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OPTIMIZATION OF THE COMPOSITION OF MUFFINS ON THE BASIS OF ESSENTIAL INDICATORS OF CHEMICAL COMPOUND OF THE CONFECTIONARY PRODUCT "VUPI PAI"

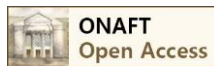
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Abstract: The article is concerned with the analysis of recipes of confectionary products on the basis of essential indicators of chemical composition meeting the demands of definite group of consumers (corresponding the physiological norms of feeding the different group of population). The ratio of carbohydrates and proteins which is determined for correlating group of the intensity of labour is analyzed. Criteria of optimality of the composition of present products were adopted on this basis. The received results give the possibility of choice of the composition of farinaceous confectionary product considering the aminoacid composition. Variants of the optimized recipes of the farinaceous confectionary product enriched with gluten were obtained. Key indicators of quality of the made farinaceous confectionary product were defined.

Key words: Objective function, optimization criteria, chemical composition, physiological standart, gluten, aminoacid, recipes.

Introduction

In recent years the government pays great attention to new approaches to solve environmental and food problems. These issues are of great socio-economic importance to the population, estimating the potential of technological development and health.

Global environment pollution almost reached critical level in water, air, medicinal herbs, food. In particular, harmful to human health products accumulate in soil and food, which reduces their usefulness and changes the chemical composition, may change the potential gene fund and cause unexpected mutations.

Scientific and technical bases of products production of popular, children, preventive, medicinal and special food is developed by scientists and has sufficient theoretical and applied levels. Scientists have suggested the technologies arranged for the protection of the health with the use of new elements of structure possessing both technological and physiological properties. They have aptitude to form a proper structure of the food and remove from it agents which are not recommended by medical demands and maintain competition ability of a producer. Today the production of health protective food is competitive factor for the development of restaurant business.

It is well known that the state of protein metabolism in humans largely depends of lack or absence of essential amino acids. High functional qualities of animal proteins occur in their water-holding capacity.

Functional and technical qualities of animal protein (water-retaining, emulsifying ability, thermal stability, etc.) permit to use them for different target areas [1, 2].

The use of animal protein material allows collagen keeping stuff to enrich products with detoxicants, and significantly improve the rheological quality and consistency of food. In order to assimilate collagen its hydrolysis is carried out [3].

Formulation of the problem

The goal of the search is to optimize recipes for muffins according to the main indicators of chemical composition, to meet the needs of a particular group of consumers (under physiological nutrition standards for different groups).

According to this goal optimality criterion has been defined. As an optimality criterion or objective function of the mathematical model we selected ratio of carbohydrates and proteins, which is set for a proper group of work intensity [4].



$$Z(x) = \frac{c_{2i} \sum_{i=1}^n x_i}{c_{1i} \sum_{i=1}^n x_i} \quad (1)$$

where $Z(x)$ – target function, which reflects a ratio of carbohydrates and proteins meeting the physiological norms of feeding for a proper group of work intensity; c_{1i} – protein content in components x_i , gr; c_{2i} – carbohydrates content in component x_i , gr.

A ratio of carbohydrates and proteins represents a balance of the developed recipe according the content of the nutrients. The developed recipes of muffins are characterized by the balance K_{36} , corresponding to objective functions set under the projecting.

According to this goal the following problems were set:

- to optimize the recipe of pastry (RPE) enriched by gluten;
- to conduct mathematical selection of composition based on RPE paying attention to amino acid composition;
- to set key indicators of quality of the got RPE.

Mathematical modeling

At the stage of clarifying of constraints the content of essential amine acid has been considered, which is limiting in the proposed raw materials and also the content of starch, of mono- and disaccharides, and the percentage content of the recipe components. The mathematical formalization of the given limitations was lying in recording of system of algebraic limitations.

The task of finding extreme of some linear forms in n-dimensional space if restrictions in the form of inequality on the set of linear forms is known in mathematics as a classical linear programming problem. To intensify and facilitate the solution of linear programming with fuzzy limitations OpenOffice Calc spreadsheet was used. Wherein the search of solution was held by the simplex method, which is an iterative phased process of aimed solution of equations system, which begins with the reference solution in search of a better alternative moves in the corner points of the field of acceptable solution that improves the objective function value unless the objective function reaches an optimum value.

As recipe components for projected mixtures such raw materials were selected: wheat flour, butter, melange, gluten, kernels, raisins, and candied fruit.

The main criteria in choosing raw material for muffins were high nutritional value and possibility of combination of the components for receiving a product with high biological value and high organoleptic indicators.

As a result of the design of muffins with using of superstructure "Search solutions" three muffin recipes with according coefficients of balance were received (Table 1).

Table 1 – Muffins recipes obtained by computer modeling

Компоненти кексу	Співвідношення компонентів, %			
	Контроль	5 % Г	8% Г	10 % Г
Борошно пшеничне	50	45	45	44
Масло вершкове	13	13	13	12
Меланж	16	5	5	5
Глютин	0	5	8	10
Ядра горіхів	2	8	8	8
Родзинки	6	6	6	5
Цукати	3	3	3	3

Taking into consideration that a number of limitations imposed (such as percentage of recipe component content of essential amino acids, etc.) directly affects the quality of the breakfast, there is the problem of finding the optimal solution when designing recipes. It is important that the developed recipe meet several requirements regarding both its feeding and biological value. It is clearly, the task is to find a compromise solution in which developed muffins will have quality that meets certain requirements.

In our case, the balancing factor is important quality criteria (which is the target function at linear programming) and the content of essential amino acids that are limiting in the raw material of different groups.

The problem of finding generalized quality criterion is considered as a problem of fuzzy nonlinear programming with n incompatible criteria , m variable controls and k nonlinear restrictions:

$$\text{Optimize } K [K_1(X), K_2(X), \dots, K_n(X)] \quad (2) \text{ provided}$$

$$C_i \equiv G_{Li} \leq G_i(X) \leq G_{Ui}, \quad i = 1, 2, \dots, k \quad (3)$$

$$x_{Li} \leq x_i \leq x_{Ui}, \quad i = 1, 2, \dots, m, \quad (4)$$



where $K_1(X)$ are unclear local criteria of quality of product;

$X(x_1, x_2, \dots, x_m)$ – vector of variable controls, that are searched;

G_{Li}, G_{Ui} – the lower and upper confines of limits, respectively,

$x_{Li} \leq x_i \leq x_{Ui}$ – lower and upper confines for variable control that are searched.

Model options X_{opt} identify compromise solution to given criteria of effectiveness. A multicriterian approach based on the combination of formal and informal procedures of adoption of solutions for finding an alternative solution of the problem. The final decision is defined as a result of the intersection of fuzzy criteria and limitations displayed with their functions of implement $\mu(X)$:

$$\mu_k(X) = \mu_{k1}(X) \cap \dots \cap \mu_{kn}(X) \cap \mu_{Gi}(X) \quad (5)$$

$$i = 1, 2, \dots, k; X \in X_p$$

The maximum and minimum confines of criteria are defined:

$$K_i^{\min} = \min_j K_j(X_j^0) = K_i(X_i^o) \quad (6)$$

$$K_i^{\max} = \max_j K_j(X_j^0), i = 1 \dots n \quad (7)$$

The function of implement for all fuzzy goals is presented in the form of:

$$\mu_{Ki}(X) = \begin{cases} 0, & \text{нпу } K_i(X) > K_i^{\max} \\ \frac{K_i^{\max} - K_i}{K_i^{\max} - K_i^{\min}}, & \text{нпу } K_i^{\min} < K_i \leq K_i^{\max} \\ 1, & \text{нпу } K_i(X) \leq K_i^{\min} \end{cases} \quad (8)$$

Fuzzy confines are formulated:

$C_j(X) \leq C_j^{\max} + d_j, j = 1, 2, \dots, q$ (9) where d_j – a real parameter which indicates the distance from the allowable offset for the C_j^{\max} -ing confine.

Thus, a generalized quality criterion is defined as the intersection of fuzzy criteria and confines submitted by their functions of implement. This problem is reduced to nonlinear programming: to find the meanings X, λ , which

$$\lambda = \mu_{Ki}(X), j = 1, 2, \dots, n$$

$$\lambda = \mu_{cj}(X), j = 1, 2, \dots, q$$

Fig. 1 illustrates the best solution for two quality criteria of designed recipes. The first criterion characterizes the change in balance factor, the second - the content of essential amino acid (lysine) contained in the raw grain in the smallest amounts. The variable of control is protein content in recipe mixture that is reflected in coded form. The intersection of fuzzy criteria and constraints that are relevant functions of implement, describes the content of lysine (1.17 mg / 100 g of the mixture) and the ratio of balance ($K_{36} = 4,0$), which is optimal for recipe number 1 under the corresponding content of protein. Similarly optimal solutions for other recipes were obtained, taking in consideration the balance factor and the content of amino acids that are limiting the raw material, which is a composite of muffins.

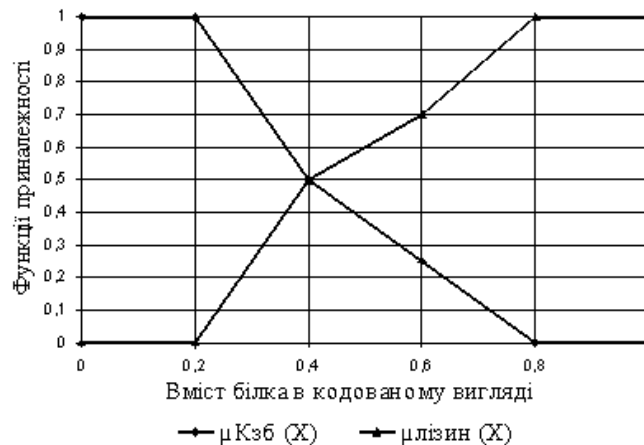


Fig. 1 – Optimal decision for fuzzy functions of implement



As gluten is a structure forming while replacing flour on it, the improving of the quality of the dough was observed, i.e. in recipes where 10 and 8% were used dough rises the best and dough porosity was better than in the sample containing gluten 5%.

The composite structure of developed "Whoopi share" formed on the base of analyzing the accounts held in Excel using superstructures *Solver* (Поиск решений). The main goal of optimizing recipes is to obtain the final product with balanced protein and carbohydrate composition. Three compositions for the production of muffins "Whoopi Pie" are received (Tabl. 1).

According to the calculations the recipe with the concentration of gluten of 10% was selected. The ratio of protein to carbohydrates in it was 1: 3, the ratio of all essential amine acids is the closest to the ideal protein, so further namely its quality indicators were studied.

It was determined the amino acid composition of optimal recipes for the production of "Whoopi Pie" muffin (Tabl. 2).

Table 2 – Aminoacid composition of muffin "Whoopi Pie"

Компоненти	Амінокислоти, г							
	Валін	Гістидин	Лейцин	Лізин	Метіонін	Тreonin	Триптофан	Фенілаланін
Пішечне борошно	228,59	193,32	366,88	169,33	84,66	183,44	70,55	235,18
Цукор-пшоч	0	0	0	0	0	0	0	0
Масло вершкове	5,13	5,01	9,29	5,50	2,07	5,74	5,25	5,13
Меланж	122,25	93,75	171,19	143,00	67,14	96,60	32,30	103,25
Дріжджі	0	0	0	0	0	0	0	0
Сіль	0	0	0	0	0	0	0	0
Розчинки	0,95	0,28	0,67	0,73	0,56	2,82	0,11	0,67
Цукрати	0,0005	0,0005	0,0005	0,0008	0,0002	0,0005	0,0002	0,0005
Ядра горіхів	18,32	14,43	23,10	8,29	5,75	11,08	3,29	14,43
Пудра ванільна	0	0	0	0	0	0	0	0
Глютин	1,02	1,0	1,5	1,76	0,25	1,12	0	0,75
Пудра рафінована	0	0	0	0	0	0	0	0
Всього	376,2605	307,79	572,630	328,610	160,430	300,80	111,50	359,4105

In the designed muffin "Whoopi pie» the parameters of nutritive, biological and energy-saving value (Tabl. 3) were analyzed.

The analysis of the chemical composition RPE showed that the introduction in the compositings of muffin of gluten increased the value of developed product through the increasing in it biologically active substances. These data show that the greatest mass proportion consists on proteins (42.8%). Disaccharide fructose in an amount of 20.3 t predominates.

Table 3 – Chemical composition and nutritive value of muffin "Whoopi pie» (n=3, p≥0.95)

Показник	Кекс «Вупі пай»	Адекватний рівень споживання г, мг / добу	
Вода, %	59,3		
Білок, %	42,8	58... 117	
Жири, %	13,3	60... 154	
Вуглеводи, % в. т.ч.:	24,6	257... 586	
моносахариди, %	20,3		
дисахариди, %	4,1	50... 100	
інулін, %	–	10... 20	
Клітковина, %	0,1	10... 15	
Пектин, %	0,1	10... 15	
Органічні кислоти, %	0,7		
Зола, %	1,0		
Мінеральні речовини, мг на 100 г	Na	108,3	4000... 6000
	K	334,4	2500... 5000
	Ca	232,7	800
	Mg	40,3	400
	P	204,8	1200
Вітаміни, мг на 100 г	Fe	2,3	10... 18
	A	10,1	800... 1000
	β-каротин	0,1	5... 10
	B ₁	–	1,1... 2,1
	B ₂	0,1	1,3... 2,4
PP	0,3	14... 28	
	C	21,5	70... 100
Енергетична цінність, ккал	170,4	1800... 4200	

Conclusions

Mathematical modeling of recipes of muffins provides to obtain a compound of products with desired food and biological characteristics. The objective function that has a common character for developed recipes reflects the coefficient of balance for muffins under the ratio of proteins and carbohydrates in their composition. The resulting composite recipes of mixtures meet



the norms of rational food and provide a full receipt of essential components while using muffin "Whoopi Pie" in the recommended amount.

Despite the effectiveness of this approach while developing the recipe composition of muffins at the phases of setting of objective functions and limits introduction some problems related to a wide range of proposed raw materials and local quality criteria arise. The applied research of generalized criterion of quality for determining the optimal balance factor and the content of limiting amino acids in the recipe.

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THE PROJECT MANAGEMENT OF INDUSTRIAL BUILDINGS REENGINEERING (RECONSTRUCTION AND COMPLETION)

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Abstract: Creative element fate of any activity may not fall to zero because of the turbulent environment in which these activities are carried out, always prevents this. Environment that makes each building unique, that is, provides the main basis