клыковой ямки. Хорошее развитие лимфатической сети объясняет возможность отеков и явления лимфостаза (особенно при травмах подглазничной области). Особенности строения костной ткани, возможность распространения гноя по межмышечным и межфасциальным клеточным пространствам, наличие верхнечелюстной пазухи и близость жизненно важных органов – зрения, обоняния, слуха, дыхательной и пищеварительной системы, а также головного мозга являются условиями для распространения воспалительного процесса на более обширную площадь [1].

Патологические процессы, связанные с воспалительными изменениями в полости рта, представляют одну из наиболее востребованных и актуальных проблем в стоматологии. Воспалительные заболевания ротовой полости имеют и социальную значимость, что обусловлено высокой распространённостью, тяжёлыми изменениями в тканях пародонта, зубов и организма больного в целом, поражением лиц молодого возраста [6]. Действие микроорганизмов, нарушение микроциркуляции, обменных процессов и другие факторы приводят к гипоксии тканей пародонта, повышению проницаемости мембран и активации процессов ПОЛ.

К настоящему времени установлено, что одним из маркеров окислительного стресса является МДА. Данный вторичный продукт ПОЛ легко диффундирует внутрь клеток, реагирует и повреждает разнообразные биомолекулярные структуры.

Проведенные нами исследования показали значительное повышение уровня МДА в слюне при различных воспалительных заболеваниях ротовой полости, таких как гингивит, стоматит, пародонтит и кариес. Особо выраженные изменения выявляются при гингивите и кариесе. Концентрация МДА при данных заболеваниях возрастает почти в 2,5 раза. При гингивите, пародонтите и стоматите концентрация МДА была увеличена в 1,8 и 1,9 раза соответственно по сравнению с контрольными значениями.

Следует отметить, что ранее было показано снижение активности антиоксидантных систем при данных стоматологических заболеваниях [6].

Выводы

Таким образом, на основании проведенных исследований установлено, что воспаление челюстно-лицевой области, сопровождающее различные стоматологические заболевания, ведет к значительному разрушению клеток, их биомолекулярных структур, посредством МДА. Концентрация МДА напрямую зависит от типа поражения тканей. Причиной, способствующими активации ПОЛ и, как следствие, проникновения МДА в клетки, что провоцирует воспаление, могут быть недостаточная гигиена полости рта, частое употребление углеводов, недостаток поступления фтора, гормональная перестройка, дефекты прикуса, воздействие химических веществ или контрастных температур.

Список литературы

1. Основы челюстно-лицевой хирургии. Гнойно-воспалительные заболевания: учебно-методическое пособие; в 2 т. / С.А. Кабанова, А.К. Погоцкий, А.А. Кабанова, Т.Н. Чернина, А.Н. Минина. Витебск, ВГМУ, 2011. Т. 2. 330 с.
2. Лущик М.В. Изменение свободнорадикального статуса слюны при заболеваниях желудочно-кишечного тракта / М.В. Лущик, А.В. Макеева, В.И. Болотских, Л.Н. Цветикова // Системный анализ и управление в биомедицинских системах. 2018. Т. 17. № 1. С. 35.
3. Меньщикова Е.Б., Зенков Н.К. Современные подходы при анализе окислительного стресса, или как измерить неизмеримое. Acta Biomedica Scientifica (East Siberian Biomedical Journal). 2016;1(3(2)):174-180.
4. Ляхович В.В., Вавилин В.А., Зенков Н.К., Меньщикова Е.Б. Активированные кислородные метаболиты в монокислородных реакциях. Бюллетень СО РАМН, № 4 (118), 2005. С. 7-12.
5. Шепелев А.П., Корниенко И.В., Шестопалов, А.В., Антипов А.Ю. Роль процессов свободнорадикального окисления в патогенезе инфекционных болезней. Вопросы медицинской химии. 2000. № 2. С. 54-59.
6. Лущик М.В. Оценка показателей оксидативного статуса в ротовой жидкости при различных заболеваниях / М.В. Лущик, В.И. Болотских, И.В. Гребенникова, Л.Н. Цветикова // Системный анализ и управление в биомедицинских системах. 2017. Т. 16. № 1. С. 62.

ОСОБЕННОСТИ РОСТА СЛИЗИСТОЙ ОБОЛОЧКИ ПОЛОСТИ РТА В РАННЕМ ОНТОГЕНЕЗЕ ЧЕЛОВЕКА

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В связи с существенным изменением образа жизни человека за последний век резко возросли заболевания, связанные с нарушениями и дефектами в процессе гистогенеза полости рта. Органы ротовой полости имеют уникальное онтогенетическое и эволюционное развитие и строение. Сюда в первую очередь относится рост аномалий и врожденных уродств. Эмбриональное развитие ротовой полости человека представляет особый интерес для исследований в медицинской науке, поскольку это связано с тем, что патологические процессы протекают в результате сигнальных взаимодействий клеток, соответствующих эмбриональной дифференцировке и развитию. Актуальным является изучение эмбриогенеза для поиска ключевых механизмов развития и проявления патологических процессов. Слизистая оболочка полости рта представляет собой источник для использования молекулярных механизмов, участвующих в репаративных процессах в тканях человека. С помощью соответствующих исследований можно изучить процессы роста и развития слизистой оболочки рта в онтогенезе, а также пролиферацию, рост и дифференцировку эпителиальных структур. В представленной работе рассмотрены ключевые процессы, протекающие в формирующейся полости рта 10 человеческих эмбрионов на стадии 3-5 недель с участием процессов клеточной миграции.

Ключевые слова: слизистая оболочка полости рта, стомодеум, эктодерма, энтодерма, онтогенез, эмбриогенез, регенерация, кератинизация

FEATURES OF ORAL MUCOSA GROWTH IN EARLY HUMAN ONTOGENESIS

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In connection with a significant change in the lifestyle of a person over the past century, diseases associated with disorders and defects in the process of histogenesis of the oral cavity have sharply increased. The organs of the oral cavity have a unique ontogenetic and evolutionary development and structure. This primarily includes the growth of anomalies and congenital deformities. The embryonic development of the human oral cavity is of particular interest for research in medical science, since this is due to the fact that pathological processes occur as a result of signal interactions of cells corresponding to embryonic differentiation and development. The study of embryogenesis in order to search for key mechanisms of development and manifestation of pathological processes is relevant. The oral mucosa is a source for the use of molecular mechanisms involved in reparative processes in human tissues. With the help of appropriate research, it is possible to study the processes of growth and development of the oral mucosa in ontogenesis, as well as the proliferation, growth and differentiation of epithelial structures. In the presented work, the key processes occurring in the forming oral cavity of 10 human embryos at the stage of 3-5 weeks with the participation of cell migration processes are considered.

Keywords: oral mucosa, stomodeum, ectoderm, endoderm, ontogenesis, embryogenesis, regeneration, keratinization

At the present stage, it is reliably known that the formation of the oral cavity occurs simultaneously with the formation of other structures of the human embryo. The development of the oral cavity occurs as a result of the interaction of a number of embryonic rudiments and structures. The formation of the primary oral cavity occurs as a result of the formation of an oral cavity called the stomodeum. The bottom of the stomodeum is the pharyngeal membrane, represented by layers of intestinal endoderm and cutaneous ectoderm, adjacent to each other quite closely without connective tissue layers. The stomodeum stops growing at the moment when the pharyngeal membrane breaks, which communicates it with the cavity of the primary

intestine. The growth of the oral cavity at this stage is provided by growing outgrowths along the edges of the stomodeum – gill pockets, gill slits and branchial arches. Of particular importance in the formation of the oral cavity are I-III branchial arches. Violation of morphogenetic processes during embryogenesis can lead to developmental abnormalities [1].

The mucous membrane of the gums and hard palate formed as a result of ontogenetic development consists of stratified squamous epithelium and the lamina propria of the mucous membrane. In the stratified squamous epithelium, there are 3 layers: basal, intermediate (prickly), superficial. On a histological section, the basement membrane is represented by a

dense network of thin argyrophilic fibers, most of which are closely associated with the processes of the cytoplasm of the cells of the basal layer. The basal epithelium consists of a layer of cylindrical cells with basophilic cytoplasm, large oval nuclei with clear boundaries. The thorny layer is represented by a wide accumulation of several rows of polygonal cells with light cytoplasm and pronounced intercellular bridges. Some of the author admit the possible existence of a pronounced granular layer here, consisting of 2-5 rows of cells. In the thickness of the basal layer, epithelial stem cells are localized, which have a pronounced ability to mitotic division. Due to the formed cells that have entered into differentiation, the epithelial cells of the overlying layers of the epithelium change. The cells of the basal layer take part in the formation of the structural components of the basement membrane. The intermediate layer forms the bulk of the stratified squamous non-keratinizing epithelium. The cells of this layer, moving towards the surface layer, gradually lose their ability to mitosis. The maturation of these cells is capable of forming the surface of the epithelial layer. When studying a histological section of the oral cavity of an embryo, a layer of non-keratinizing epithelium is found, whose cells are capable of producing substances that have an antimicrobial effect. At the same time, the layer of non-keratinizing epithelium is much thicker than the keratinizing one. For these reasons, it can be argued that if the non-keratinizing epithelium in the oral cavity is thinner than the keratinizing epithelium, this can lead to a decrease in local immunity, which in turn will lead to congenital pathology. In the proper gum plate and the mucous membrane of the hard palate, densely located bundles of collagen and a thin network of elastic fibers, characteristic of fibrous connective tissue, are determined, between which fibroblasts, histiocytes, single or in the form of clusters of mast cells and lymphocytes are located [2].

Purpose of our research is the study of the mechanisms of development of the mucous membrane of the human oral cavity in ontogenesis.

Material and methods

The study was carried out with the permission of the Ethics Committee of the Far Eastern Federal University. The provisions of the Helsinki Declaration (2000, 2013) were taken into account and taken into account. Biopsies of the oral mucosa were obtained in accordance with the order of the Ministry of Health of the Russian Federation dated 04.29.94 N 82 «On the procedure for conducting pathological autop-

sies» and in accordance with the nomenclature of clinical and laboratory tests of the Ministry of Health of the Russian Federation (order of February 21, 2000, No. 64). Clinical material for the study was obtained at the Kolot Medical Center (Vladivostok) during 2019-2020. The biological material of 10 human embryos and fetuses, the age of which was determined according to ultrasound data and the Haas rule, was studied. Staining of biopsy sections was performed according to the classical protocol for the method using hematoxylin and eosin.

Results of own research and their discussion

The epithelium of the vestibule of the oral cavity originates from the cutaneous ectoderm, and the epithelium lining the oral cavity itself is of endodermal origin. The mucous membrane of the oral cavity is divided into lining, or covering (the mucous membrane of the lips, cheeks), chewing (the mucous membrane of the hard palate and gums) and specialized, which covers the upper and lateral surfaces of the tongue. In turn, the epithelium of the lining mucosa is non-keratinizing, the epithelium of the lining mucous membrane is non-keratinizing, the epithelium of the masticatory mucosa is multilayered flat keratinizing, and the epithelium of the specialized membrane of the tongue forms the epithelial-connective tissue papillae. The development of these parts of the mucous membrane goes with certain differences, primarily related to the epithelium [3].

It was revealed that at the 3rd week the wall of the oral fossa of the embryo is covered with a single-layer epithelium. The floor of the oral fossa is covered with a two-layer low-prismatic epithelium, and the roof is covered with ciliated epithelium (Fig. 1-4).

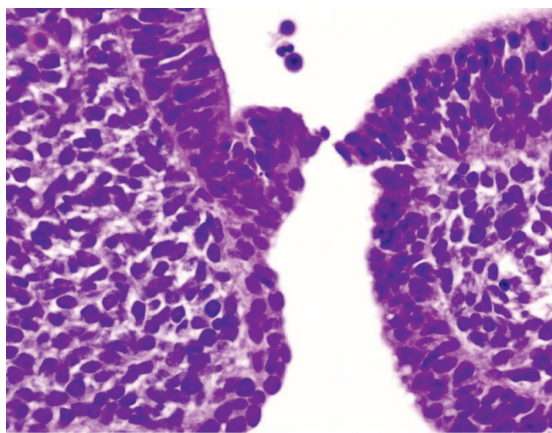


Fig. 1. Oral fossa of a human embryo of 3 weeks. Staining with hematoxylin and eosin. Microphoto. Magnification: x200

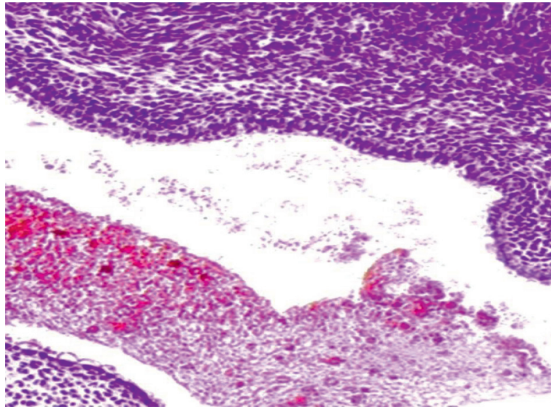


Fig. 2. Oral fossa of a human embryo of 4 weeks. Staining with hematoxylin and eosin. Microphoto. Magnification: x100

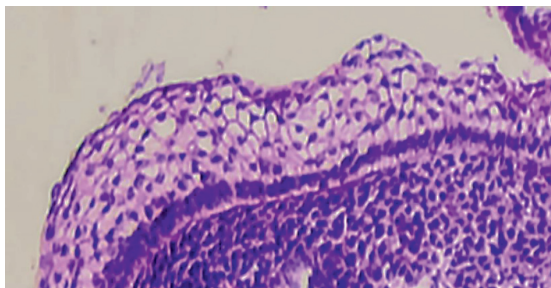


Fig. 3. The oral cavity of a human embryo of 5 weeks. Staining with hematoxylin and eosin. Microphoto. Magnification. x400

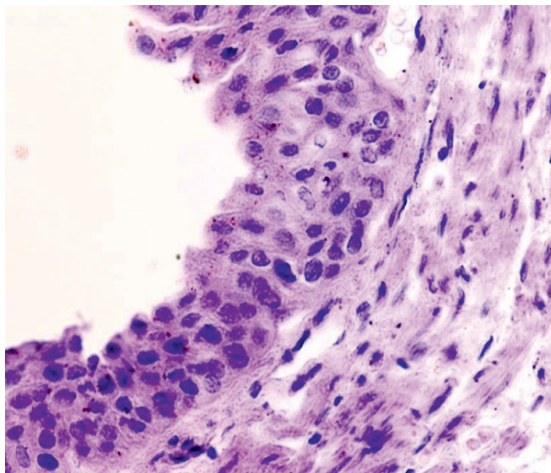


Fig. 4. The oral cavity of a human embryo of 5 weeks. Staining with hematoxylin and eosin. Microphoto. Magnification. x200

The surface of the oral mucosa is represented by stratified squamous epithelium. In the area of the tooth neck, the submerging ectoder-

mal epithelium forms an enamel cap. Behind the neck of the tooth, a two-layer epithelium is revealed. The first is a bright basophilic basal layer, above which squamous epithelium with apically located nuclei is identified. The cytoplasm can be weakly colored or not colored at all. Nuclear-cytoplasmic ratios are high [4].

The mucous membrane is covered with stratified non-keratinized epithelium, under which the basement membrane is identified. In the lamina propria, blood vessels are revealed, the lumen of which is filled with erythrocytes, and numerous fibroblasts are revealed in the intercellular substance with a predominant content of the amorphous substance [5].

We found an increase in the length of the connective tissue papillae protruding into the epithelial layer, a change in the nuclear-cytoplasmic relationship towards their decrease. Differentiation of epithelial cells and their specialization correspond to a gradual increase in the barrier function of the integumentary epithelium of the oral mucosa. The regenerative potential gradually decreases, the structure of the connective tissue is characterized by the appearance of collagen fibers adjacent to the epithelial layer [6].

In the composition of the epithelium of the oral mucosa, cells appear, the cytoplasm of which is vacuolated, there are sufficiently large vacuoles that displace the nucleus to the cytoplasmic membrane. At the border of the prickly and basal layers, single Langerhans cells are located, mainly identified among the epithelium of the mucous membrane, which suggests and indirectly indicates the presence of antigenic presentation in the oral mucosa for restructuring at the stages of maturation. In the lamina propria of the oral mucosa, a leukocyte reaction can be observed, where monocytes, neutrophils and lymphocytes are identified, which are involved in the regulation of physiological regeneration.

It should be noted that the formation of keratinizing and non-keratinizing epithelium of the oral mucosa is determined by differences in the expression of cytokeratins in epithelial cells, and the differences begin to appear from 10-12 weeks of embryogenesis. At the same time, in the mucous membrane of the chewing type, the epithelium forms scallops protruding into its own lamina, as a result of which the border of the epithelium and connective tissue becomes wavy. As a result of proliferation and further differentiation of cells, the epithelial layer is gradually subdivided into layers (basal, prickly, granular and horny). Initially, before the eruption of teeth, keratinization in the

epithelium is carried out by parakeratosis and only after their appearance – by orthokeratosis [7].

The source of development of the lamina propria of the mucous membrane is ectomesenchyme. First, the formation of an amorphous substance occurs, after which the process of fiber synthesis begins: at 6-8 weeks of embryonic development, reticular fibers are formed, and collagen fibers appear already at 8-12 weeks. Elastic fibers are formed at 17-20 weeks of development. The differences between the proper laminae of the chewing and lining mucosa are in the greater number of fibers in the mucous membrane of the chewing type. With the development of the latter in the mesenchyme, starting from 6-8 weeks of embryogenesis, clusters of mesenchymal cells appear, which turn into fibroblasts, intensively synthesizing fibers.

Physiological regeneration and maturation of the oral mucosa in human ontogenesis are associated with the constant proliferative activity of the structures of the oral mucosa. They are under the control and regulation of the effector immunocompetent cells of the oral mucosa [8].

Conclusion

Knowledge of the development of the oral mucosa in human ontogeny are necessary to create an innovative platform for cellular technologies in medicine. This would help to exclude the common pathology of the formation of lateral clefts and underdevelopment, leading to non-union of the middle part of the upper lip

with its outer part, which is a consequence of the appearance of the cleft lip, or the formation of a gap between the middle and lateral parts of the palate, which forms the cleft palate.

Scientific adviser – Doctor of Medical Sciences, Professor G.V. Reva.

References

1. Melino G, Memmi EM, Pelicci PG, Bernassola F. Maintaining epithelial stemness with p63. *Science Signaling*. 2015. vol. 8. no. 387. DOI: 10.1126/scisignal.aaa1033.
2. Akiyama N, Yamamoto-Fukuda T, Yoshikawa M, Kojima H. Regulation of DNA methylation levels in the process of oral mucosal regeneration in a rat oral ulcer model. *Histology and histopathology*. 2020. vol. 35. no. 3. P. 247-256. DOI: 10.14670/HH-18-147.
3. Akintoye SO, Mupparapu M. Clinical Evaluation and Anatomic Variation of the Oral Cavity. *Dermatologic Clinics*. 2020. vol. 38. no. 4. P. 399-411. DOI: 10.1016/j.det.2020.05.001.
4. Amagasa T, Yamashiro M, Uzawa N. Oral premalignant lesions: from a clinical perspective. *International Journal of Clinical Oncology*. 2011. vol. 16. no. 1. P. 5-14. DOI: 10.1007/s10147-010-0157-3.
5. Chen J, Ahmad R, Li W, Swain M, Li Q. Biomechanics of oral mucosa. *Journal of the Royal Society Interface*. 2015. vol. 12. no. 109. art. 20150325. DOI: 10.1098/rsif.2015.0325.
6. Sugibayashi K, Yamamoto N, Itakura S, Okada A, Hijikuro I, Todo H. Development of Spray Formulations Applied to the Oral Mucosa Using Non-lamellar Liquid Crystal-Forming Lipids. *Chemical and Pharmaceutical Bulletin*. 2020. vol. 68. no. 11. P. 1025-1033. DOI: 10.1248/cpb.c20-00333.
7. Oliva J, Florentino A, Bardag-Gorce F, Niihara Y. Vitri-fication and storage of oral mucosa epithelial cell sheets. *Tissue Engineering and Regenerative Medicine*. 2019. vol. 13. no. 7. P. 1153-1163. DOI: 10.1002/term.2864.
8. Roy RR, Shimada K, Murakami S, Hasegawa H. Contribution of transglutaminases and their substrate proteins to the formation of cornified cell envelope in oral mucosal epithelium. *European Journal of Oral Sciences*. 2020. vol. 129. no. 1. P. 1-10. DOI: 10.1111/eos.12760.

ТЕХНОЛОГИЯ ПЕРЕРАБОТКИ МОЛОКА С ВЫПУСКОМ СУХОГО МОЛОКОСОДЕРЖАЩЕГО ПРОДУКТА

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Важную роль в расширении ассортимента выпускаемых сухих молочных и молокосодержащих продуктов играет возможность организации здорового и разнообразного питания различных детерминированных групп населения. Актуальна задача по организации выпуска сухих белковых продуктов для питания школьников. К их преимуществам относится возможность легко изменять вкусоароматический профиль продукта за счет использования разнообразных вкусовых наполнителей, которые можно использовать индивидуально или в комбинации. Цель работы – обосновать современные технологии переработки молока с выпуском сухих молочных консервов и сухого молокосодержащего продукта на примере конкретного предприятия, в частности, в условиях ООО «Доктор Хоффман», г. Воронеж. Объектом исследования служила совокупность технологических процессов переработки молока-сырья с выпуском широкого ассортимента сухих молочных продуктов. Предметом исследования служили вопросы организации переработки молока-сырья с выпуском сухих молочных консервов в условиях ООО «Доктор Хоффман», город Воронеж. В процессе выполнения работы решали задачи по обоснованию ассортимента и аппаратурно-технологических схем переработки молока с получением сухих молочных консервов; расчету технико-экономических показателей проектных решений, связанных с капитальными вложениями денежных средств. Ассортимент предлагаемой к выпуску продукции включает продукты традиционного ассортимента – молоко сухое цельное, сливки сухие, сухое обезжиренное молоко, а также оригинальный сухой молокосодержащий продукт для питания школьников. Предложенная аппаратурно-технологическая схема производства инстантированных продуктов на основе сухого молока или его составных частей является перспективной для выпуска расширенного ассортимента сухих белковых продуктов.

Ключевые слова: сухие молочные консервы, аппаратурно-технологическая схема, сухое смешивание, питание школьников, вкусоароматический профиль

MILK PROCESSING TECHNOLOGY WITH PRODUCTION OF DRY MILK-CONTAINING PRODUCT

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An important role in expanding the range of produced dry milk and milk-containing products is played by the possibility of organizing a healthy and varied diet for various deterministic groups of the population. The task of organizing the production of dry protein products for schoolchildren's nutrition is urgent. Their advantages include the ability to easily change the flavor profile of the product through the use of a variety of flavoring fillers, which can be used individually or in combination. The purpose of the work is to substantiate modern milk processing technologies with the production of canned milk powder and dry milk-containing product in the conditions of Doctor Hoffman LLC, Voronezh. The object of the study was a set of technological processes for processing raw milk with the release of a wide range of dry milk products. The subject of the research was the organization of raw milk processing with the production of canned milk powder in the conditions of Doctor Hoffman LLC, Voronezh. In the course of the work, we solved the problems of substantiating the range and hardware and technological schemes for processing milk to produce canned milk powder; calculating the technical and economic indicators of design solutions related to capital investments of funds. The range of products offered for release includes products of the traditional range – whole milk powder, dry cream, skimmed milk powder, as well as the original dry milk-containing product for the nutrition of schoolchildren. The proposed apparatus and technological scheme for the production of instant products based on milk powder or its constituents is promising for the production of an expanded range of dry protein products.

Keywords: dry milk canned food, instrumental and technological scheme, dry mixing, food for schoolchildren, flavor profile

Производство и использование сухих молочных консервов в России имеет социальное значение – это снабжение населения труднодоступных регионов страны полноценными молочными продуктами, а также стратегическое значение – создание пищевых запасов для обеспечения продовольственной независимости. Важную роль в расширении ассортимента выпускаемых сухих молочных и молокосодержащих про-

дуктов играет возможность организации здорового и разнообразного питания различных детерминированных групп населения, в частности, школьников, в том числе за счет возможности легко изменять вкусоароматический профиль употребляемого продукта за счет использования разнообразных вкусовых наполнителей, которые можно использовать индивидуально или в комбинации [1, 2].

На рис. 1 представлены данные о динамике производства сырого молока в России в 2018-2020 годах, откуда видно, что оно имеет, с одной стороны, стабильный объем, а с другой стороны – сезонный характер [3]. Данные о динамике производства сухого молока в России за период 2018-2019 гг. представлены на рис. 2, откуда видно, что производство сухих молочных продуктов носит сезонный характер и имеет тенденцию к росту. Это связано с их высокой хранимостью и воз-

можностью транспортирования и хранения без потери качества. Дополнительным фактором роста производства этой группы молочных продуктов является растущий спрос на рынке на сухие молокосодержащие продукты [4].

Цель работы – обосновать современные технологии переработки молока с выпуском сухих молочных консервов и сухого молокосодержащего продукта на примере конкретного предприятия, в частности, в условиях ООО «Доктор Хоффман», г. Воронеж.

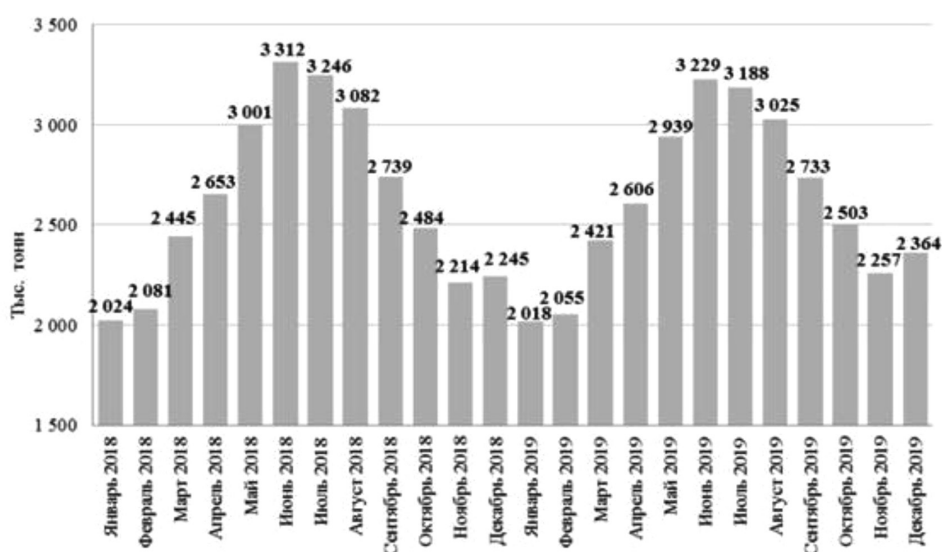


Рис. 1. Динамика производства сырого молока в России в 2018-2019 гг., тыс. т [3]

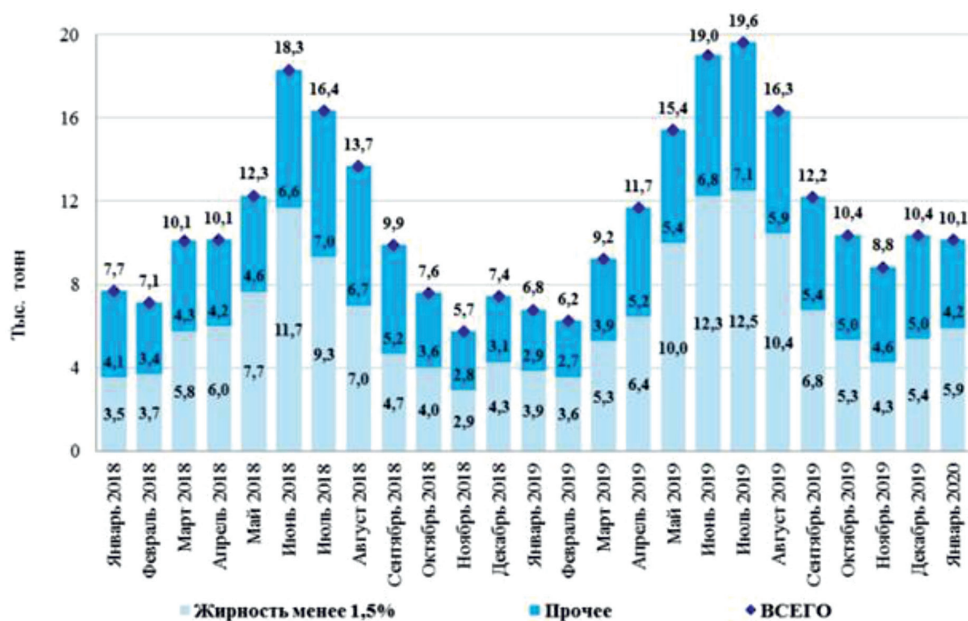


Рис. 2. Динамика производства сухого молока в России в 2018-2019 гг., тыс. т [3]

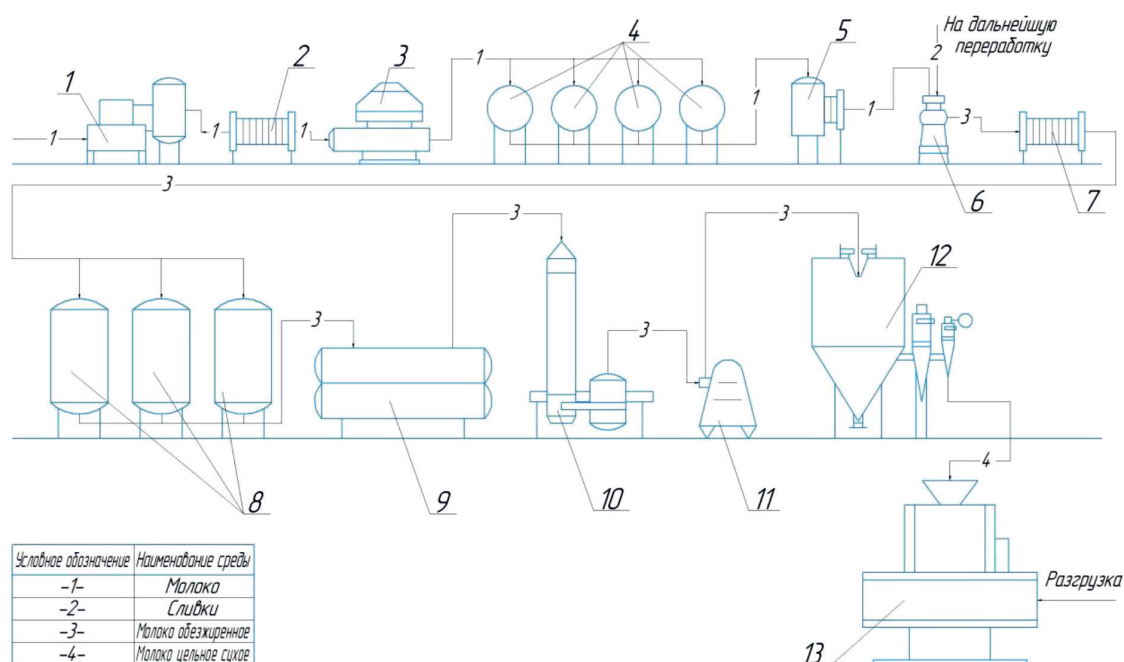


Рис. 3. Аппаратурно-технологическая схема производства сухих молочных консервов

Объектом исследования служила совокупность технологических процессов переработки молока-сырья с выпуском сухих молочных и молокосодержащих продуктов.

Предметом исследования служили вопросы организации переработки молока-сырья с выпуском сухих молочных консервов в условиях ООО «Доктор Хоффман», г. Воронеж. В процессе выполнения работы решали задачи по обоснованию ассортимента и аппаратурно-технологических схем переработки молока с получением сухих молочных консервов; расчету технико-экономических показателей проектных решений, связанных с капитальными вложениями денежных средств.

Ассортимент предлагаемой к выпуску продукции включает продукты традиционного ассортимента – молоко сухое цельное, сливки сухие, сухое обезжиренное молоко, а также оригинальный сухой молокосодержащий продукт для питания школьников [5]. При обосновании технологических режимов и аппаратурно-технологических схем переработки молока с выпуском сухих молочных консервов учитывали рекомендации [6, 7].

На рис. 3 представлена аппаратурно-технологическая схема получения сухих молочных консервов.

Для приемки молока предусмотрен комплекс приемки молока (поз. 1), в который

входит счетное устройство. Далее молоко через пластинчатый охладитель (поз. 2) подается в сепаратор холодной очистки (поз. 3). Далее молоко передается в резервуары для хранения (поз. 4).

Часть цельного молока подвергают сепарированию на сепараторе-сливкоотделителе (поз. 6) для получения сливок и обезжиренного молока.

Для этого цельное молоко подают в пластинчатую пастеризационно-охладительную установку (поз. 5) и подогревают до температуры $(40 \pm 5)^\circ\text{C}$. Полученные сливки поступают в пластинчатую охлаждающую установку, охлаждаются до температуры $(4 \pm 2)^\circ\text{C}$ и подаются в резервуар (поз. 8) для кратковременного хранения. Обезжиренное молоко, полученное при сепарировании, возвращается в пастеризационно-охладительную установку, также охлаждается до температуры $(4 \pm 2)^\circ\text{C}$ и резервируется (поз. 8).

Пастеризацию проводят в пастеризационной трубчатой установке (поз. 9) при температуре не менее $(90 \pm 2)^\circ\text{C}$ без выдержки, передают в вакуум-выпарную установку (поз. 10) и направляют на гомогенизацию (поз. 11). Гомогенизация цельного молока проводится при температуре $45-60^\circ\text{C}$, и давлении 10-15 МПа; сливок при $55-60^\circ\text{C}$ и 5-6 МПа. Обезжиренное молоко гомогенизации не подвергается.

Сушку продуктов проводят в распылительной сушильной установке (поз. 12), снабженной циклонами, где из отработанного воздуха выделяются частицы порошка размером более 10 мкм. Из разгрузочного циклона продукт направляется в бункер-накопитель фасовочного автомата (поз. 13) и далее фасуется в потребительскую или транспортную тару.

С целью расширения ассортимента продукции, выпускаемой на базе имеющегося производства ООО «Доктор Хоффман», предлагается выпуск сухого молокасодержащего продукта для питания школьников, рецептура которого предусматривает использование следующих ингредиентов в соответствии с массой сырья, необходимой для производства 1000 кг готового продукта: сухое цельное молоко – 280,1; сухое обезжиренное молоко – 142,0; сухая молочная сыворотка – 33,0; сухой концентрат сывороточных белков – 71,0; сухое кокосовое молоко – 142,0; рисовая мука – 28,4; соевый концентрат – 24,9; сахар/фруктоза – 218,5; пектин – 21; вкусовой наполнитель – 38,0; витаминно-минеральный премикс – 1,1. Функции вкусового наполнителя могут выполнять кокосовая стружка, цукаты, какао-порошок или другие компоненты, в со-

ответствии с предпочтениями потребителей продукции.

Производительность имеющегося оборудования позволяет выпускать сухой молокосодержащий продукт для питания школьников 1000 кг в смену. Смесь вырабатывается сухим смешиванием компонентов. Аппаратурно-технологическая схема производства сухого молокосодержащего продукта для различных детерминированных групп потребителей, в том числе для питания школьников, представлена на рис. 4.

Сырьевые ингредиенты взвешивают и подают сначала в просеиватель (поз. 1), затем шнековым транспортером (поз. 2) в лопастной смеситель (поз. 3). Полученный полуфабрикат шнековым транспортером (поз. 4) подают в весовой дозатор (поз. 5), наполняют потребительскую тару, наносят этикетку на этикетировочной машине (поз. 6) и далее передают на склад готовую продукцию.

Авторами [5] разработаны рецептуры, которые позволяют восстанавливать сухой молокосодержащий продукт с получением пудинга, замороженного или взбитого десерта. Это позволит существенно разнообразить ассортимент белковых продуктов для питания школьников за счет современных и оригинальных пищевых форм.

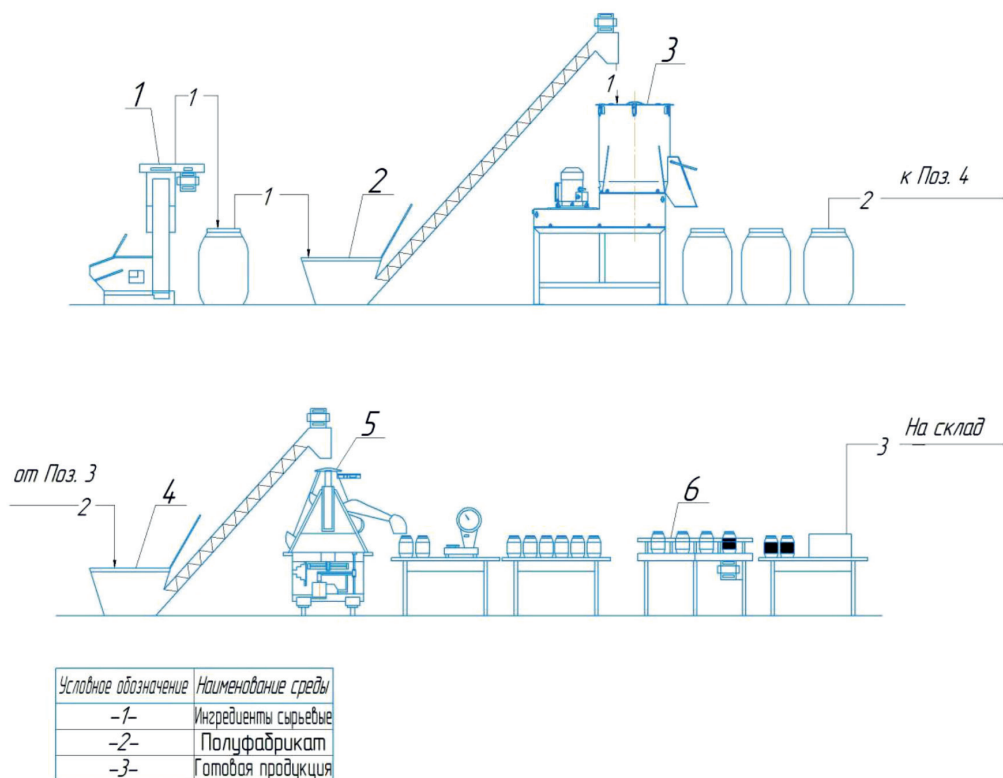


Рис. 4. Аппаратурно-технологическая схема производства сухого молокосодержащего продукта для питания школьников

Предложенная аппаратурно-технологическая схема для производства инстантированных продуктов на основе сухого молока и/или его составных частей является перспективной для выпуска расширенного ассортимента сухих белковых продуктов. Это могут быть сухие растворимые белковые напитки с биопротекторным действием в отношении суставно-связочного аппарата [8], социально адаптированные белковые продукты для лиц с повышенной физической активностью [9, 10], включая потребителей предпенсионного и пенсионного возраста. Использование в качестве ингредиентов продуктов мембранного фракционирования вторичного молочного сырья обеспечивает, с одной стороны, высокую пищевую и биологическую ценность сухим белковым продуктам, а с другой – их ценовую доступность потребителям с различным уровнем доходов.

Выводы

Продукция предприятий по производству сухого молока и сухих высокобелковых смесей на его основе имеет стратегическое значение, особенно в условиях угрозы чрезвычайных положений и критических ситуаций на территории страны, и пользуется стабильным спросом. Расчеты показали, что предприятие – ООО «Доктор Хоффман» – получит прибыль от производства предлагаемых к внедрению продуктов, выпуск которых требует капитальных затрат, в размере 9600 тыс. руб. Уровень рентабельности составит при этом 7,36%, что является оптимальным для проектов такого типа. Расчетный срок окупаемости капитальных вложений составит 5 лет. Таким образом, производство сухих молочных консервов на базе ООО «Доктор Хоффман» целесообразно с экономической точки зрения.

Список литературы

1. Кондратьева Н.А., Глотова И.А. Перспективы разработки белоксодержащих корректоров структуры питания: анализ ассортимента и пищевой ценности протеиновых коктейлей // Технологии и товарооборот сельскохозяйственной продукции. 2020. № 2. С. 39-47.
2. Тихонов Г.С., Кондратьева Н.А., Глотова И.А. Концентрированные формы пищевых веществ на основе молочной сыворотки: показатели биологической безопасности // Технологии пищевой и перерабатывающей промышленности АПК – продукты здорового питания. 2020. № 3. С. 25-30.
3. О производстве молочных продуктов в России по виду в 2019-2020 гг. [Электронный ресурс]. URL: <https://agrovesti.net/lib/industries/dairy-farming/o-proizvodstve-molochnykh-produktov-v-rossii-po-vidu-v-2019-2020-gg.html> (дата обращения: 01.03.2021).
4. Национальный доклад о ходе и результатах реализации в 2015 году Государственной программы развития сельского хозяйства и регулирования рынков сельскохозяйственной продукции, сырья и продовольствия на 2013-2020 годы [Электронный ресурс]. URL: <http://www.mcx.ru> (дата обращения: 01.03.2021).
5. Тихомирова Н.А., Ле Тхи Диеу Хуонг. Сухой молоко-содержащий продукт для школьного питания // Молочная промышленность. 2013. № 5. С. 77-78.
6. Буйлова Л.А. Технология молочных, молоко-содержащих и молочных составных консервов. Вологда – Молочное: ИЦ ВГМХА, 2010. 276 с.
7. Буйлова Л.А., Острцова Н.Г. Оценка и планирование процессов производства молока на основе принципов ХАССП. // Молочная река. 2015. № 4 (60). С. 62-64.
8. Тихонов Г.С., Глотова И.А., Галочкина Н.А., Шахов С.В. Разработка сухого концентрата напитка с биопротекторным действием в отношении суставно-связочного аппарата // Студенческий научный форум 2020: материалы XII Международной студенческой научной конференции (Москва, 1 декабря 2019 г. – 6 марта 2020 г.). Саратов: Издательство: ООО «Евразийская научно-промышленная палата», 2020. № 5. С. 93-94.
9. Елисеева Л.Г., Грибова Н.А., Беркетова Л.В., Крюкова Е.В. Анализ современных тенденций в области производства продуктов питания для людей, ведущих активный образ жизни (Часть 1) // Пищевая промышленность. 2017. № 1. С. 16-19.
10. Штерман С.В., Сидоренко М.Ю., Штерман В.С., Сидоренко Ю.И. Заменители питания для спортсменов и не только // Пищевая промышленность. 2018. № 3. С. 60-62.