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TECHNOLOGICAL ASPECTS OF PRODUCTION OF FROZEN DESSERT WITH PROTEIN-HERBAL COMPONENT

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Abstract. *The aim of scientific work is to improve the technology of frozen desserts enriched with protein-herbal component by the obtained thermo & heat coagulation of skimmed milk with Rumex juice. The emergency of the development of new frozen desserts with protein-milk concentrates, obtained by different coagulation methods, is substantiated. The advantages of using the thermo & heat coagulation of milk proteins are taken into consideration. Having in view the complex influence on the proteins of high temperature milk and the Rumex acid reagent, the parameters of the process are specified. As raw material for coagulation, skimmed milk with a mass fraction of dry matter of 11.2 ± 0.7%, protein, 3.7 ± 0.2%, titrated acidity, 17 ± 1.0°T, density, 1032 kg/m³ was selected. The amount of coagulant with a pH of 3.1 at a level of 7 ± 0.5% of the weight of skimmed milk satisfies the requirements for protein-herbal clots according to quality indices. The technological process of production of frozen dessert with protein-herbal component was provided, which envisaged the receipt of raw materials and preparation of the milk basis, production of protein-herbal component, mixing, milling and packing. The refined technological parameters of production and the biological value of dessert are determined. Thus, it was established that the introduction of the protein-herbal component into the frozen dessert composition at the ratio of the milk basis to protein-herbal 80:20 will allows getting the product with the corresponding organoleptic and physico-chemical indicators of quality with increased nutritional and biological value.*

Keywords: *sorrel (Rumex), thermo & heat coagulation of proteins, biological value, ice cream*

1. Introduction

The nutrition structure of the population of Ukraine to a large extent does not correspond to modern principles rational nutrition and practical diet. In the food ration of the population is an excess of bakery products and potatoes. There are few main sources of complete food protein (meat, fish and dairy products), food fibers, micronutrients (vegetables, fruits, nuts, etc.).

The results of studies on the actual state of nutrition in different regions of Ukraine testify to the fact that the food status of both children and adults is characterized by serious violations: the lack of valuable (animal) proteins; polyunsaturated fatty acids; vitamins C, B, E, folic acid, retinol, β-carotene); macro- and trace elements: Ca, Fe, Zn, F, Se, I; food fibers. On the contrary, there is an over-consumption of animal fats and easily digestible carbohydrates. Fat consumption is higher than the recommended norm - more than 32% of the caloric intake of the diet. The deficiency of protein intake is on average 20%, most of the vitamins and trace elements are 55%, of food fibers 30% [1].

When forming a modern assortment of food products should take into account the main stages selection of prescription

components indicators of economic efficiency from possible introduction into production. According to the scheme, it is necessary to highlight the most important directions in this area. They should take into account the need for further research work. Priority directions of the complex the problem is to provide healthy nutrition to the population. The structure of nutrition requires considerable correction in the direction of greater balance. Food products should increase the body's resistance to conditions of unfavourable environment. Providing mass release of such products is possible improve the quality of life of the sick person. A healthy person helps to reduce the risk of the most widespread diseases. Ensure adaptation of the body to adverse living and working conditions. Above this information is fully applicable to dairy products, especially those widely used [2].

Ice cream is a stuffed, frozen dessert, a popular product from the population of our country. This is due not only to its pleasant flavoring properties, but also to its high nutritional and biological value.

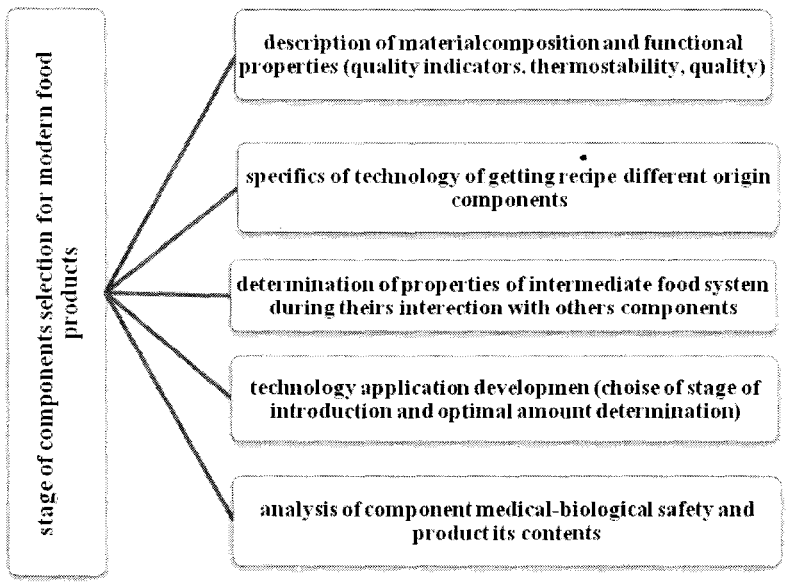

Fig.1. Stage of components selection for modern food products

On average, the energy value of milk and fruit ice cream is 560.7 - 616.2 kJ / kg, creamy - up to 836.0 kJ / kg, pencil - up to 1010 kJ / kg. Chemical composition of ice cream (in %): carbohydrates, 14 - 25; fat, 0.5 - 20; proteins, 3.5 - 4.5, minerals, up to 0.7. Ice cream is digested by the body on 95 - 98% [3].

Protein in ice cream on a milk basis is represented mainly by casein. Whey proteins - albumin and globulin - partly coagulate when pasteurizing mixtures of ice cream.

Scientists have already developed a technology of ice cream with the addition of cheese sour milk low-fat obtained by acid coagulation of milk proteins [4] and a frozen dessert enriched with soy protein component [5].

At present, vegetable ingredients are used as technological components in the production processes. So, the thermo & heat coagulation of milk proteins occurs under the action of whey with acidity 150 - 200° T, and coagulants of vegetable origin with corresponding characteristics [6, 7].

Sour milk cheese is obtained according to the classical technology with the thermo

acid deposition of proteins allows you to get the finished product enriched with serum proteins.

The aim of the work is to improve the technology of enriched frozen desserts protein-herbal component. The object of the study is the technology of frozen desserts on the basis of PHC. Subject of research – skimmed milk; Rumex juice; PHC; quality indicators and biological value of a frozen dessert with protein-herbal component.

The task is:

- establishment of a rational ratio of milk base and protein-herbal component in mixtures for frozen dessert;
- development of technology of frozen dessert with protein-herbal component;
- research of qualitative indicators and biological value of model samples of frozen desserts.

2. Materials and methods

Method of obtaining protein - herbal component. Raw material for coagulation - skimmed milk with a mass fraction of dry matter of 11.2 ± 0.7%, protein, 3.7 ± 0.2%, titrated acidity, 17 ± 1.0°T, density, 1032 kg/m³. Earlier studies, which took into account organoleptic constraints and protein yield, the optimal amount of coagulant with pH 3.1 was determined at a level of 7 ± 0.5% of the milk mass. That is the number that changes active acidity in the mixture to ensure a balanced is electric state of proteins in all volume and leads to their active coagulation in classical modes. In a heated temperature of 93 ... 95 ° C, skim milk was introduced by Rumex juice with a mass fraction of dry substances 3.2%, moderately stirred and kept at 3 ... 5 minutes until a clot was formed. Comprehensive impact on high temperature milk proteins and acid reagent leads to their full deposition. The coagulation process was set visually for intense formation of strong protein clot and release whey [8].

The paper uses both standard and adapted methods for determining the quality indices. *The mass fraction of dry substances in ice cream* was determined by the arbitration method by drying for temperature 102 ÷ 105°C (GOST 3626). *The titratable acidity of an ice cream* is titer-metric (GOST 3624). *The loss of ice cream* was determined according to DSTU 4733: 2007. *Resistance to melting of ice cream* - expressed through the accumulation time of 10 cm³ mixture (in minutes), which it is formed due to the melting of ice cream in a thermostat at a temperature of 25 °C by ion-exchange liquid-column chromatography on the automatic analyzer of amino acids T339 was determined which based on the acid-base properties of amino acids. To register the amino acids in elutes use the detection method with ninhydrin. It interacts with the amino acid by amino group and forms a hydrindantin compound, which causes a coloration of 560 nanometers. Qualitative and quantitative composition of the amino acid mixture is determined by comparing the standard chromatogram and the studied mixtures of amino acids and calculating the peak area of each amino acid. *Amino acid fast* - the ratio of the content of the essential amino acid product to the corresponding content an indispensable amino acid "ideal protein" on the FAO / WHO scale:

$$AF = EAApr / EAAe \quad (2.1)$$

where AF - amino acid rate,%;

EAApr - the content of the essential amino acid in the product, g/1 g protein;

EAAep - the content of the "essential protein" of the "essential protein" on the

FAO / WHO scale, g / l protein.

The coefficient of difference of amino acid fast (KDAF) and biological value of protein (BV) was determined by the

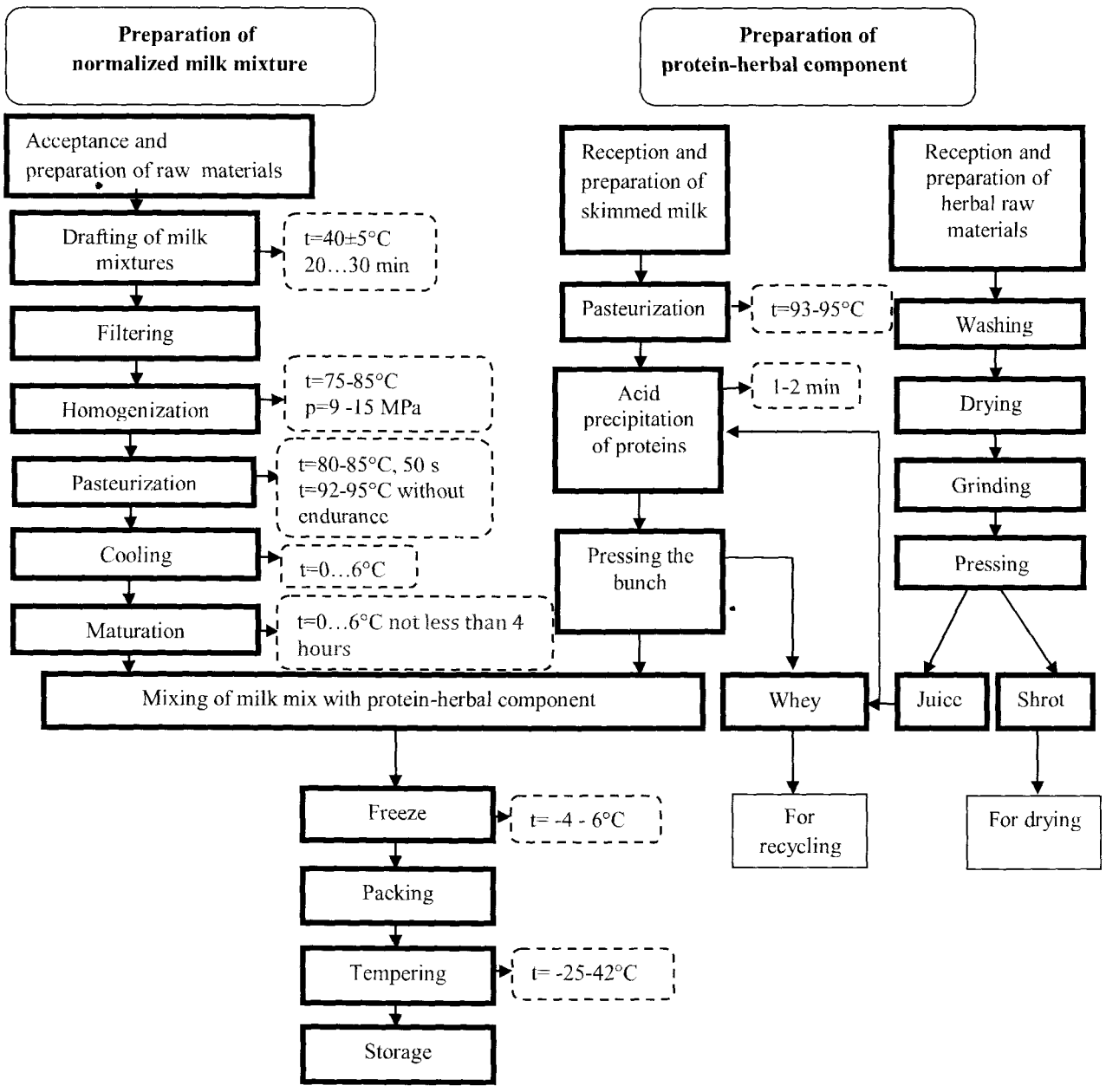

Fig. 2. Parametric scheme of production of frozen dessert with protein-herbal component

method M.P. Chernikov [9]. It is based on the postulate that the assimilation of EAA is limited to limiting content amino acids that is, the KDAF is the average arithmetic excess of the EAA amino acid accelerator compared to the smallest limit of limiting amino acids. KDAF are found by the formula:

$$KDAF = (\Sigma DAF) / n, \quad (2.2)$$

where KDAF - coefficient of difference of an amino acid,%;

DAF is the difference in the amino acid rate for each NAC compared with the amino acid soon limiting amino acids, %;

n - the number of amino acids.

The smaller the value of KDAF, the more is fully used by EAA for the needs of biosynthesis. So the biological value of the protein is calculated by the formula:

$$BV = 100 - KDAF, \quad (2.3)$$

where BV - biological value of protein,%.

3. Results and discussion

The basis of the technology of a new kind of frozen dessert is the classical technological scheme ice cream Preparation of a normalized mixture for ice cream (scheduled figures: mass the share of fat - 3.5%, the skimmed milk powder balance - 12%, sugar - 14%). Preparation of PHC with a mass fraction of moisture 64% was made as follows: mixing of normalized milk base and PHC in ratio 80:20. The limitations of adding protein-herbal component are as specific organoleptic characteristics and color, and pH at the level of 5.4 ... 5.7.

The ground part of Rumex was used to get the protein-herbal clot as a coagulant with a thermo & heat coagulation [10, 11].

The obtained protein-herbal component had the following qualitative indices: the mass fraction of moisture at the level (64 ± 2)%; titrated acidity (80 ± 1) °T; color - light pistachio, not uniform; consistency – soft slightly broken on the cut, as tight as it is; taste, milk-protein, cheesy, without foreign smells, with light herbal flavor. After maturation, the milk base was mixed production. Technology of production of frozen dessert with protein-herbal component was carried out in three stages. Technological scheme of production is shown in Fig. 2.

with protein-herbal component in the ratio of 80:20%. It is expedient to carry out this operation immediately before the freeze of the mixture. It provides admission to the free homogeneous mixture, without increasing the titrated acidity.

Organoleptic and physico-chemical parameters of freshly prepared samples of frozen dessert from protein-herbal component are given in Tables 1 and 2.

It is known that the biological value of a product depends on the quality of the proteins that are part of the raw materials ingredients and are characterized by the content of essential amino acids. To study the biological value of the developed dessert, its amino acid composition was determined. Samples were studied for protein-herbal component, milk ice cream (control) and frozen dessert with PHC. The results of research on the amino acid composition of these samples are showed in Table 3.

Table 1

Organoleptic characteristics of frozen dessert with protein-herbal component

Indicator	Characteristics of a frozen dessert
Taste and smell	Pure, delicious sour-milk taste with a light herbal flavor, no foreign smells
Structure and consistency	Homogeneous throughout the mass, delicate creamy
Color	Light pistachio

Table 2

Physico-chemical parameters of frozen dessert with protein-herbal component

Characteristic	Indicator rate
Mass fraction,%, not less: fat / sugar / dry matter	3.5/14.0/29.5
Acidity, ° T	45
Active acidity, pH	6.15
Damage, %	52
Resistance to melting, min	43

It was revealed (Table 3) that the total content of amino acids of frozen dessert in comparison with protein-herbal component has decreased, as frozen desserts contain more carbohydrates and less amount of protein. The calculation of the amino acid rate of the essential amino acids was carried out on the basis of the obtained data It was found that the limiting amino acid in milk ice cream is methionine + cysteine, and for groups of experimental samples of protein-herbal component and

Table 3

Amino acid composition of protein-herbal component and frozen desserts

The name of the amino acid	PHC		milk ice cream		frozen dessert with PHC	
	mg/100g	% to the total	mg/100g	% to the total	mg/100g	% to the total
lysine	752.393	9.07	161.707	7.36	301.4922	8.82
histidine	327.7321	3.95	57.105	2.60	119.9816	3.51
arginine	377.5142	4.55	59.318	2.70	109.0431	3.19
aspartic acid	365.8984	4.41	157.169	7.15	219.1117	6.41
threonine	315.2866	3.8	105.477	4.80	135.3638	3.96
serine	270.4827	3.26	129.391	5.89	131.9456	3.86
glutamic acid	1749,011	21.08	471.154	21.43	726.7261	21.26
proline	513,5852	6.19	287.500	13.08	310.7216	9.09
glycine	92,09687	1.11	48.320	2.20	45,80494	1.34
alanine	233.1461	2.81	82.540	3.75	125.7927	3.68
cysteine+	274,6312	3.31	11.667	0.53	63.92182	1.87
valine	588,2584	7.09	117.000	5.32	216.7189	6.34
methionine	269.653	3.25	49.434	2.25	83.74784	2.45
isoleucine	301.1816	3.63	95.469	4.34	141.8586	4.15
leucine	1011.406	12.19	219.715	9.99	389.342	11.39
tyrosine++	314.4569	3.79	42.843	1.95	86.14063	2.52
phenylalanine	540.1357	6.51	102.785	4.68	210.566	6.16
total Amino Acid	8297.015	100.00	2198.595	100.00	3418.279	100.00

frozen dessert - threonine (Table 4).The amino acid rate of each amino acid does not give a general idea of the biological value of the product. To evaluate the degree of use of the protein was calculated by the coefficient of difference of the amino acid AF (KDFA) and biological protein value (BV) by the method of M.P. Chernikov [9]. All the excess amino acids are used by the body for energy needs, not by protein biosynthesis. KDFA is an arithmetic mean of AF essential amino acids relative to the AF of the limiting amino acid. Differences of amino acid AF essential amino acids of the experimental samples are presented in Fig.3.

Table 4

Amino acid rate of protein-herbal component and frozen desserts

The name of the amino acid	Standard FAO / WHO, g / 1 g "essential protein"	Amino acid AF, %		
		PHC	milk ice cream	frozen dessert with PHC
lysine	5.5	165	134	160
threonine	4	93	120	99
methionine + cysteine	3.5	187	79	123
valine	5	142	106	127
isoleucine	4	95	108	104
leucine	7	174	143	163
phenylalanine+ tyrosine	6	172	111	145

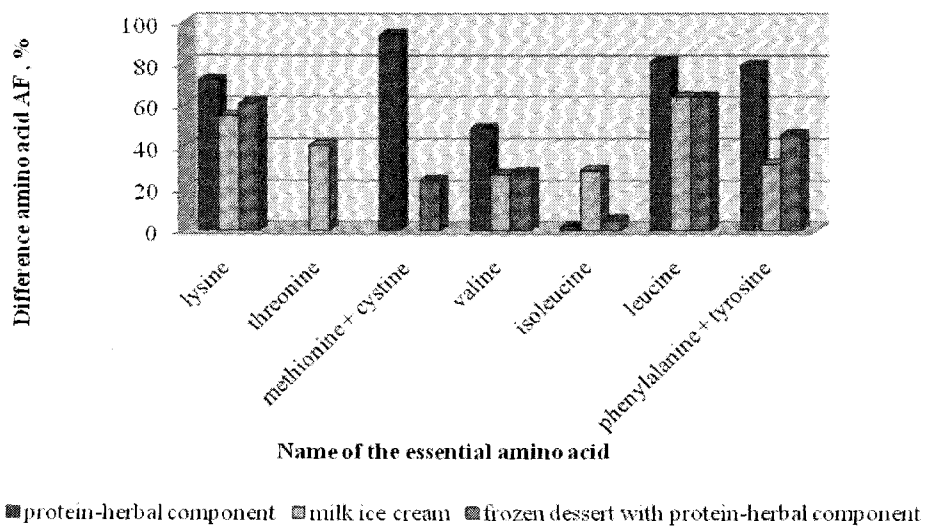

Fig. 3. Difference of amino acid AF essential amino acids of the experimental samples

According to Fig. 3, the maximum excess, characteristic of protein-herbal component, provides methionine + cysteine, and samples of dessert - leucine. The smaller the value of KDFA, the more fully is used by the EAA for the needs of biosynthesis. The determination of biological value (BV) was carried out through the coefficient of difference of the amino acid AF:

$$BV = 100 - KDFA, \%$$

The relevant indicators are presented in Fig. 4.

It was revealed (Fig. 4) that the introduction of the frozen dessert PHC in the amount of 20% will not allow only to enrich the product with whey proteins, but also to increase its biological value to 62%.

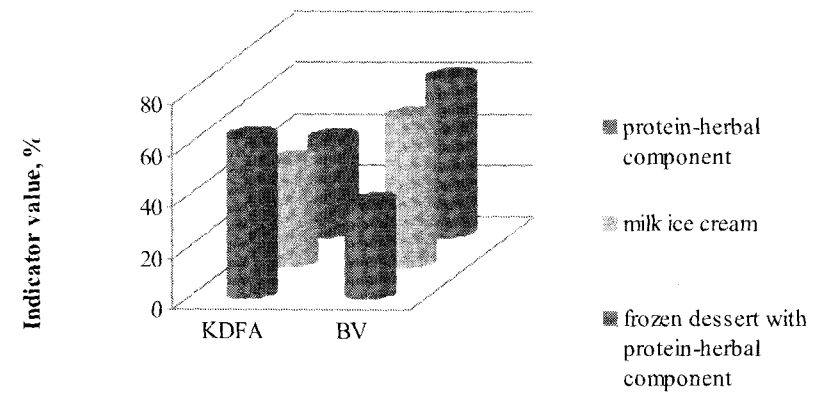

Fig. 4. Indicators of biological value of experimental samples

The technology of the frozen dessert with the natural biologically complete protein-herbal component is used to bring the composition of the product closer to the optimal ratio of the main nutrients. The development can be implemented in dairy enterprises, restaurants, shops of low capacity with periodic action freezers.

4. Conclusions

1. The authors established a rational ratio of the normalized mixture for milk ice cream and protein-herbal component at the level of 80:20, which ensures the receipt of the product with the corresponding organoleptic and physico-chemical indicators with high nutritional and biological value.
2. The technology of frozen dessert with PHC is developed, which involves the introduction of protein enrichment in cooled, normalized basis after ripening at a temperature of 0 ... 6 °C for at least 4 hours, directly before freezing.
3. The chemical composition of the developed frozen dessert determines the high digestibility level of all nutrients, which is a particularly valuable characteristic of food. We found that the introduction into the composition of ice-cream protein enrichment will increase the biological value of ice cream by 3.33%. Consequently, the inclusion of a frozen dessert with protein-herbal component to a diet for adults and children is promising. Its consumption will contribute to the daily physiological needs for basic nutrients and energy.

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