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Research paper

Justification of the optimal ratio of components in macaroni products enriched with composite mixture

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Abstract

This article presents the results of mathematical calculations of nutritive value of macaroni product enriched with composite mixture. While creating the paste there was developed a composite mixture containing high-grade wheat flour, buckwheat and flax flour, and a characteristic of its biological value was obtained.

Keywords: *composite mixture, metric comparison measures, non-metric comparison measures, essential amino acid.*

1. Introduction

In recent years, macaroni products with various herbal supplements has been widely distributed [1–6]. Creating food for therapeutic and prophylactic purposes, the integrated use of food raw materials, improving the quality, nutritional and biological value of the products is an important component of the "Concept of state policy in the field of healthy nutrition of the population". Paste, being often consumed, is the most convenient object through which one can adjust the nutritional and prophylactic value of the diet in the right direction. The relatively simple technology for the production of paste makes it possible to use various types of plant raw materials, which is of particular interest in solving the problem of rational use of various resources. Increasing the biologicalvalue of alimentary paste can be achieved by introducing into the formulation additional types of raw materials or additives with a higher protein content and the most deficient amino acids in comparison with wheat flour [3, 7].

The efficiency of protein metabolism in the human body largely depends on the qualitative and quantitative composition of food. When proteins are supplied with food below the recommended standards, tissue proteins begin to decompose in the body, and the resulting amino acids are spent on the synthesis of enzymes, hormones and other biologically active compounds necessary for the body. The state of protein metabolism is largely dependent on the lack or absence of essential amino acids. Human cells cannot synthesize the necessary proteins if at least one essential amino acid is missing in food [8].

The lack of at least one essential amino acid in food causes negative nitrogenous balance, impaired activity of the central nervous system, stunting and severe clinical consequences such as avitaminosis. The lack of one essential amino acid leads to incomplete absorption of others [9].

One of the main scientific areas of modern biotechnology is modeling, in particular, modeling the technology of compiling and predicting the functional and technological properties of food mixture formula.

The purpose of this study is to develop macaroni paste containing composite mixture.

2. Materials and methods

To determine the optimal ratio of flour there was used the method of mathematical statistics using comparison (similarity) measures [10, 11].

The use of comparison (similarity) measures makes it possible to choose the best options in the development of both functional food and general-purpose food on meat, vegetable and other bases.

The use of similarity measures for the development of functional foods was suggested by the doctor of physical and mathematical sciences, professor Krasnov A.E. [10]. When applying similarity measures, control samples or indicators are selected for which the products under investigation are considered [12].

3. Results and discussion

The ratio of components varied: wheat flour - from 86% to 100%, buckwheat flour and linseed flour - from 1% to 13% by weight of wheat flour. Thus, (X tested) scores of essential amino acids with different ratio of ingredients were calculated.

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Of all the calculated scores of the composite mixtures, the maximum score values for each amino acid (control S), shown in Figure 1, were selected.

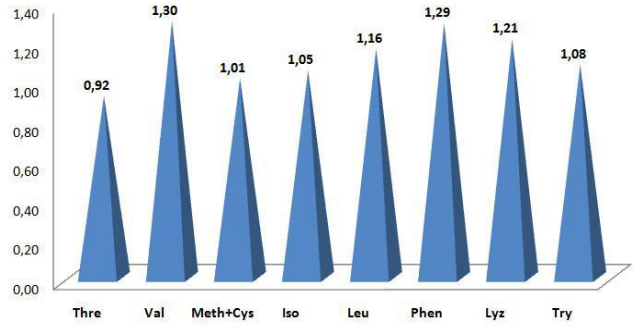


Figure 1 – The maximum score values for essential amino acids of the composite mixtures

Using metric and nonmetric measures of comparison [10, 12, 13] to the tested X and control S scores, we obtained the optimal ratio of wheat flour 86–90%, buckwheat flour - 8–10%, flax flour - 2–4%.

Scores of essential amino acids of the composite mixture are presented in Figure 2.

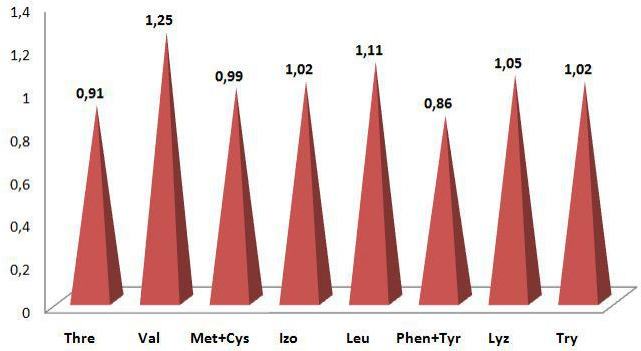


Figure 2 – Essential amino acids scores of the composite mixture

Applying control S to the matrix vector

$$S=\begin{pmatrix}s_1\\s_2\\\vdots\\s_n\end{pmatrix}=\begin{pmatrix}s_1\\s_2\\\vdots\\s_8\end{pmatrix}=\begin{pmatrix}0{,}92\\1{,}30\\1{,}01\\1{,}05\\1{,}16\\0{,}90\\1{,}21\\1{,}08\end{pmatrix}$$

And tested

$$X=\begin{pmatrix}x_1\\x_2\\\vdots\\x_n\end{pmatrix}=\begin{pmatrix}x_1\\x_2\\\vdots\\s_8\end{pmatrix}=\begin{pmatrix}0{,}91\\1{,}25\\0{,}99\\1{,}02\\1{,}11\\0{,}86\\1{,}05\\1{,}02\end{pmatrix}$$

get the results shown in Figure 3.

The data obtained are summarized in table 1.

Table 1 – Mathematical processing of data

Equation	Calculation result
$\sqrt{\sum_{n=1}^{8}(x_n-s_n)^2}$	0,192873
$\frac{\sum_{n=1}^{8}s_nx_n}{\sqrt{\sum_{n=1}^{8}x_n^2}\sqrt{\sum_{n=1}^{8}s_n^2}}$	0,999238
$\frac{\left(\sum_{n=1}^{8}s_nx_n\right)^2}{\sum_{n=1}^{8}s_n^2\sum_{n=1}^{8}x_n^2}$	0,998477
$\frac{2\sum_{n=1}^{8}s_nx_n}{\sum_{n=1}^{8}s_n^2+\sum_{n=1}^{8}x_n^2}$	0,997929
$\frac{\sum_{n=1}^{8}s_nx_n}{\sum_{n=1}^{8}(x_n-s_n)^2}$	241,043

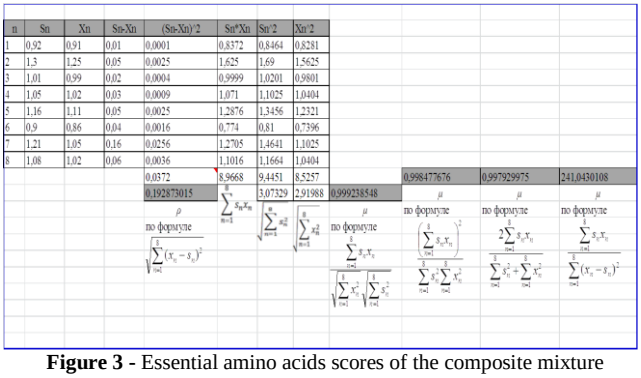


Figure 3 - Essential amino acids scores of the composite mixture

4. Conclusion

The study found that the results obtained are greater than any value calculated for any other ratios of wheat, buckwheat and flax flour. The optimal ratio of wheat flour is - 86–90%, buckwheat flour - 8–10%, flax flour - 2–4% .

The use of comparison (similarity) measures makes it possible to choose the best options in the development of both functional foods and general foods.

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