The object of research is a composition of aerated dessert with a balanced nutritional composition for nutrition of people suffering from hypolactasia. The article describes the mathematical and computer design to obtain recipe compositions of desserts, namely blancmange «Fruit Breeze» and «Protein Breeze» with high content of vitamins and protein. When designing blancmange recipes, the main goal was to obtain the maximum value of the product with the following content of nutrients (per 100 g of finished product):

- fat – not more than 11 %;
- monocarbohydrates – not more than 65 % and not less than 50 %;
- dry matter – not more than 85 % and not less than 96 %;
- proteins – not less than 20 %.

Optimization of blancmange formulations was performed using the Excel Solver of the MS Excel spreadsheet (WINDOWS 2010). The content of basic macronutrients in a portion of «Fruit Breeze» is 69.77 g/portion, in a portion of «Protein Breeze» – 78.55 g/portion. The developed products have a high content of protein, and they do not contain lactose, which is important in terms of meeting the needs of the human organism with hypolactasia.

The change of sensory and microbiological parameters of the developed desserts during storage for 5 days at a temperature of (4±2) °С with a humidity of 70–85 % in glass and polypropylene containers was determined. The obtained data of the study of qualitative indicators showed that under certain storage conditions, the content of sanitary-indicatory microorganisms meets the sanitary requirements for sweet dishes. Sensory indicators during storage showed high values. Thus, the total sensory indicator after 5 days of storage for «Fruit Breeze» was 29.5 points, and «Protein Breeze» was 31.7 points out of 35 possible.

Developed desserts can be recommended for use by people with hypolactasia, children, in the dietary nutrition.

Keywords: mathematical modeling of recipe, sweet dishes, nutrition of people suffering from hypolactasia.

1. Introduction

One of the promising areas of research in the field of healthy eating is the development of the food industry focused on the production of healthy foods – low-calorie, high in vitamins, minerals, polyunsaturated fatty acids (PUFA) and more. Particular attention is paid to the creation of products that have antiallergenic, anti-stress, adaptogenic, tonic, stimulating and radioprotective properties.

It should be noted that the number of consumers who choose a vegetarian lifestyle and do not eat animal products is growing every year. This is due to the desire to avoid the now common «diseases of civilization», such as atherosclerosis, hypertension, allergies, various tumors, as well as premature aging.

Increasing the number of people suffering from allergies or hypersensitivity to animal proteins, as well as unable to digest milk sugar (lactose), stimulates the development of new generation products based on the use of vegetable raw materials as a source of protein and protein-fatty products. Special attention needs to be paid to the organization of nutrition of people suffering from allergies to dairy products, as well as to such an inherited disease as hypolactasia, rather the inability of the organism to absorb milk sugar – lactose.

2. The object of research and its technological audit

The object of research is a composition of aerated dessert with a balanced nutritional composition for nutrition of people suffering from hypolactasia.

Blancmange is a French dairy dessert with a jelly structure. Milk of both animal and vegetable origin is used for its production, gelatin is usually added as a gelling component.

The following raw materials were used for the study:
- almond kernels (DSTU UNECE DDF-06:2007. Almond kernels. Guidelines for supply and quality control);
- dried sunflower fruits (DSTU 8494:2015. Dried sunflower fruits. Specifications);
- cocoa powder (DSTU 4391:2017. Cocoa powder. General specifications);
- fresh blueberries (DSTU 691:2004. Fresh blueberries. Specifications);
3. The aim and objectives of research

The aim of research is the mathematical design of a multicomponent blancmange composition for people with hypolactose.

To achieve this aim, the following objectives were set:
1. To carry out mathematical and computer design of blancmange recipes for people with hypolactose.
2. To determine the conditions and terms of storage of the received blancmange according to change of their sensory and microbiological indicators.
3. To determine the nutrient composition of the obtained blancmange.

4. Research of existing solutions of the problem

Approximately 15 % of people in Europe report on lactose intolerance, the Latin Americans have lactose intolerance up to 80 % and the Chinese have almost 100 % [2]. People with lactose intolerance are unable to fully digest it, which leads to the accumulation of lactose in the small intestine, which affects intestinal disorders [3]. However, the effect of accumulated lactose on cellular aging remains largely unknown.

An important direction in the food industry is the search for promising vegetable raw materials and the creation of new food products for the dessert group. Recently, organic products have become increasingly popular – without the addition of sugar, hormones, antibiotics, growth stimulants and more. Dining outlets try to introduce such products during storage, which is an important indicator for the content of basic nutrients, the authors used as an optimal criterion only sensory indicators.

The known food additive «Magne to food» [9] in the form of nanopowder, which was used as an improver in the structure of whipped desserts. Due to the content of Fe^{2+} the additive has a wide range of rheological properties. The foaming ability in the production of desserts increases by (40±2) % for mousses and almost 55 % for fruit and egg jelly. However, this study does not reveal the effect of the additive on the commercial indicators of finished products during storage, which is an important indicator for products, which are sold in dining outlets.

The physicochemical properties of different types of chocolate ganache from whipped cream, milk, vegetable cream and coconut milk have been studied [10]. The control group was considered ganache with whipped chocolate cream. Ganache with whipped cream with the lowest humidity and highest fat content showed the same result (lowest moisture content and highest fat content; p<0.05) and resulted in medium hardness. Ganache of vegetable cream and chocolate showed results similar to the results of the mentioned above whipped cream, except for the category of hardness. In general, whipped cream ganache was the

- cashew kernels (DSTU ISO 6477:2019. Cashew kernels. Specifications (ISO 6477:1988, IDT));
- soy yogurt (DSTU 4343:2004. Yogurts. General specifications);
- coconut oil (DSTU 4562:2006);
- fresh mango (ISO 6660:1993, IDT. Mango. Cold storage);
- vanilla sugar (DSTU 1009:2005. Vanilla sugar. Specifications);
- coconut shavings (TU 10.39.23-003-49073982);
- collagen hydrolyzate [1].

One of the problems is the development of a prescription composition of a dessert with a balanced nutrient composition that does not contain lactose and can be recommended for use by people suffering from hypolactose.

4. Research of existing solutions of the problem

The known food additive «Magne to food» [9] in the form of nanopowder, which was used as an improver in the structure of whipped desserts. Due to the content of Fe^{2+} the additive has a wide range of rheological properties. The foaming ability in the production of desserts increases by (40±2) % for mousses and almost 55 % for fruit and egg jelly. However, this study does not reveal the effect of the additive on the commercial indicators of finished products during storage, which is an important indicator for products, which are sold in dining outlets.

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As non-dairy desserts, fruit gels have been developed, which are recommended in the heroic diet [6]. Banana gels are recommended as an alternative to foods that provide the necessary nutrition for the elderly persons with dysphagia. Various hydrocolloids of plant origin were used to provide the required structure. The nutrient composition of the products was not taken into account when making up of the gel recipes, only rheological indicators were the main indicator.

The use of protein from legume seeds as an alternative to animal protein in the production of desserts has been studied [7]. Isolates of lupine, pea and soy protein were used in combination with κ-carrageenan, gelan and xanthan gum to obtain a synergistic effect. Rheological studies have shown that mixed protein-polysaccharide systems with plant proteins and κ-Carrageenan or gelan gum were good systems for the development of plant-based desserts. However, the study identified only a change in the rheological index – the strength of the gel and did not take into account a comprehensive indicator of the quality of desserts, based on both rheological and sensory indicators.

Stevia extract was used to produce whipped dessert based on cottage cheese [8]. Gelatin is used as a structuring agent, and table salt is used to enhance the sweet taste. But the mentioned above recipe was not optimized for the content of basic nutrients, the authors used as an optimal criterion only sensory indicators.

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most popular chocolate in the sensory analysis, but coconu-

t milk chocolate was the softest chocolate among cream
substitutes. Due to its low caloric content and softness, coconut

cut was considered suitable for making chocolate ganache.

Heated soluble complexes of whey protein isolate with
polysaccharides can be used to modify the properties of
aerated milk gels, which can be introduced into new tex-
tured high-protein desserts [11]. Three polysaccharides with
different degrees of density were selected: low-methoxyl
pectin, high-methoxyl type D pectin and guar gum. Heated
complexes were prepared by heating mixed dispersions (8 %
of protein, 0–1 % of polysaccharide) at pH=4.7. The foam
was introduced into the gel in the form of glucono-δ-lactone,
acidified to the final pH=4.5. The excess of aerated gel

decreased (up to 73 %) as the concentration of polysaccha-
drides increased from 0.105 to 0.315 % due to the increased
viscosity, which limited the introduction of air. There is a
negative relationship between the percentage of drainage
and the viscosity of the dispersion.

Thus, the direction of a complex approach to the de-
velopment of recipes for whipped desserts, taking into ac-
count the composition and interaction of basic nutrients is
relevant. Expanding the range of cold lactose-free desserts
will reduce the level of protein deficiency, enrich the diet
with essential vitamins, macro- and micronutrients, dietary
fibers and other biologically active substances.

5. Methods of research

The process of combining components was based on a
priori analysis of information base data on their chemical
composition and the calculated degree of balance obtained in
modeling variants of prescription mixtures [12]. The imple-
mentation of mathematical design of recipes was carried out
according to a set of mathematical equations in the editor
MS Excel 2010 according to the method described in [12].

The main indicators of the quality of ready-made blan-
cmange were sensory and microbiological indicators. The
preparation of blancmange were divided into samples weighing
100 g, which were stored in glass and polypropylene con-
tainers at a temperature of (4±2) °C, at a relative humidity
of 75–85 % for 5 days. Sensory analysis was performed by
profiling using the developed scale in accordance with
DSST ISO 8589:2013. Sensory research. General guide-
lines for the design of test rooms (ISO 8589:2007, IDT).
Organoleptic evaluation was conducted by a tasting com-
mision, which included a teaching staff of 15 people.

To predict the actual shelf-life of blancmange the pres-
ence of major pathogenic bacteria and microorganisms was
determined. Microbiological indicators were determined:
- **MAE:nM** – according to GOST 10444.15;
- **Escherichia coli** – according to DSTU GOST
30726-2002. Food products. Methods for detecting and
determining the number of bacteria of the **Escherichia
acolispecies** (GOST 30726-2001, IDT);
- pathogenic microorganisms, in particular bacteria of the
*Salmonellagenus* were studied according to DSTU
IDF 122C:2003.

6. Research results

6.1. Rationale for the choosing of raw materials for
the manufacture of blancmange. For the design of recipes
deterministic standard was used, which is entered into the
database and it included the norms of physiological needs
of the human organism for carbohydrates and proteins.
For selected types of nutrients in the process of model-
and assessing the balance of virtual recipes as criteria
of food adequacy customized and general indicators of
desirability were used. The module, which implemented
the evaluation algorithm, at this stage of development
functioned without calling the subroutine for calculating
the integrated criterion of food adequacy.

When designing Blancmange recipes «Fruit Breeze» and
«Protein Breeze» it was necessary to achieve the goal – the
maximum value of the product. In the Tables 1, 2 data
matrix and a range of variation of recipe ingredients (RI)
for the design of blancmange recipes «Fruit Breeze» and
«Protein Breeze» is presented.

The target function in the design of the recipe com-
position of blancmange «Protein Breeze» is:

\[
F(x) = \begin{pmatrix} 85.3 - x_1 + 72.2 - x_2 + 49.5 - x_3 + \\
+ 81.54 - x_4 + 93.7 - x_5 + 89.5 - x_6 + \\
+ 21.06 - x_7 + 65.51 - x_8 + 99.9 - x_9 + \\
+ 14.6 - x_{10} + 87.8 - x_{11} + 70 - x_{12} \end{pmatrix} \]

On the basis of the information matrix of data (Table 1)
let’s form a system of linear balance equations for the
content in the recipe of macronutrients, in accordance
with the following restrictions:

Protein content is not less than 3, not more than 10:

\[
F(x) = \begin{pmatrix} 85.3 - x_1 + 72.2 - x_2 + 49.5 - x_3 + \\
+ 81.54 - x_4 + 93.7 - x_5 + 89.5 - x_6 + \\
+ 21.06 - x_7 + 65.51 - x_8 + 99.9 - x_9 + \\
+ 14.6 - x_{10} + 87.8 - x_{11} + 70 - x_{12} \end{pmatrix} \]

Fat content (F) is not less than 2, not more than 5:

\[
2 \leq 53.7 - x_1 + 0.5 - x_2 + 15 - x_3 + 35.49 - x_4 + \\
+ 0.6 - x_5 + 48.5 - x_6 + 18 - x_7 + 0.01 - x_8 + \\
+ 0.4 - x_{10} + 0.1 - x_{11} \leq 5.5. \]

Table1

| Recipe ingredients | Index, x | Dry matter content RI, % | Possible range of variation RI, g/portion |
|-------------------|--------|--------------------------|------------------------------------------|
| Almond            | x_1    | 33.8                     | 35–45                                    |
| Dates             | x_2    | 24.5                     | 12–20                                    |
| Cocoa powder      | x_3    | 90.8                     | 12–20                                    |
| Shredded coconut  | x_4    | 74.6                     | 35–45                                    |
| Blueberries       | x_5    | 26.3                     | 25–35                                    |
| Cashew            | x_6    | 65.8                     | 50–60                                    |
| Soy yogurt        | x_7    | 25.3                     | 50–60                                    |
| Artichoke syrup   | x_8    | 19.3                     | 12–20                                    |
| Coconut oil       | x_9    | 21.5                     | 12–20                                    |
| Fresh mango       | x_{10} | 18.9                     | 40–50                                    |
| Vanillin          | x_{11} | 87.8                     | 4–6                                      |
| Collagen hydrolyzate | x_{12} | 94                       | 5–10                                     |
The nutritional value of blancmange recipe ingredients

| Nutrients | Almond | Dates | Cocoa powder | Shredded coconut | Blueberries | Cashew | Soy yogurt | Artichoke syrup | Coconut oil | Fresh mango | Vanillin | Collagen hydrolyzate |
|-----------|--------|-------|-------------|------------------|-------------|--------|-----------|----------------|------------|-------------|----------|--------------------|
| Macronutrients, g/100 g |
| Protein | 18.6 | 2.5 | 24.3 | 2.88 | 1.1 | 18.5 | 3.5 | 2 | 0 | 0 | 0.8 | 0.1 | 70 |
| Fat | 53.7 | 0.5 | 15 | 35.49 | 0.6 | 48.5 | 1.8 | 0.01 | 0 | 0.4 | 0 | 0.1 | 0 |
| Carbohydrates | 13 | 69.2 | 10.2 | 15.76 | 7.6 | 22.5 | 15.76 | 63.5 | 99.9 | 13.4 | 87.6 | 0 |
| Total | 85.3 | 72.2 | 49.5 | 81.54 | 9.3 | 89.5 | 21.06 | 65.51 | 99.9 | 14.6 | 87.8 | 70 |
| Micronutrients, g/100 g |
| ω3 | 0.006 | 0.003 | 0 | 0 | 0.058 | 0.161 | 0 | 0 | 0 | 0.1 | 0.051 | 0.058 | 0 |
| ω6 | 12.05 | 0.016 | 9 | 0 | 0.088 | 7.66 | 0 | 0 | 1.7 | 0.019 | 0.088 | 0 |
| Vitamin C | 1.5 | 0.3 | 0 | 0.7 | 10 | 0.5 | 2.5 | 0 | 0 | 36.4 | 0 | 0 |
| Anthocyanins | 0 | 0.137 | 0 | 0 | 0 | 0 | 0 | 0 | 0.237 | 0 | 0.556 | 0 |
| Flavonoids | 0 | 0.247 | 0 | 0 | 0 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0.586 | 0 |

The content of carbohydrates (C) is not less than 10, not more than 15:

\[
10 \leq x_1 + 0.62 \cdot x_2 + 10.2 \cdot x_3 + 43.17 \cdot x_4 + \\
+ 7.6 \cdot x_5 + 22.5 \cdot x_6 + 15.76 \cdot x_7 + 63.5 \cdot x_8 + \\
+ 99.9 \cdot x_9 + 13.4 \cdot x_{10} + 87.6 \cdot x_{11} \leq 15.
\]

Content $\omega_3$ is not less than 200 mg:

\[
0.006 \cdot x_1 + 0.003 \cdot x_2 + 0.058 \cdot x_3 + 0.161 \cdot x_4 + \\
+ 0.1 \cdot x_5 + 0.051 \cdot x_6 + 0.088 \cdot x_7 \leq 200.
\]

Content $\omega_6$ is not less than 600 mg:

\[
12.05 \cdot x_1 + 0.016 \cdot x_2 + 9 \cdot x_3 + \\
+ 0.088 \cdot x_4 + 7.66 \cdot x_5 + 1.7 \cdot x_6 + \\
+ 0.019 \cdot x_7 + 0.088 \cdot x_8 \geq 600.
\]

The ratio:

\[
0.2 \leq \frac{\omega_6}{\omega_3} \leq 1.5.
\]

The ratio of fat to carbohydrates (mono carbohydrates and starch) is not more than 4, not less than 2:

\[
2 \leq \frac{F}{C} \leq 4.
\]

Vitamin C content is not less than 14 mg/100 g (20 % of daily requirement):

\[
1.5 \cdot x_1 + 0.3 \cdot x_2 + 0.7 \cdot x_3 + 10 \cdot x_4 + \\
+ 0.5 \cdot x_5 + 2.5 \cdot x_6 + 36.4 \cdot x_7 \geq 14.
\]

Anthocyanin content is not less than 5 mg/100 g (10 % of daily requirement):

\[
0.137 \cdot x_1 + 0.237 \cdot x_2 + 0.556 \cdot x_3 \geq 5.
\]

The content of flavonoid compounds is not less than 1 mg/100 g:

\[
0.247 \cdot x_2 + 0.02 \cdot x_3 + 0.586 \cdot x_4 \geq 1.
\]

Limitations on collagen hydrolyzate (is not less than 2 %, but not more than 5 %):

\[
2 \leq x_{11} \leq 5.
\]

Rationing conditions (yield per 250 g):

\[
x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11} = 250.
\]

Lower RI limits:

\[
x_1 \geq 35; \quad x_2 \geq 12; \quad x_3 \geq 12; \quad x_4 \geq 35; \\
x_5 \geq 25; \quad x_6 \geq 50; \quad x_7 \geq 50; \quad x_8 \geq 12; \\
x_9 \geq 12; \quad x_{10} \geq 40; \quad x_{11} \geq 4; \quad x_{12} \geq 5.
\]

Upper RI limits:

\[
x_1 \leq 45; \quad x_2 \leq 20; \quad x_3 \leq 20; \quad x_4 \leq 45; \\
x_5 \leq 35; \quad x_6 \leq 60; \quad x_7 \leq 60; \quad x_8 \leq 20; \\
x_9 \leq 20; \quad x_{10} \leq 50; \quad x_{11} \leq 6; \quad x_{12} \leq 10.
\]

Similarly, a mathematical model was made to design a prescription composition for «Fruit Breeze» blancmange. As a result of calculation of the program the shares of prescription components were received:

– for Blancmange «Protein Breeze»:

\[
x_1 = 38; \quad x_2 = 12; \quad x_3 = 12; \quad x_4 = 35; \\
x_5 = 25; \quad x_6 = 35; \quad x_7 = 35; \quad x_8 = 12; \\
x_9 = 35; \quad x_{10} = 5; \quad x_{11} = 4; \quad x_{12} = 2.
\]

In this case, $F(x) = 65.78$.

– for the «Fruit Breeze» blancmange:

\[
x_1 = 38; \quad x_2 = 12; \quad x_3 = 12; \quad x_4 = 32; \\
x_5 = 25; \quad x_6 = 35; \quad x_7 = 35; \quad x_8 = 12; \\
x_9 = 32; \quad x_{10} = 5; \quad x_{11} = 12.
\]

In this case, $F(x) = 65.78$. 
Thus, the content of basic macronutrients in a portion of «Fruit Breeze» blancmange is 63.24 g/portion, in a portion of «Protein Breeze» blancmange – 65.78 g/portion.

According to the results of mathematical design blancmange formulations were received (Table 3).

| Raw material        | «Protein Breeze» | «Fruit Breeze» |
|---------------------|------------------|----------------|
|                     | Gross, g | Waste % | Net, g | Gross, g | Waste % | Net, g |
| Almond              | 40       | 5       | 38     | 40       | 5       | 38     |
| Dates               | 17       | 29      | 5      | 17       | 29      | 5      |
| Cocoa powder        | 12       | 0       | 12     | 12       | 0       | 12     |
| Shredded coconut    | 32       | 0       | 32     | 32       | 0       | 32     |
| Blueberries         | 25       | 0       | 25     | 25       | 0       | 25     |
| Cashew              | 35       | 0       | 35     | 35       | 0       | 35     |
| Soy yogurt          | 35       | 0       | 35     | 35       | 0       | 35     |
| Artichoke syrup     | 12       | 0       | 12     | 12       | 0       | 12     |
| Coconut oil         | 45       | 29      | 13     | 45       | 29      | 13     |
| Fresh mango         | 5        | 0       | 5      | 5        | 0       | 5      |
| Vanillin            | 6/15     | 0       | 6/15   | 12       | 0       | 12     |
| Collagen hydrolyzate| 5        | 0       | 5      | 5        | 0       | 5      |
| **Total**           | 269      | 63      | 20     | 250      | 270     | 63     |

6.2. Determination of sensory parameters of the finished product. The sensory evaluation was performed by a tasting commission, which consisted of a total of 15 people, immediately after making blancmange.

Evaluation of sensory parameters of the obtained products is given in Table 4.

| Indicator          | «Fruit Breeze» | «Protein Breeze» |
|--------------------|----------------|------------------|
| **Appearance**     | Sphere shape, smooth surface, slightly porous in section, without deformations and tears, attractive appearance | Elongated, gelatin form, slightly porous in section and evenly distributed pieces of blueberries throughout the volume, tender |
| **Structure**      | Creamy, even, porous and gentle | Elastic, gelatin form, slightly porous in cross-section and evenly distributed throughout the volume. Slices of berries are evenly distributed throughout the volume (impregnation), tender |
| **Consistence**    | Sweet, creamy, without extraneous flavors | Sweet, creamy, without extraneous flavors |
| **Taste**          | Pure, coconut with a subtle smell of blueberries and nuts, pleasant, pronounced, without impurities | Pure, coconut with a subtle smell of blueberries and nuts, pleasant, pronounced, without impurities |
| **Flavor**         | Light purple, with dark purple specks | Light purple, with dark purple specks |
| **Color**          | Light purple, with dark purple specks | Light purple, with dark purple specks |

6.3. Analysis of nutritional and energy value, antioxidant activity of developed blancmange. It should be noted that...
the developed products have a high content of all essential micronutrients necessary for the human organism namely calcium, phosphorus and potassium, because the production in the recipe uses raw materials with a high content of trace elements such as Ca, K and R. The degree of daily needs human in the main vitamins, % when consuming one serving of blancmange is presented in (Table 5).

Table 5
(The degree of satisfaction of the daily human demand for essential vitamins, % (when consuming a portion of blancmange))

| Micronutrients | Daily demand, mg | «Protein Breeze» in a portion, 250 g | sati- | «Fruit Breeze» in a portion, 250 g | sati- |
|----------------|------------------|---------------------------------|-------|---------------------------------|-------|
| A              | 0.1              | 0.02                            | 21.24 | 0.02                            | 19.66 |
| β-carotene     | 6                | 0.02                            | 0.34  | 0.02                            | 0.34  |
| B₁             | 1.5              | 0.19                            | 12.35 | 0.18                            | 12.28 |
| B₂             | 1.8              | 0.12                            | 6.76  | 0.12                            | 6.75  |
| B₃             | 2                | 0.93                            | 46.31 | 0.91                            | 45.43 |
| B₅             | 0.6              | 0.33                            | 54.93 | 0.33                            | 54.27 |
| B₇             | 0.2              | 0.06                            | 29.92 | 0.06                            | 29.52 |
| E              | 15               | 11.41                           | 76.06 | 11.49                           | 76.62 |
| PP             | 20               | 5.62                            | 28.12 | 5.62                            | 28.11 |
| C              | 80               | 14.99                           | 18.74 | 14.68                           | 18.35 |
| Na             | 400              | 117.74                          | 29.44 | 110.33                          | 27.59 |
| Ca             | 300              | 189.93                          | 63.31 | 190.43                          | 63.48 |
| Mg             | 400              | 250.94                          | 62.74 | 249.62                          | 62.41 |
| S              | 1000             | 119.51                          | 11.95 | 119.86                          | 11.99 |
| P              | 400              | 372.97                          | 93.24 | 370.38                          | 92.60 |
| Cl             | 2000             | 22.31                           | 1.12  | 22.94                           | 1.15  |
| Fe             | 18               | 6.50                            | 36.10 | 6.49                            | 36.06 |
| K              | 2500             | 843.21                          | 33.73 | 832.14                          | 33.29 |

Because blancmange contains protein, an analysis of the amino acid composition was performed. Studies have shown that the protein component contains nineteen amino acids, all of which are essential.

The daily demand of the human organism for essential amino acids due to the consumption of a portion of blancmange is presented in Table 6. Consumption of one portion of Blancmange «Protein Breeze» will provide the human organism with essential amino acids in total by almost 106 %, and Blancmange «Fruit Breeze» – 58.6 %.

Studies of the biological value of blancmange were studied by calculating the amino-acid score, which is given in Table 7.

The biological value of proteins is determined not only by their amino acid composition, but also the degree of digestibility. The intensity of the process of protein breakdown in the human digestive tract depends on the activity of proteolytic enzymes and the biological form of the protein components of the product.

According to the research results, the degree of digestibility of the developed desserts «Protein Breeze» and «Fruit Breeze» was 84.5 and 82.1 %, respectively.

Also, as a part of the study, the qualitative and quantitative composition of the microbiota developed blancmange during their storage for 5 days in glass and polypropylene containers at a relative humidity of 75–85 % and a temperature of 4±2 °C was determined. Establishment of safe shelf-life was performed in the presence of sanitary-indicator microorganisms. To study microbiological parameters during storage (for 5 days) determined the presence and amount of MAFAaN – according to GOST 10444.15, pathogenic bacteria, including Escherichia coli – according to GOST 30726-2001, yeast and molds – according to GOST 10444.12.

On the basis of the received data of definition of change of sensory and microbiological indicators at storage of the developed blancmange it is possible to state that at observance of the recommended conditions, products have rather high indicators of quality (Fig. 1, 2). Thus, when stored for 5 days, the total score on sensory indicators is reduced to 31.7 points for «Protein Breeze» and 29.5 points

| Amino acids | Daily demand, mg | «Protein Breeze» in a portion, 250 g | sati- | «Fruit Breeze» in a portion, 250 g | sati- |
|-------------|------------------|---------------------------------|-------|---------------------------------|-------|
| Arginine    | 5                | 4.0                             | 80.7  | 2.3                             | 46.1  |
| Valine      | 0.8              | 2.1                             | 264.2 | 1.3                             | 169.3 |
| Histidine   | 2                | 0.7                             | 35.1  | 0.5                             | 27.1  |
| Isoleucine  | 0.7              | 1.4                             | 207.0 | 0.9                             | 133.2 |
| Leucine     | 1.1              | 2.7                             | 242.7 | 1.7                             | 150.8 |
| Lysine      | 0.8              | 2.0                             | 250.9 | 1.0                             | 127.4 |
| Methionine  | 1.1              | 0.6                             | 53.7  | 0.4                             | 39.2  |
| Cysteine    | 3                | 0.3                             | 11.5  | 0.3                             | 11.5  |
| Threonine   | 0.5              | 1.5                             | 307.4 | 0.8                             | 165.2 |
| Tryptophan  | 0.25             | 0.3                             | 117.8 | 0.5                             | 117.8 |
| Phenylalanine | 1.1           | 1.7                             | 154.5 | 1.2                             | 109.2 |

| Determination of amino-acid score in the developed blancmange |
|-------------------------------------------------------------|
| Essential amino acid | The content of essential amino acids in the ideal protein, mg/g P | «Protein Breeze» amino-acid score, % | «Fruit Breeze» amino-acid score, % |
|----------------------|---------------------------------------------------------------|---------------------------------|---------------------------------|
| Isoleucine           | 40                                                            | 74.0                            | 185.10                          | 47.6  | 119.08 |
| Leucine              | 70                                                            | 136.4                           | 194.89                          | 84.0  | 121.10 |
| Lysine               | 55                                                            | 102.6                           | 186.51                          | 52.1  | 94.723 |
| Methionine           | 35                                                            | 30.2                            | 86.17                           | 22.0  | 62.87 |
| Phenylalanine        | 60                                                            | 86.8                            | 144.73                          | 61.4  | 102.33 |
| Threonine            | 40                                                            | 79.5                            | 196.32                          | 42.2  | 105.54 |
| Tryptophan           | 10                                                            | 15.1                            | 150.52                          | 15.1  | 150.52 |
| Valine               | 50                                                            | 108.1                           | 216.03                          | 68.9  | 137.58 |
| Total                | 350                                                           | 631.65                          | 393.98                          | 303.98 |
for «Fruit Breeze» from 35 possible points in accordance with the microbiological indicators of SanPIN 2.3.4.551-96. Thus, the following storage conditions can be recommended: for 5 days in glass containers or polypropylene packaging at a temperature of (4±2) °C and relative humidity not exceeding 75 %.

7. SWOT analysis of research results

Strengths. The strengths of this research are the development of blancmange recipes with a balanced nutrient composition using vegetable raw materials.

Weaknesses. The weak side of the research is the almond content, which can cause an allergic reaction. Also, the presence of fat-containing raw materials (coconut oil and cashews) significantly increases the energy value of the product, which narrows the range of consumers developed blancmange.

Opportunities. The resulting blancmange can be recommended for use by people with hypolactasia. Developed desserts can be included in the diet in the field of HoReCa: dining outlets, hospitality industry and children’s nutrition.

Threats. For the introduction of the developed blancmange into production, it is planned to conduct a SWOT-analysis of the technology for obtaining these desserts, to develop prerequisite programs for the developed technology in accordance with international HACCP safety standards.

8. Conclusions

1. Blancmange recipes using non-traditional raw materials have been developed. Due to the use of vegetable milk, blancmange compositions were obtained, which can be used for the production of dessert products for people suffering from hypolactasia. The recipes were optimized using the Solver spreadsheet (MS Excel 2010), the optimal content of all components was set.

2. On the basis of the conducted microbiological researches it is established that at storage of the developed blancmange in regulated conditions, these products have rather quite good quantitative and qualitative indicators (Fig. 1, 2). The recommended shelf-life is 5 days at air temperature (4±2) °C and relative humidity not more than 75 % in glass or polypropylene containers.

3. Consumption of 100 g of developed blancmange «Fruit Breeze» and «Protein Breeze» will provide the human organism with 63.24 g and 65.78 g of macronutrients, respectively. Consumption of a portion of developed blancmange will meet the average requirements of the organism in B vitamins by almost 40 %. The ratio of calcium, magnesium and phosphorus is equal to blancmange «Fruit Breeze» 0.98:1:1.48, and blancmange «Protein Breeze» 1.01:1:1.49, which corresponds to the recommendations of nutrition.

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