

## NEWS

OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN  
SERIES OF GEOLOGY AND TECHNICAL SCIENCES

ISSN 2224-5278

Volume 5, Number 437 (2019), 151 – 157

<https://doi.org/10.32014/2019.2518-170X.137>

UDK 641.56:637.5

M. A. Aslanova<sup>1</sup>, O. K. Derevitskaya<sup>1</sup>,  
A. S. Dydykin<sup>1</sup>, M. H. Iskakov<sup>1</sup>, D. E. Nurmukhanbetova<sup>2</sup>

<sup>1</sup>Federal state budgetary scientific institute «V. M. Gorbatov Federal Research Center for Food Systems  
of Russian Academy of Sciences», Moscow, Russia,

<sup>2</sup>NARXOZ university, Almaty, Kazakhstan.

E-mail: m.aslanova@fncps.ru, o.derevickaya@fncps.ru, a.didikin@fncps.ru,  
m.iskakov@fncps.ru, [dinar2080@mail.ru](mailto:dinar2080@mail.ru)

## DEVELOPMENT OF BIOLOGICALLY ACTIVE COMPLEXES TAKING INTO ACCOUNT TECHNOLOGICAL REQUIREMENTS

**Abstract.** Nutrition during pregnancy is one of the main conditions for the healthy fetal development, favorable course of pregnancy and its outcome. One of the ways for optimization of the nutritional status of pregnant and breastfeeding women is using specialized foods with the optimized chemical composition in a diet. The V. M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences (Gorbatov Research Center for Food Systems) developed the biologically active additives (BAAs) intended for the use in production of the specialized cooked sausages for nutrition of pregnant and breastfeeding women. With consideration for the requirements of the body in nutritional and biologically active substances and technological peculiarities of cooked sausage production, the composition of additives was substantiated, their medico-biological assessment was carried out and the parameters of their addition were established. The BAAs correspond to the established norms by the sanitary-chemical indicators, which will ensure safety of an enriched meat product. Using the developed BAAs, the biologically full-value sausages were produced, which correspond to the medico-biological requirements specified for this consumer group. Addition of the BAAs into a meat product in the recommended dose ensures meeting the daily requirement for biologically active substances (vitamins and calcium) by 15-28%, recommended ratio of omega-6:omega-3 fatty acids (5:1) and the calcium: phosphorus ratio (1:1.5).

**Keywords:** sausage, specialized nutrition, pregnant women, vitamins.

**Introduction.** Intake of the necessary amount of nutrients and energy by pregnant women and breastfeeding mothers is, largely, ensured by a correspondent range of products in a diet. Balanced nutrition should be accomplished due to the use of different product groups - meat (beef, lean grades of pork and mutton, chicken, turkey, rabbit), fish, bread, cereals, pasta, butter, vegetable oil, vegetables, and fruit. It is necessary to exclude from a diet products that contain preserving agents, coloring agents and artificial flavoring agents. It was established that for support of active lactation, the optimal composition of breast milk and health of a breastfeeding mother, her daily diet should additionally include vitamins and minerals, as well as up to 40 g of protein and carbohydrates, up to 15 g of fat, which bring into a diet of about 500 kkal [1-5].

Meat and meat products in nutrition of a pregnant and breastfeeding woman are a source of full value protein, fat, B-group vitamins and, more importantly, easily assimilable iron.

Insufficient protein consumption is dangerous during pregnancy, especially in its second half, and during breast feeding, when the need for protein increases almost by 1.5 times from 66 to 96 g per day, which is conditioned by its increased expenditure for the growth of the placenta, uterus, fetus, mammary glands and later for production of breast milk [6]. All women during pregnancy (especially those in the risk group of the development of iron deficiency anemia) need mainly the prophylaxis to prevent the development of this condition. The prophylaxis of the development of iron deficiency anemia should be

carried out beginning from the earliest period of pregnancy. It consists largely in administration of a full value diet that ensures increasing iron requirements of pregnant women. In case of detection of latent iron deficiency or diagnosis of anemia, a woman needs not only dietetic therapy but also pharmaceutical treatment. When making one or another recommendation, it is necessary to take into account the peculiarities of iron metabolism in the body, mainly, the peculiarities of its absorption in the gastrointestinal tract. It is known that heme ferrous iron is utilized most successfully in the digestive tract. The sources of this iron form are, primarily, meat products [7-9].

The main aspect of a balanced diet of a pregnant woman as well as a woman during breast feeding of a baby is a sufficient content of vitamins and minerals in a menu. Analysis of the actual nutrition of pregnant and breastfeeding women carried out in different Russian regions gives evidence about the significant alimentary imbalance of their diets. It does not seem possible to satisfy increasing requirements of a future mother in these substances only with foods in her diet. Therefore, it is necessary to correct a diet of pregnant and breastfeeding women using specialized foods that contain the main macro- and micronutrients in quantities that, to a large extent, can meet the requirements of women in this important period of their life, achieve the optimal composition of breast milk and ensure the adequate development of a child [10-19].

Table 1 highlights the key micronutrients influencing the fetal development, which a woman has to intake both before and during pregnancy.

Table 1 – An effect of several disorders of the nutritional status of pregnant women on the fetal development

Nutrition disorders	Disorders of fetal development
Deficiency of protein and energy	Intrauterine hypotrophy, arrest of the brain development
Deficiency of PUFA; imbalance of the $\omega 6$ : $\omega 3$ PUFA ratio	Disorders in the development of neuroretina and brain
Deficiency of folic acid (especially, in combination with deficiency of vitamins C, B6, B12)	Defects of the neural tube development (anencephalia, cephalocele)
Deficiency or excess of vitamin A	Congenital malformation
Deficiency of vitamin D3 and Ca	Disorders of calcium and phosphorus metabolism in the bone tissue
Deficiency of iron (Fe)	Leads to iron deficiency anemia

The aim of the work was to develop the biologically active additives for specialized meat products for pregnant and breastfeeding women and to carry out their medical and biological assessment.

**Materials and methods.** The content of calcium in BAAs was detected by the complexometric method based on formation in the alkaline medium of the slightly dissociated complex compounds of calcium cations with disodium salt of ethylenediaminetetraacetic acid (trilon B). The content of vitamin D3 was detected according to GOST 30624-98, biotin (vitamin H), vitamins B5, B9, B12 using the high performance liquid chromatography. The content of the dietary fibers was detected using the enzymatic method, which consists of hydrolysis and elimination of protein and starchy substances by enzymes that are analogous to the enzymes of the human digestive tract. The general content of omega-3 PUFA was detected by the method of gas chromatography with the use of a packed column or a capillary column to detect qualitative and quantitative composition of the mixture of fatty acids in a form of methyl esters obtained according to GOST 31665. Heavy metals were detected by the following methods: lead and cadmium by the method of inverse voltammetry, mercury and arsenic by the method of atomic absorption spectrometry. Pesticides were detected by the chromatographic methods; antibiotics were detected using the test-system RIDASCREEN® Chloramphenicol (for chloramphenicol) and by the screening method using enzyme immunoassay (for the tetracycline group). The melamine content was detected by the method of high resolution liquid chromatography, aflatoxins by thin-layer and high performance liquid chromatography.

The obtained results of investigations were processed by the methods of mathematical statistics. Statistical processing was carried out using the software package Statistica 10.0. The results are presented as a weighted average  $\pm$  standard deviation.

**Results.** The Gorbатов Research Center for Food Systems developed the biologically active additives (BAAs) intended for the use in manufacture of cooked sausages for nutrition of pregnant and breast-feeding women, substantiated their composition and technology of production and addition. The ingredient composition and dosage of additives are presented in table 2.

Table 2 – Ingredient composition of biologically active additives

Additive	Ingredient composition	Dosage, kg/100 kg
BAA (mixture No. 1)	Dry nonfat milk, wheat fiber, calcium lactate, calcium carbonate, dry egg mélange, calcium D-pantothenate, folic acid, D-biotin, D3 cholecalciferol, cyanocobalamin	7.84
BAA (mixture No. 2)	Dry nonfat milk, wheat fiber, calcium citrate, dry egg mélange, omega-3 polyunsaturated fatty acids (eicosapentaenoic acid, docosahexaenoic acid), calcium D-pantothenate, folic acid, D-biotin, D3 cholecalciferol, cyanocobalamin	7.87

The choice of components is conditioned by their compatibility and an effect on normalization of processes occurred during pregnancy. Addition of dietary fibers is determined by their function of improvement of intestinal peristalsis; addition of dry milk and mélange is conditioned by an increase in the biological value due to the balanced amino acid composition. Vitamin D, which participates in the calcium and phosphorus metabolism, facilitates ossification of the fetal skeleton and thereby prevents the development of rachitis, while folic acid ( $B_9$ ) plays an important role in formation of the placenta tissue and new blood vessels in the uterus, therefore, the vitamin deficiency during pregnancy can lead to its premature termination. The presence of  $\omega_3$  PUFA in the mixture is conditioned by their effect on the normal course of pregnancy and prevention of premature delivery, the development and function of the organ of vision and fetal nervous system, formation of new tissues during pregnancy [3, 11, 17, 19]. As a source of calcium, calcium salts (carbonate and lactate) were used in the mixture composition. The effective concentration of calcium salts was selected that ensured the required content of the element in the product and at the same time positively affected the functional properties of minced meat [20]. The use of phosphates in production of meat products for pregnant and breastfeeding women is impermissible as it is known that the calcium and phosphorus ratio in meat is about 1:10; as a result of phosphate addition, the imbalance increases leading to elimination of calcium from the body of a mother and a child. The optimal assimilation of calcium (70-72%) requires the calcium and phosphorus ratio of 1:1÷2.

The quantitative ratio of the ingredients in the mixtures was established with consideration for degradation of the enriching components in the process of thermal treatment and storage, mutual compatibility and so on.

Medico-biological assessment of the developed BAAs was carried out in the Federal Research Centre of Nutrition and Biotechnology. Table 3 presents the values of the nutritional value indicators of the developed additives and the content of the biologically active substances.

Table 3 – Actual values of the indicators of the nutritional value and biologically active substances in BAAs

Indicator	Units of measurement	Actual content	
		BAA (mixture No. 1)	BAA (mixture No.2)
Biotin (vitamin H)	mg/100 g	0.240±0.036	0.240±0.036
vitamin B12	µg /100 g	11.0±2.0	11.0±2.0
vitamin B5	mg /100 g	20.7±1.0	21.7±1.1
vitamin B9	mg /100 g	1.85±0.09	1.91±0.10
Calcium	g/100 g	4.80±0.28	3.80±0.23
vitamin D3	µg/100 g	54.80±0.54	52.60±0.52
Sum of omega-3 fatty acids	mg /100 g	–	694.0±138.8
Dietary fibers (sum)	g/100 g	28.0±2.8	28.40±2.84
Protein	g/100 g	19.7±0.3	17.4±0.3
Fat	g/100 g	3.50±0.42	5.64±0.67

Along with the solution to the task of increasing the nutritional value of meat products, an important factor is its hygienic safety, including microbiological safety, which to a large degree depends on raw material quality and recipe components [21-25].

Pregnant women are one of the population groups that are most sensitive to the content of chemical contaminants and biological agents in foods. Taking into consideration the purpose of the product, for which production the BAAs are used, sanitary-chemical safety of the additive and its correspondence to the existing norms (TR TS 021/2011 “On food safety”) are of great importance. Table 4 presents the values of the sanitary-chemical indicators.

Table 4 – Actual and regulatory values of the sanitary-chemical indicators

Indicator	Actual value of the indicator		Regulatory value of the indicator
	BAA (mixture No.1)	BAA (mixture No.2)	
Lead	≤0.001 mg/kg		Not more than 1.0 mg/kg
Cadmium	≤0.001 mg/kg		Not more than 1.0 mg/kg
Mercury	not detected (limit of detection 0.0025 mg/kg)		Not more than 0.2 mg/kg
Arsenic	0.048 mg/kg (±35%)	0.012 mg/kg (±35%)	Not more than 1.5 mg/kg
Hexachlorocyclohexane (α,β, γ-isomers)	not detected (limit of detection 0.001 mg/kg)		Not more than 0.1 mg/kg
dichlorodiphenyl trichloromethyl methane and its metabolites	not detected (limit of detection 0.001 mg/kg)		Not more than 0.1 mg/kg
Aldrin	not detected (limit of detection 0.0025 mg/kg)		Not allowed
Heptachlor	not detected (limit of detection 0.0025 mg/kg)		Not allowed
Aflatoxin M1	<0.00002 mg/kg		Not more than 0.0005 mg/kg
Melamine	not detected (less than 1 mg/kg)		Not allowed (less than 1.0)
Chloramphenicol	0.00015 mg/kg (±8%) (limit of detection 0.00008 mg/kg)	not detected (limit of detection 0.00008 mg/kg)	Not allowed (less than 0.0003)
Tetracycline antibiotics	not detected (limit of detection 0.0015 mg/kg)		Not allowed (less than 0.01)
Streptomycin	not detected (limit of detection 0.1 mg/kg)		Not allowed (less than 0.2)
Penicillin	not detected (limit of detection 0.004 mg/kg)		Not allowed (less than 0.004)

By the sanitary-chemical indicators, the BAAs correspond to the established norms, which will allow ensuring safety of an enriched meat product.

According to the results of the medico-biological assessment, the mixture is recommended for the use in the food industry for enrichment of specialized sausages intended for nutrition of pregnant and breastfeeding women. The Gorbatov Research Center for Food Systems developed the technologies of specialized meat products intended for nutrition of pregnant and breastfeeding women [20].

Cooked sausages are one of the most popular meat products of industrial production in Russia. Their significant drawback is a high content of saturated fats, salt, the use of phosphoric acid salts that lead to imbalance of the calcium:phosphorus ratio, and other food additives.

Particular requirements are specified for sausages intended for nutrition of pregnant and breastfeeding women: they have to be balanced by the macro- and micronutrient composition, have restrictions regarding the content of salt, sodium nitrite and fat, do not contain phosphates, hot spices, synthetic coloring and flavoring agents. With that, all raw materials and used components should strictly correspond to the Russian effective regulation regarding the allowable levels of toxic elements and microbiological indicators. The balance of protein and fat composition is ensured by selection of combinations of animal and plant raw materials. The recipe composition of cooked sausages includes: option 1 - rabbit meat, pork, soybean oil, BAA (mixture No. 1), curing mixture, ascorbic acid, sugar, spices; option 2 - beef, pork, turkey meat, BAA (mixture No.2), curing mixture, ascorbic acid, sugar, spices.

Addition into a meat product (sausage) of BAAs in the recommended dose will ensure meeting a daily requirement in biologically active substances (vitamins and calcium) by 15-28%, as well as the favorable ratio of omega-6/omega-3 fatty acids.



BAAAs are added at the final stage of minced meat preparation not less than 3-5 minutes before the end of cutting.

Table 5 presents the indicators of the nutritional value of cooked sausages produced with the use of the developed BAAs and intended for nutrition of pregnant and breastfeeding women.

Table 5 – Physico-chemical indicators of cooked sausages produced with BAAs and intended for pregnant and breastfeeding women

Indicator	Content in sausage with BAA (mixture No. 1)	Content in sausage with BAA (mixture No. 2)
Mass fraction of protein, %	14.5	14.0
Mass fraction of fat, %	19.0	18.5
Mass fraction of edible salt, %	1.75	
Mass fraction of sodium nitrite, %	0.0018	
Ratio of ω-6 : ω-3 PUFA	7:1	5:1
Mass fraction of vitamins and minerals in 100 g	0.12/25* 1.4 /23,3* 0.5/14,3* 10.0/ 20* 3.5 /28* 250.0/19* 1:1.5 2.0	
B <sub>9</sub> , mg		
B <sub>5</sub> , mg		
B <sub>12</sub> , μg		
H, μg		
D <sub>3</sub> , μg		
Ca, mg		
Ca:P ratio		
Dietary fibers, %		
*Percent of daily norm upon consumption of 100 g of a product.		

**Conclusion.** Therefore, the biologically full value sausages that corresponded to the medico-biological requirements for the products intended for this group of consumers were produced using the developed BAAs. Introduction into a diet of pregnant and breastfeeding women of the specialized sausages enriched with physiologically beneficial ingredients instead of traditional products will provide them with quality products without sharp changes in food stereotypes.

**М. А. Асланова<sup>1</sup>, О. К. Деревицкая<sup>1</sup>, А. С. Дыдыкин<sup>1</sup>, М. Х. Искаков<sup>1</sup>, Д. Е. Нурмуханбетова<sup>2</sup>**

Федералдық мемлекеттік бюджеттік ғылыми мекеме

"В. М. Горбатов атындағы азық-түлік жүйелерінің федералдық ғылыми орталығы", РҒА, Мәскеу, Ресей,

<sup>2</sup>НАРХОЗ университеті, Алматы, Қазақстан

#### ТЕХНОЛОГИЯЛЫҚ ТАЛАПТАРДЫ ЕСЕПКЕ АЛУ ЕСЕБІНЕН БИОЛОГИЯЛЫҚ БЕЛСЕНДІ КЕШЕНДІ ӘЗІРЛЕУ

**Аннотация.** Жүктілік кезінде тамақтану ананың құрсағындағы баланың толыққанды дамуының, жүктіліктің қолайлы ағымының және оның нәтижесінің ең басты шарттарының бірі болып табылады. Жүкті және бала емізетін әйелдердің тағамдық мәртебесін оңтайландыру жолдарының бірі рационда оңтайландырылған химиялық құрамды арнайы тамақ өнімдерін пайдалану болып табылады. ФМБФМ "В. М. Горбатов атындағы азық-түлік жүйелерінің федералдық ғылыми орталығы" РҒА жүкті және бала емізетін әйелдерді тамақтандыруға арналған арнайы пісірілген шұжық өнімдерін өндіру кезінде қолдануға арналған биологиялық белсенді қоспалар (ББҚ) әзірленді. Ағзаның тағамдық және биологиялық белсенді заттарға қажеттілігін және пісірілген шұжықтарды өндірудің технологиялық ерекшеліктерін ескере отырып, қоспалар құрамында негізделіп, олардың медициналық-биологиялық бағасы жүргізілді, енгізу параметрлері белгіленді. Санитарлық-химиялық көрсеткіштер бойынша ББҚ белгіленген нормативтерге сәйкес келеді, бұл байытылатын ет өнімінің қауіпсіздігін қамтамасыз етуге мүмкіндік береді. Әзірленген ББҚ-ны қолдана

отырып, тұтынушылардың осы тобына қойылатын медициналық-биологиялық талаптарға сәйкес келетін биологиялық толыққанды шұжық өнімдері алынды. Ет өніміне ББК ұсынылатын дозада енгізу биологиялық белсенді заттарға (дәрумендер мен кальций) тәуліктік қажеттілікті 15-28%-ға қанағаттандыруды қамтамасыз етеді, омега-6:омега – 3 (5:1) тұқымдас май қышқылдарының ұсынылатын арақатынасы, кальций арақатынасы: фосфор-1:1,5.

**Түйін сөздер:** шұжық, арнайы тамақтану, жүкті әйелдер, дәрумендер.

**М. А. Асланова<sup>1</sup>, О. К. Деревицкая<sup>1</sup>, А. С. Дыдыкин<sup>1</sup>, М. Х. Искаков<sup>1</sup>, Д. Е. Нурмуханбетова<sup>2</sup>**

<sup>1</sup>Федеральное государственное бюджетное научное учреждение  
«Федеральный научный центр пищевых систем им. В. М. Горбатова» РАН, Москва, Россия,  
<sup>2</sup>университет НАРХОЗ, Алматы, Казахстан

### **РАЗРАБОТКА БИОЛОГИЧЕСКИ АКТИВНЫХ КОМПЛЕКСОВ С УЧЕТОМ ТЕХНОЛОГИЧЕСКИХ ТРЕБОВАНИЙ**

**Аннотация.** Питание во время беременности является одним из самых главных условий полноценного развития плода, благоприятного течения беременности и ее исхода. Одним из путей оптимизации пищевого статуса беременных и кормящих женщин является использование в рационе специализированных пищевых продуктов оптимизированного химического состава. В ФГБНУ «ФНЦ пищевых систем им. В.М.Горбатова» РАН разработаны биологически активные добавки (БАД), предназначенные для использования при производстве специализированных вареных колбасных изделий для питания беременных и кормящих женщин. С учетом потребностей организма в пищевых и биологически активных веществах и технологических особенностей производства вареных колбас обоснован состав добавок, проведена их медико-биологическая оценка, установлены параметры внесения. По санитарно-химическим показателям БАД соответствуют установленным нормативам, что позволит обеспечить безопасность обогащаемого мясного продукта. С применением разработанных БАД получены биологически полноценные колбасные изделия, соответствующие медико-биологическим требованиям, предъявляемым к продуктам для данной группы потребителей. Внесение в мясной продукт БАД в рекомендуемой дозе обеспечивает удовлетворение суточной потребности в биологически активных веществах (витаминах и кальции) на 15–28 %, рекомендуемое соотношение жирных кислот семейств омега-6:омега-3 (5:1), соотношение кальций: фосфор – 1:1,5.

**Ключевые слова:** колбаса, специализированное питание, беременные женщины, витамины.

#### **Information about authors:**

Aslanova Marietta Arutunovna, Candidate of technical Sciences, leading researcher, V. M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences, Moscow, Russia; [m.aslanova@fnfps.ru](mailto:m.aslanova@fnfps.ru); <http://orcid.org/0000-0003-2831-4864>

Derevitskaya Olga Konstantinovna, Candidate of technical Sciences, leading researcher, V. M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences, Moscow, Russia; [o.derevickaya@fnfps.ru](mailto:o.derevickaya@fnfps.ru); <http://orcid.org/0000-0003-1785-7994>

Dydykin Andrey Sergeevich, Candidate of technical Sciences, docent, Head of the Department of functional and specialized nutrition V. M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences, Moscow, Russia; [a.didikin@fnfps.ru](mailto:a.didikin@fnfps.ru); <http://orcid.org/0000-0002-0208-4792>

Iskakov Mikhail Haluskarovic, Candidate of technical Sciences V.M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences, Moscow, Russia; [m.iskakov@fnfps.ru](mailto:m.iskakov@fnfps.ru); <http://orcid.org/0000-0002-3441-8275>

Nurmukhanbetova Dinara Erikovna, candidate of engineering sciences, acting associate professor, Almaty technological university, Department of Food safety and quality, Almaty, Kazakhstan; [dinar2080@mail.ru](mailto:dinar2080@mail.ru); <https://orcid.org/0000-0002-8939-6325>

#### **REFERENCES**

- [1] Borovik T.E., Skvortsova V.A., Yatsyk G.V., Belyaeva I.A., Lukyanova O.L., Semenova N.N., Terzyan E.O. (2011). Optimization of nutrition of breast-feeding mothers with specialized dairy products // Current Pediatrics. 10 (5):111-116 (in Rus.).
- [2] Troshina A.O., Krasnoyarova L.E. (2017). Nutrition of women during pregnancy // Akademicheskaya Publicistika. 9: 70-74 (in Rus.).

- [3] Kon I.Ya., Gmshinskaya M.V., Fateeva E.M. (2003). The main approaches to realization of pregnant woman nutrition // *Pediatric Nutrition*. 1:3:83-88 (in Rus.).
- [4] Chabanova N.B., Mataev S.I., Vasilkova T.N., Shevlyukova T.P., Troshina I.A. (2017). The role of a nutritional factor in the development of obstetric and perinatal pathology in obese women // *Problems of nutrition*. Vol. 86. 4: 6-21. DOI: 10.24411/0042-8833-2017-00055
- [5] Nikitina M.A., Chernukha I.M., Nurmukhanbetova D.E. (2019). Principles of development and optimization of diets for targeted consumer groups // *News of the National academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences*. 2019. Vol. 1. P. 231-241. ISSN 2518-170X (Online), ISSN 2224-5278 (Print). <https://doi.org/10.32014/2019.2518-170X.28>
- [6] Mamonova L.G. (2006). Modern problems of nutrition of pregnant and breastfeeding women // *Current Pediatrics*. 4:104-106 (in Rus.).
- [7] Gordeeva E.A. (2008). Specialized foods for pregnant women: the significance of prevention of iron deficiency anemia // *RMZH. Mat' i Ditya*. 16:19: 1226-1227 (in Rus.).
- [8] Beard J.L. (1994). Iron deficiency: assessment during pregnancy and its importance in pregnant adolescents // *Am. J Clin Nutr*. 59: 1: 502-10 (in Eng.).
- [9] Alwan N., Cade J., McArdle H., Greenwood D., Hayes H., Simpson N. (2015). Maternal iron status in early pregnancy and birth outcomes: insights from the Baby's Vascular health and Iron in Pregnancy study // *British Journal of Nutrition*. Vol. 12: 1985-1992. DOI 10.1017/S0007114515001166 (in Eng.).
- [10] Kodentsova V.M., Gmshinskaya M.V., Vrzhesinskaya O.A. (2015). Vitamin and mineral complexes for pregnant and breastfeeding women: Substantiation of composition and doses // *Pediatric and Adolescent Reproductive Health*. 3: 73-96 (in Rus.).
- [11] Shikh E.V., Makhova A.A., Eremenko N.N., Grebenshchikova L.Yu. (2017). Polyunsaturated fatty acids and selenium as essential components of micronutrient support during pregnancy // *RMZH. Mat' i Ditya*. 25: 2: 126-131 (in Rus.).
- [12] Vrzhesinskaya, O.A., Pereverzeva O.G., Gmshinskaya M.V., Kodentsova V.M. et al. (2015). Sufficiency with water-soluble vitamins and state of bone in pregnant women // *Problems of nutrition*. Vol. 84. 3: 48-54. ISSN: 0042-8833 (in Rus.).
- [13] Kodentsova V.M., Vrzhesinskaya O.A., Nikityuk D.B., Tutelyan V.A. (2018). Vitamin status of adult population of the Russian Federation: 1987-2017 // *Problems of nutrition*. Vol. 87. 4: 62-68. DOI: 10.24411/0042-8833-2018-10043, ISSN: 0042-8833 (in Rus.).
- [14] Sorokina E.Yu., Pogozheva A.V., Aristarkhova T.V., Baturin A.K., Tutelyan V.A. (2018). Assessment of the sufficiency of Moscow population with folic acid, depending on the combined effect of polymorphism of MTHFR and FTO genes // *Problems of nutrition*. Vol. 87. 2: 17-23. DOI: 10.24411/0042-8833-2018-10014. ISSN: 0042-8833 (in Rus.).
- [15] Ladipo O.A. (2000). Nutrition in pregnancy: mineral and vitamin supplements // *Am J Clin Nutr*. 72(1): 280-90 (in Eng.).
- [16] Prentice A. (2000). Calcium in pregnancy and lactation // *Ann Rev Nutr*. 20: 249-72 (in Eng.).
- [17] Kodentsova V.M., Vrzhesinskaya O.A. (2013). Vitamins in nutrition of pregnant and breastfeeding women // *Voprosi Ginekologii, Akusherstva i Perinatologii (Gynecology, Obstetrics and Perinatology)*. 12: 3: 38-50 (in Rus.).
- [18] Sidorova E.S., Pashkevich L.A., Izvekova E.V. (2016). The Russian market of specialized products for supplemental nutrition for pregnant women // *Obrazhovaniye i Nauka bez Granits: Fundamentalnye i Prikladnye Issledovaniya*. 2:117-127 (in Rus.).
- [19] Spirichev V.B., Kon' I.Ya., Shatnyuk L.N., Mikheeva G.A., Spiricheva T.V. (2005). Medico-biological approaches to the development of specialized foods for pregnant and breastfeeding women // *Pediatric Nutrition*. 3: 3: 41-48 (in Rus.).
- [20] Ustinova A.V., Aslanova M.A., Govor I.A. (2011). Cooked sausages for specialized nutrition of pregnant and breastfeeding women // *Meat Industry*. 11: 18-21 (in Rus.).
- [21] Shur P.Z., Zaitseva N.V. (2018). Assessment of risk for health when substantiating hygienic criteria of food safety // *Health Risk Analysis*. 4: 43-56. DOI: 10.21668/health.risk/2018.4.05 (in Rus.).
- [22] Lazareva N.V., Lineva O.I. (2017). Mutually dependent pathogenetic risks of influence of ecotechnological factors on somatic and reproductive health of a person // *Medical Almanac*. 6 (51): 63-68 (in Rus.).
- [23] Shukesheva S.E., Uzakov Y.M., Chernukha I.M., Nurmukhanbetova D.E., Nabiyeva Zh.S., Nurtaeva A.B. Research To Improve The Quality Of Food Products Abstract // *News of the National academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences*. ISSN 2224-5278. Vol. 3, N 430 (2018). P. 37-45.
- [24] Uzakov Y.M., Shukesheva S.E., Chernukha I.M., Nabiyeva Zh.S., Kozybayev A. On The Role of Controlling Systems In The Quality Of Food Products, Jour Of Adv Research In Dynamical & Control Systems. Vol. 10. 13-Special Issue, 2018.
- [25] Kaldarbekova M., Uzakov Y., Chernukha I., A study of the process of salting of horse meat with the use of a biological product, electro mash service and machining // *The 5th International youth conference "Perspectives of science and education"* (May 10, 2019) SLOVO\WORD. New York, USA. 2019. 194 p.
- [26] Galstyan A.G., Turovskaya S.N., Ryabova A.E., Illarionova E.E., Semipyatniy V.K., Radaeva I.A., Petrov A.N., Nurmukhanbetova D.E., Assembayeva E.K. Technological additives as an element of dry milk properties directed formation // *News of the National academy of sciences of the Republic of Kazakhstan. Series of geology and technical sciences*. ISSN 2224-5278. 2019. Vol. 4, N 436. P. 95-102. <https://doi.org/10.32014/2019.2518-170X.102>
- [27] Kenzhaliyev B.K., Surkova T.Yu., Yessimova D.M. Concentration of rare-earth elements by sorption from sulphate solutions // *Complex Use of Mineral Resources*. 2019. N 3. P. 5-9. <https://doi.org/10.31643/2019/6445.22>
- [28] Mochamad B., Triyono, LilisTrianingsih, Didik Nurhadi. Students' employability skills for construction drawing engineering in Indonesia // *World Transactions on Engineering and Technology Education*. 2018. Vol. 16, Issue 1. P. 29-35.
- [29] Kenzhaliyev B.K., Berkinbayeva A.N., Sharipov R.H. (2015). Research of the Interacting Process of Copper-Base Alloys with Leaching Solutions under the Action of Different Physicochemical Factors // *American Journal of Applied Sciences*. 12(12), 982-992. <https://doi.org/10.3844/ajassp.2015.982.992>