UDC 641,887:661.691
DOI https://doi.org/10.37734/2518-7171-2022-1-6

DEVELOPMENT OF THE CHEESE PRODUCT COMPONENT COMPOSITION WITH VEGETABLE FILLER ENRICHED WITH SELENIUM

V. PRYMENKO, PhD, Associate Professor;
K. SEFIKHANOVA, PhD, Associate Professor
(Autonomous Subdivision «Dnipro Faculty of Management and Business of Kyiv University of Culture»)

Abstract. *The most complete provision of the human body with physiologically useful nutrients in the required quantities can be achieved due to the diversity of the chemical composition of the group of functional products, which determines the actualization of its creation. Approaches, based on experimental-statistical and linear programming methods, are mainly used to design recipes for multicomponent food systems. One of the most common programs for calculating recipes is MS Excel. The aim of the study is to design with the help of MS Excel software a complex multi-component cheese product with vegetable filling, enriched with selenium, which will increase the content of essential fatty acids to a level comparable to human daily needs, reduce cholesterol to WHO recommended consumption, increase in carotenoids, vitamin C, dietary fiber and selenium. Results. A recipe for a multicomponent cheese product enriched with selenium has been developed. An optimized complex cheese product with a vegetable filler based on a multicomponent cheese product enriched with selenium has been designed. The article presents the method of designing new functional food products, the chemical composition of developments, determines the nutritional and energy values of cheese product enriched with selenium, and optimized cheese product with vegetable filler based on it. It was found that the consumption of 100 g of cheese product with vegetable filler is able to meet the daily need for nutrients by 13.4%, while the multi-component cheese product – by 9.6%. Conclusions. Development of food products of optimal composition by mathematical modeling allows to reduce financial and time costs for food development, respond to changes in human needs in a man-made society and significantly expand the range of functional, dietary products, aimed at feeding certain groups. Expanding the capabilities of optimization software allows reaching a qualitatively new level in the development of new types of food products with a given chemical composition, consumer and technological characteristics. Thus, the implementation of this task allowed to increase the share of vegetable fat as a source of polyunsaturated fatty acids in the cheese product, antioxidants, some vitamins and cheaper raw materials, by adding selenium-protein dietary supplement and pumpkin puree.*

Key words: *cheese product, vegetable filler, selenium-protein dietary supplement, pumpkin puree, optimization, multicomponent composition.*

Problem statement in general. Production of products with a multicomponent composition, which includes both basic and micronutrients, is one of the main areas of health nutrition. The most complete provision of the human body with physiologically useful nutrients in the required quantities can be achieved due to the diversity of the chemical composition of this group of products, which determines the actualization of its formation. Such products are able to restore the microflora of the gastrointestinal tract, improve the immune resistance of various diseases, maintain human health and facilitate its recovery after illness [1].

Nutrients must enter the human body in a certain amount and ratio – such principle of the theory of balanced nutrition is the basis for the design of food products of complex raw materials. That is why it is possible to achieve a directed physiological effect by combining the composition of prescription mixtures. In the development of new recipes, it is also important to be able to model the consumer characteristics of finished products, predict their biosafety, quality and functional and technological properties, taking into account the phenomenon of synergy, which ultimately increases their competitiveness [2].

The optimal solution to these problems in food design can be achieved through their formalized mathematical description. This description is called a mathematical model, which reflects in analytical form many functional relationships between technological, economic and other parameters of raw ingredients, the required characteristics of finished products (target function) and a number of limitations arising from regulatory requirements [3]. Therefore, it is possible to calculate the recipe, which in quantitative content and qualitative composition will best meet the formula of a balanced diet, medical and biological requirements and have high consumer properties.

Analysis of recent studies and publications. Approaches, based on methods of experimental and statistical modeling and linear programming, are mainly used to design recipes for multicomponent food systems.

© Prymenko V., Sefikhanova K., 2022

So, when developing optimal recipes for dry breakfasts of increased biological value, the methodology of experimental and statistical modeling is used, the class of tasks «technology–system». The methodology is based on the identification of the key modeling nutrient and optimization of its quality [4].

When optimizing food recipes, it is known to use the simplex method, which is a numerical method for solving a linear programming problem that allows to find the optimal solution: find the extremum of a linear objective function under linear constraints on the desired variables. The calculations involve objective function, restrictions on the content of nutrients and boundary conditions for some variables [5].

Based on the Mitchell-Block principle, the following are proposed: the coefficient of utilization of essential amino acids; coefficient of utility of the amino acid composition in the product g/100 g of protein; coefficient of amino acid composition, characterizing the balance of essential amino acids in relation to the physiologically necessary norm (standard). In addition, this method provides definition of an indicator of comparable redundancy of the content of essential amino acids, characterizing the total mass of essential amino acids that are not used for anabolic purposes [6].

The paper [7] considers a method for designing recipes for multicomponent food products, which includes three stages: modeling the amino acid composition of the protein of the designed food product and choosing the values that best meet the criterion; assessment of the fatty acid composition of the designed product; calculation of the energy value of the designed food products. It is most promising to apply this technique to meat products that are included in the diets of certain groups of people, united by age, professional or other characteristics, whose nutrition is centralized.

Of particular interest is the work [8], which describes the solution of the problem of optimizing the recipe for a biscuit semi-finished product. As the main trends in the formulation of the problem, the replacement of wheat flour with a more nutritious one – triticale is taken. The criteria for assessing the impact of various amounts of prescription components on the quality of the finished product include a complex indicator that characterizes the properties and appearance of products, as well as the height of the biscuit.

In the work [9] for the design of multicomponent food products, the use of an object-oriented approach is proposed. A distinctive feature of the object-oriented approach to the design of recipes for multicomponent food systems is the presentation of the recipe in the form of a hierarchical structure. The main advantage of an object-oriented representation is the possibility of inheriting properties and methods, together with the addition of new calculation formulas that take into account the expansion of the raw material assortment, production features, technical and economic indicators of the processes occurring in the production line devices.

An analysis of literary sources has shown that when designing food products, the optimization problem is sought to be simplified by reducing it to a single-criterion one. The use of an object-oriented approach to the calculation of recipes will allow solving problems of multicriteria optimization. MS Excel is one of the most widely used recipe calculators. When using this software product, the data necessary for the calculation, as well as the calculation formulas are entered in the corresponding cells of the spreadsheet.

Formation of the purposes of the article. The aim is to design with MS Excel software a complex multicomponent cheese product with vegetable filling, enriched with selenium, which will increase the content of essential fatty acids to a level comparable to daily human needs, reduce cholesterol to WHO recommended consumption, increase carotene, vitamin C, dietary fiber and selenium amounts to enhance the functionality of the product.

Presentation of the main research material. To meet the requirements for the recipe of processed cheese product with the addition of selenium-protein

Table 1

Recipe for processed cheese with SPDS

Name of raw materials	Content, kg		
	raw materials	dry matter	fat
Unsalted fresh cheese (dry matter of 55%, fat in dry matter of 45%)	206	113,3	51
Low–fat cheese (dry matter of 40%)	184,5	83,0	–
Skimmed cow's milk powder (dry matter of 96%)	30,9	29,7	–
Peasant butter (dry matter of 75%, fat 72,5%)	84,5	63,4	61,3
Mixture of sodium polyphosphate and sodium pyrophosphoric trisubstituted (dry matter of 20%)	103,0	20,6	–
Granulated sugar	206,0	206	–
Selenium Protein Dietary Supplement (SPDS)	33,9	28,8	–
Drinking water	9,1	–	–
Total:	1030	544,8	112,3
Output:	1000	500	100

dietary supplement (SPDS) component composition of processed cheese enriched with selenium, the recipe of which is given in table 1, has been analyzed.

The raw material base of processed cheese is represented by fat-containing (fat rennet cheese, butter), protein-containing (rennet cheeses, skimmed milk powder, SPDS), as well as carbohydrate components (granulated sugar, skimmed milk powder (SMP), SPDS). Based on the available data on the chemical composition of prescription ingredients (table 2), the nutritional and energy value of processed cheese was determined using a MS Excel spreadsheet program.

The protein content in the raw material set was calculated. 1st, 2nd, 3rd, 4th and 7th raw material component contained proteins (table 2). Taking into account their share in the raw material set weighing 103.0 g, the absolute protein content is:

$$AC_p = \sum_{i=1,2,3,4,7} \frac{m_i}{100} P_i. \quad (1)$$

Nutrient conservation is determined by the formula

$$C_n = 100 - L, \quad (2)$$

where L is the loss of substance, % [11].

Loss of protein during heat treatment is about 6%. Similarly, according to formula (3), the content of proteins (NC_p) was calculated.

The yield of the finished product (Y) is found by subtracting from 100 the amount of mass loss equal to 3%.

The content of the test substance in g, 100 g of product is determined by the formula

$$C_i = \frac{C_n AC_i}{Y}. \quad (3)$$

The protein content was found by formula (3):

$$C_p = \frac{C_p AC_p}{Y}. \quad (4)$$

The fat content in the raw material set was calculated. Fats are contained in the 1st, 4th raw material component (table 2). Taking into account their share in the raw material set weighing 103 g, the absolute fat content is:

$$AC_f = \sum_{i=1,4} \frac{m_i}{100} F_i. \quad (5)$$

Fat loss during heat treatment is about 7%. Preservation of fats C_f is calculated by formula (3). The fat content in g per 100 g of the finished product was found by formula (4). The content of carbohydrates in the raw material set is calculated. Carbohydrates are contained in the 3rd, 4th, 6th, 7th raw material component (table 2). Taking into account their share in the raw material set weighing 103 g, the absolute carbohydrate content is

$$AC_c = \sum_{i=3,4,6,7} \frac{m_i}{100} C_i. \quad (6)$$

Carbohydrate losses during heat treatment are about 8%. Preservation of carbohydrates was calculated by formula (3). The carbohydrate content per 100 g of the finished product is found by formula (4). The cholesterol content in the raw material set was calculated. Cholesterol is contained in 1st, 4th raw materials (table 2). Given its share in the raw material set weighing 103 g, the absolute cholesterol content is:

$$AC_h = \sum_{i=1,4} \frac{m_i}{100} H_i. \quad (7)$$

Cholesterol loss during heat treatment is about 7%. The cholesterol content in g per 100 g of the finished product was found by formula (4).

The content of dietary fiber in the raw material set was calculated. They are contained in the 7th raw material component (table 2). Taking into account their share in the raw material set weighing 103 g, the absolute content of dietary fiber is:

Table 2

Nutritional value of the components of the recipe mixture of processed cheese with SPDS

Name of raw materials	Content, g / 100 g of component				
	proteins	fats	carbohydrates	cholesterol	dietary fiber
1. Unsalted fresh cheese (dry matter of 55%, fat in dry matter of 45%)	26,8	24,75	–	0,15	–
2. Low-fat cheese (dry matter of 40%)	26,8	–	–	–	–
3. Skimmed cow’s milk powder (dry matter of 96%)	37,9	–	49,3	–	–
4. Peasant butter (dry matter of 75%, fat 72,5%)	0,96	72,5	1,35	0,19	–
5. Mixture of sodium polyphosphate and sodium pyrophosphoric trisubstituted (dry matter of 20%)	–	–	–	–	–
6. Granulated sugar	–	–	100	–	–
7. Selenium Protein Dietary Supplement (SPDS)	30,25	–	39,3	–	1,4
8. Drinking water	–	–	–	–	–

$$AC_{df} = \sum_{i=7} \frac{m_i}{100} DF_i. \quad (8)$$

Loss of dietary fiber during heat treatment does not occur.

The content of dietary fiber in g per 100 g of finished product is found by formula (4).

The energy value of 100 g of processed cheese (table 3) was calculated because the decomposition of 1 g of protein released 4 kcal, 1 g of fat – 9 kcal, 1 g of carbohydrates – 4 kcal.

Nutritional and energy values of processed cheese, as well as the content of dietary fiber and cholesterol are given in table 3.

The nutritional value of a cheese product with a vegetable filler was calculated according to the following method [10]. The absolute content of proteins (AC_p) taking into account their share in the raw material set (RMS) weighing 100 g is:

$$AC_p = \sum_{i=1,2,3,4} \frac{m_i}{100} P_i. \quad (9)$$

The protein content (C_p) in 100 g of product was found by formula (10), where indicators of nutrient preservation (NP) and yield of the finished product (Y) were taken into account:

$$C_p = \frac{NP_p \cdot AC_p}{Y}. \quad (10)$$

The absolute fat content (AC_f) taking into account its share in the raw material set weighing 100 g is:

$$AC_f = \sum_{i=1,4} \frac{m_i}{100} F_i. \quad (11)$$

The fat content in g per 100 g of the finished product (C_f) was found by formula (10). The absolute content of carbohydrates (AC_c) taking into account their share in the raw material set weighing 100 g is:

$$AC_c = \sum_{i=3,4,6,7} \frac{m_i}{100} C_i. \quad (12)$$

The carbohydrate content in g per 100 g of the finished product was found by formula (10). The results of the calculation are summarized in table 4.

The energy value of 100 g of cheese product was found. The nutritional and energy values of the cheese product are shown in table 4 below.

The caloric content of the cheese product increased by 30% due to the increase in vegetable fat content by 60%. At the same time, the protein content decreased, because of which the consumption of 100 g of product per day will satisfy the human need for protein by only 3%. The proposed recipe satisfies the functional focus: in the processed cheese product, the cholesterol content has decreased by 75% compared to processed cheese; dietary fiber content increased by 20%. In addition, the consumption of 100 g of cheese product will provide the daily human need for polyunsaturated fatty acids by 30% and selenium by 50%.

Table 3

Nutritional and energy value of processed cheese from SPDS

Ingredients	Consumption rate, g (mg, kcal) / day	Processed cheese with SPDS	
		Contents	Satisfaction of daily needs,%
Proteins, g / 100 g	77,5	11,4	14,7
Fats, g / 100 g	87	10,9	12,5
Carbohydrates, g / 100 g	320,5	21,3	6,6
Dietary fiber, g / 100g	20	3,5	17,5
Cholesterol, mg / 100 g	150	45	30
PUFA, g / 100 g	12	–	–
Carotenoids, mg / 100 g	1,5	0,27	18
Vitamin C, mg / 100 g	75	1,08	1,2
Energy value, kcal / 100 g	2375	228,9	9,6

Table 4

Nutritional and energy value of cheese product with vegetable filler

Ingredients	Contents	Consumption rate, g / day	Satisfaction of daily needs,%
Proteins, g / 100 g	2,95	77,5	3,8
Fats, g / 100 g	26,2	87	30,2
Carbohydrates, g / 100 g	17,8	320,5	5,6
Dietary fiber, g / 100g	4,3	20,0	22,0
Cholesterol, mg / 100 g	11,3	150	7,5
PUFA, g / 100 g	3,6	12,0	30,0
Carotenoids, mg / 100 g	0,37	1,5	25,0
Vitamin C, mg / 100 g	2,0	75,0	3,0
Energy value, kcal / 100 g	318,0	2375	13,4

The content of the main recipe components of the cheese product in the mixture was determined by their physicochemical properties, in particular the content of dry matter in their composition and the relative proportion of fat. Therefore, the product calculation, the initial data for which are presented in table 5, was carried out in order to determine the consumption of raw materials to obtain 100 kg of product of the required fat content and moisture.

The balance of the total mass of the mixture (m_{cm} = 100 kg) is as follows

$$\sum_{i=1}^{9} m_i = m_{cm}, \quad (13)$$

where m_i – weight of the i-th component of the recipe mixture (table 6), kg.

Table 5

Components of the recipe mixture of cheese product with the addition of dietary selenium-protein (SPDS)

Name of raw materials	Costs of dry matter *Gi*, kg / 100 kg	Dry matter content *Gi*, %	Relative fat content *Fi*, %
1. Brynza	7	48	45
2. Vegetable oil	–	100	100
3. Pumpkin puree	3,5	14	–
4. Granulated sugar	16	100	–
5. Mix of potato and corn starches	2	95	–
6. Citric acid	0,1	100	–
7. Melting salt	1,6	100	–
8. SPDS	–	95	–
9. Drinking water	–	–	–

Table 6

Formulation of cheese product enriched with selenium

Raw material component	Costs m_i, kg / 100 kg	Dry matter content, kg	Fat content, kg
1. Brynza (mass fraction of dry matter 48%, fat in dry matter 45%)	14,6	7	3,2
2. Vegetable oil	24,3	24,3	24,3
3. Pumpkin puree (mass fraction of dry matter 14%)	25	3,5	0
4. Granulated sugar	16	16	0
5. Mix of potato and corn starches	2,1	2,0	0
6. Citric acid	0,1	0,1	0
7. Melting salt	1,6	1,6	0
8. SPDS	0,5	0,48	0
9. Drinking water	15,8	0	0
Total, kg:	100	55	27,5

The balance on the dry matter (kg) has the form

$$\sum_{i=1}^{9} m_i \frac{c_i}{100} = m_{cm} \frac{c_{cm}}{100}, \qquad (14)$$

where c_{cm} – mass fraction of dry matter in the mixture, %.

The balance of fat (kg) has the form

$$\sum_{i=1}^{9} m_i \frac{c_i}{100} \frac{F_i}{100} = m_{cm} \frac{c_{cm}}{100} \frac{F_{cm}}{100}, \qquad (15)$$

where F_{cm} – relative proportion of fat in the mixture, %.

Data on the relative fat content and dry matter content of the components are given in table 6. Using them, it was found:

$$m_1 = \frac{G_1}{C_1} \cdot 100; \quad m_3 = \frac{G_3}{C_3} \cdot 100; \quad m_4 = \frac{G_4}{C_4} \cdot 100;$$

$$m_5 = \frac{G_5}{C_5} \cdot 100; \quad m_6 = \frac{G_6}{C_6} \cdot 100; \quad m_7 = \frac{G_7}{C_7} \cdot 100.$$

Taking into account that F_{cm} = 50%, c_{cm} = 55%, then solving equation (15) it was found the required amount of vegetable fat m_2. The solution of equation (14) allowed determining the required number of SPDS m_8. The required amount of drinking water m_9 was determined from equation (13). The results of the product calculation are presented in table 6.

Conclusions on mentioned problems and prospects for further research in this direction. Designing food products of optimal composition by mathematical modeling allows to reduce financial and time costs for food development, timely respond to changing needs of the human body in a man-made society and significantly expand the range of functional, dietary products aimed at feeding certain groups. The expanding of capabilities of optimization software allows us to reach a qualitatively new level in the development of new types of food products with a given chemical composition, consumer and technological characteristics.

Thus, the implementation of this task was carried out using the following technological solutions: increasing the proportion of vegetable fat as a source of polyunsaturated fatty acids, antioxidants, some vitamins and cheaper raw materials, adding SPDS containing dietary fiber and biologically active substances. With the help of automated design, the recipe of the cheese product with DDSB was determined, which allowed to ensure the preservation of biologically active substances and a high level of organoleptic characteristics of the product. A recipe with a predetermined chemical composition, nutritional value and functional orientation has been created.

BIBLIOGRAPHY

1. Сефіханова К. А., Применко В. Г., Геліх А. О. Моделювання рецептурного складу напівфабрикатів білково-вуглеводних. *Готельно-ресторанний та туристичний консалтинг*. 2020. Т. 3, № 1. С. 25–36.

2. Prymenko V. H., Sefikhanova K. A., Helikh A. O., Golovko M. P., Vasylenko O. O. Choice justification of dairy raw materials according to indicators of their structure for obtaining selenium-protein dietary supplements. *Journal of Chemistry and Technologies*. 2022. Vol. 30, № 1. P. 79–87.

3. Prymenko V., Helikh A., Stepanova T. Influence of Se-lactoalbumin on functional and technological properties of selenium-protein dietary supplements. *Journal of Chemistry and Technologies*. 2021. Vol. 29. № 1. P. 162–174.

4. Калугіна І., Тележенко Л., Дзюба Н. Проектування граноли з фейхоа із підвищеним вмістом йоду для закладів ресторанного господарства. *Продовольчі ресурси*. 2020. № 8(15). С, 102–113.

5. Hadzhikolev E., Hadzhikoleva S. Application of the simplex method to create a weekly menu planner. *Acta Universitatis Cinbinesis, Series E: Food Technology.* 2018. Vol. 22, № 2. P. 77–84.

6. Berezina N. A., Artemov A. V., Nikitin I. A., Budnik A. A. The method of computer-aided design of a bread composition with regard to biomedical requirements. *International Journal of Advanced Computer Science and Applications*. 2019. Vol. 10, № 5. P. 137–143.

7. Ghimire S. Recipe optimization of buffalo meatball : Doctoral dissertation of the requirement for the B. Tech. degree in Food Technology, Nepal, 2018. 116 p.

8. Lisovska T., Stadnik I., Piddubnyi V., Chorna N. Effect of extruded corn flour on the stabilization of biscuit dough for the production of gluten-free biscuit. *Ukrainian Food Journal*. 2020. Vol. 9, № 1. P. 159–261.

9. Eremenko V. N., Grinchenko V. S., Pitkin V. A., Levchenko A. A., Sinko O. V., Tsaava S. V. Optimization of food recipes for people of mental work and their lifestyle. *IOP Conference Series: Earth and Environmental Science.* 2021. Vol. 659, No.1, p. 121–136.

10. de Jesus Filho M., Klein B., Wagner R., Godoy H. T. Key aroma compounds of Canastra cheese: HS-SPME optimization assisted by olfactometry and chemometrics. *Food Research International*. 2021. Vol. 150. P. 110788.

11. Nirmal I., Caldera A., Bandara R. D. Optimization framework for flavour and nutrition balanced recipe: A data driven approach. In *2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON).* Pp. 1–9.

REFERENCES

1. Sefikhanova, K. A., Prymenko, V. H., & Helikh, A. O., (2020). Modeling of prescription composition of protein-carbohydrate semi-finished products. *Hotel-restaurant and tourist consulting*, 3 (1), 25–36 [in English].

2. Prymenko, V. H., Sefikhanova, K. A., Helikh, A. O., Golovko, M. P., & Vasylenko, O. O. (2022). Choice justification of dairy raw materials according to indicators of their structure for obtaining selenium-protein dietary supplements. *Journal of Chemistry and Technologies*, 30(1), 79–87 [in English].

3. Prymenko, V., Helikh, A., & Stepanova, T. (2021). Influence of Se-lactoalbumin on functional and technological properties of selenium-protein dietary supplements. *Journal of Chemistry and Technologies*, 29 (1), 162–174 [in English].

4. Kalugina, I., Telezhenko, L., & Dziuba, N. (2020). Design of feijoa granola with high iodine content for restaurants. *Food resources*, 8(15), 102–113 [in Ukrainian].

5. Hadzhikolev, E., & Hadzhikoleva, S. (2018). Application of the simplex method to create a weekly menu planner. *Acta Universitatis Cinbinesis, Series E: Food Technology*, 22(2), 77–84 [in English].

6. Berezina, N. A., Artemov, A. V., Nikitin, I. A., & Budnik, A. A. (2019). The method of computer-aided design of a bread composition with regard to biomedical requirements. *International Journal of Advanced Computer Science and Applications*, 10(5), 137–143 [in English].

7. Ghimire, S. (2018). *Recipe optimization of buffalo meatball* (Doctoral dissertation) [in English].

8. Lisovska, T., Stadnik, I., Piddubnyi, V., & Chorna, N. (2020). Effect of extruded corn flour on the stabilization of biscuit dough for the production of gluten-free biscuit. *Ukrainian Food Journal*, 9(1), 159–261 [in English].

9. Eremenko, V. N., Grinchenko, V. S., Pitkin, V. A., Levchenko, A. A., Sinko, O. V., & Tsaava, S. V. (2021, February). Optimization of food recipes for people of mental work and their lifestyle. In *IOP Conference Series: Earth and Environmental Science.* Vol. 659, No. 1, p. 121–136. IOP Publishing [in English].

10. de Jesus Filho, M., Klein, B., Wagner, R., & Godoy, H. T. (2021). Key aroma compounds of Canastra cheese: HS-SPME optimization assisted by olfactometry and chemometrics. *Food Research International*, *150*, 110788 [in English].

11. Nirmal, I., Caldera, A., & Bandara, R. D. (2018). Optimization framework for flavour and nutrition balanced recipe: A data driven approach. In *2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON).* Pp. 1–9. IEEE [in English].

В. Г. Применко, *кандидат технічних наук, доцент;* ***К. А. Сефіханова,*** *кандидат технічних наук, доцент (Відокремлений підрозділ «Дніпровський факультет менеджменту і бізнесу Київського університету культури»).* ***Розробка компонентного складу сирного продукту із рослинним наповнювачем, збагаченого селеном.***

Анотація. *Найповнішого забезпечення організму людини фізіологічно корисними нутрієнтами у необхідних кількостях можна досягти за рахунок різноманіття хімічного складу групи функціональних продуктів, що й обумовлює актуалізацію її створення. Для проєктування рецептур багатокомпонентних харчових систем переважно застосовуються підходи, що базуються на методах експериментально-статистичного та лінійного програмування. Однією з найпоширеніших програм для розрахунку рецептур є MS Excel. Метою дослідження є проєктування за допомогою програмного забезпечення MS Excel складного багатокомпонентного сирного продукту із рослинним наповнювачем, збагаченого селеном, що забезпечуватиме підвищення вмісту ессенціальних жирних кислот до рівня, співставного із добовою потребою людини, зниження частки холестерину до рекомендованої ВООЗ норми споживання, збільшення кількості каротиноїдів, вітаміну С, харчових волокон та селену. Результати. Розроблено рецептуру багатокомпонентного сирного продукту, збагаченого селеном. Спроєктовано оптимізований складний сирний продукт із рослинним наповнювачем на основі багатокомпонентного сирного продукту, збагаченого селеном. У статті наведені методика проведення проєктування нового харчового функціонального продукту, хімічний склад роз-*

робок, визначені показники харчової та енергетичної цінностей сирного продукту, збагаченого селеном, та оптимізованого сирного продукту із рослинним наповнювачем на його основі. Встановлено, що споживання 100 г сирного продукту із рослинним наповнювачем здатне задовольняти добову потребу в поживних речовинах на 13,4%, в той час як, багатокомпонентний сирний продукт – на 9,6%. Висновки. Розробка харчових продуктів оптимального складу методом математичного моделювання дозволяє скоротити фінансові та часові витрати на розробку харчових продуктів, своєчасно реагувати на зміни потреб організму людини в техногенному суспільстві та значно розширити асортимент функціональних, дієтичних продуктів, спрямованих на харчування певних груп населення. Розширення можливостей програмного забезпечення щодо оптимізації дозволяє вийти на якісно новий рівень у розробці нових видів харчових продуктів із заданим хімічним складом, споживчими та технологічними характеристиками. Таким чином, реалізація поставленого завдання дозволила збільшити частку рослинного жиру як джерела поліненасичених жирних кислот у сирному продукті, антиоксидантів, деяких вітамінів та дешевшої сировини, за рахунок додавання ДДСБ та гарбузового пюре.

Ключові слова: *сирний продукт, рослинний наповнювач, добавка дієтична селен-білкова, гарбузове пюре, оптимізація, багатокомпонентний склад.*