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ИССЛЕДОВАНИЕ ХИМИЧЕСКОГО СОСТАВА И БИОЛОГИЧЕСКОЙ ЦЕННОСТИ ПОЛУФАБРИКАТА НА ОСНОВЕ ОБЕЗЖИРЕННОГО МОЛОКА С ЭКСТРАКТОМ КОРНЯ СОЛОДКИ

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Аннотация. В статье представлено одно из направлений решения проблемы полного и рационального использования продуктов переработки молока, реализации принципов безотходной технологии переработки сырья, разработка технологии нового пищевого продукта с полным использованием компонентов молочного сырья. Такие принципы позволят не только рационально использовать вторичное молочное сырье, но и приводят к энергосбережению, минимальным трудовым и финансовым затратам для обеспечения технологических процессов. Рассмотрены результаты исследований по разработке полуфабриката на основе обезжиренного молока и экстракта корня солодки, его химического состава и биологической ценности. Доказаны возможность и преимущества использования данного полуфабриката на предприятиях ресторанного хозяйства, а именно, расширение ассортимента продукции, повышение ее качества, снижение стадийности технологического процесса, затрат на транспортировку и хранение сырья, улучшение санитарного состояния и работы предприятия в течение года, решения проблемы недополучения белковых веществ в питании населения.

Ключевые слова. Биологическая ценность, полуфабрикат на основе обезжиренного молока, экстракт солодки, аминокислоты

CHEMICAL COMPOSITION AND BIOLOGICAL VALUE ANALYSIS OF SEMI-PRODUCT FROM SKIMMED MILK WITH ADDITION OF LICORICE EXTRACT

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Abstract. This article presents a solution for problem of complete and efficient use of milk derived products, implementation of wasteless processing technology principles for raw materials, development of new food product technology with complete use of milk raw material components. Such principles will allow efficient use of secondary milk raw materials and also will lead to energy saving, minimal labor and financial costs in technological process assurance. The research results for development of semi-product on the basis of skimmed milk with addition of licorice extract, its chemical composition and biological value are considered. Possibility of usage of this semi-product at restaurants, as well as benefits of such usage are proved, in particular as follows: diversification, increasing of products quality, diminishing of technological process stages amount, diminishing of raw materials transportation and storage costs, improvement of sanitary condition and operation of an enterprise within a year, solving the problem of shortfall of protein substances in population nutrition.

Keywords. Biological value, semi-product from skimmed milk, licorice extract, amino acids.

Introduction. Having analyzed up-to-date conditions of human life and activities, it is possible to reach a conclusion that decreasing of physical activity, stresses, nervous and emotional tension, unhealthy ecology and many other factors adversely affect health of population. As a result of overload, relevant protection systems of an organism are not able to neutralize environmental adverse factors and this dramatically increases pathogenic risk. Currently some concern is caused by nutritional imbalance of population Donetsk People's Republic, especially of problem areas inhabitants. Their dietary intake shows significant shortfall in vitamins, microelements and other essential nutrients.

Nowadays it is an important task for restaurants Donetsk to implement products with high biological value into dietary intake of population. This requires searching of new ingredients and development of advance food technologies with their further employment. That is why choosing ingredients for food products (having

relevant technological properties and providing complete proteins, vitamins, macro- and microelements) emerges full blown in this context.

Aiming to provide the population with valuable, accessible and safe food products, researches and scientific work intended to creation of new types of dairy products are carried out intensively. Carbohydrate-protein milk raw materials are used for such products development since they contains considerable amount of substances of high physiological significance in terms of human's body biological needs. One of the ways to use milk raw materials is development of technology of sweet dishes and desserts with foamy structure.

Though, due to peculiarities of functional and technological properties of ingredients included in recipes, structure-formers being used are not always reasonably foam-forming, their foam stability is sometimes insufficient, amount of complete proteins is limited.

The most promising direction is usage of high molecular foam-formers – proteins and saponins. They are able to create strong elastic double-ply absorption layers on the phase separation borderline. These layers stipulate for high stability of the system formed on their basis [1]. Development of food products technology which uses plant-derived saponins will allow effective usage of local and nontraditional plant raw materials. It will contribute to diversification of baby food products, dietary and therapeutic food products, as well as creation of products with longer storage term, higher quality and improved structure.

This problem may be solved by dint of creation of semi-product on the basis of skimmed milk with addition of licorice extract. Such semi-product is expected to speed up technological process, to have higher nutrition and biological value, to be easy-to-use, to facilitate prolongation of product storage term. According to the above-mentioned, semi-product technology was developed. This product is made from skimmed milk with addition of licorice extract in the form of dry mix which is highly concentrated system with humidity of 4 ... 5 % and having certain functional and technological properties [2].

Objective of this work is analysis of chemical composition and biological value of developed semi-product.

To calculate specific weight of humidity, the method of drying sample to constant weight was used.

Specific weight of ash was calculated by dint of commonly used weight method after sample mineralization in muffle furnace at 500-600^{0}C.

Sugar content was measured according to GOST 8756.13-87.

Chemical composition of semi-product, in particular content of crude protein, crude fat, and solids was determined automatically in one sample by dint of instrument Bentley – 150 according to ISO 9001:2000. Determination of nitrogen content by dint of this instrument is carried out using Kjeldahl method [3]. At this, the sample is automatically weighted, burned in concentrated sulfuric acid, cooled and diluted with distilled water, acid is neutralized, ammonia is distilled and its water solution is titrated with acid. Amount of acid used for titration is proportional to content of protein nitrogen in the sample. To evaluate nitrogen in crude protein, coefficient of evaluation (typical of milk products) equal to 6.38 was entered into the instrument memory.

Amino acid content of semi-product protein was analyzed by dint of amino acid analyzer AAA-339M. Quantitative test for tryptophan was carried out separately after Graham alkaline hydrolysis.

Balance level of key amino acids was determined by dint of comparison of their score with standard protein, suggested by FAO/WHO [4].

Specific weight of carbohydrates was determined in accordance with the methodology of physiological and biochemical research techniques in biology, live stock breeding and veterinary medicine.

Research of content of such microelements as copper (GOST 27995-88), manganese (GOST 27997-88), zinc (GOST 27996-88), iron (GOST 27998-88), lead and cadmium (DSTU 30823-2002) was carried out by dint of spectrophotometry using atomic absorption spectrophotometer AAS-30.

Toxic substances was detected through common methods according to GOST 26929-94, GOST 26930-86, GOST 26931-86, GOST 26932-86, GOST 26933-86, GOST 26934-86.

Vitamin content was determined using the following methods. Specific weight of vitamin A was determined using photoelectric colorimeter according to DSTU ISO 14565:2004. Content of vitamins B_1 (DSTU 4482:2005), B_2 (DSTU 4687:2006), PP, C and ascorbic acid was determined using fluorometer EF-3MA.

Microbiological quality evaluation was carried out through detection of presence and amount of microorganisms in Kirovska regional sanitary-epidemiological station of the city of Donetsk for the purpose of establishing correspondence with DSP 4.4.5.078-2001.

Considering previous researches and experience of domestic and foreign scientists, a process flow diagram for manufacturing of semi-product on the basis of skimmed milk with addition of licorice extract was developed for manufacturing sweet dishes with foamy structure.

The semi-product is manufactured in the following way. Structure-former of microbial origin biopolymer xanthan gum is dissolved in a part of prepared skimmed milk for swelling at 40…45^{0}C during 10·60 sec at water duty of 1 : 4. Then licorice extract is added and dispersed during (6…10)·60 sec, ω = (200…220)·60 sec^{-1}, dried at 60^{0}C to moisture content 5%. Such drying temperature is efficient for maximum preserving of key amino acids in proteins. When exceeded, the reaction of melanoidin formation is caused, as

well as undesired change of color. Temperature decreasing causes slowdown in drying process which leads to additional energy expenditures. After this, mixture is cooled to 15…20^{0}C. Obtained semi-product is pre-packed, packed and transported to a place of supply. Semi-product is stored at 16...17^{0}C and air humidity not more than 75% for 12 months.

Developed semi-product is dry powder mixture, without foreign additions, having milk sweet flavor, solids content - 96…95%, high organoleptic properties. Semi-product is easily reconstituted and after this the compound has properties typical for it prior being dried. Speed and completeness of dissolution of the semi-product depends on the product properties, reconstitution method and mode, type and parameters of environment, in which reconstitution takes place.

According to the up-to-date nutrition principles, products must contain wide range of ingredients necessary for a human's organism, as well as must be balanced in terms of nutrition and biological value.

Chemical composition analysis was carried out for the semi-product on the basis of skimmed milk with addition of licorice extract. Research data are presented in the Table 1.

Table 1 **-** Chemical Composition of the Semi-product, (X±m, m ≤0,05)

Test Type, UOM	Test Results
Moisture, %	4.77
Protein, %	24.75
Fat, %	1.25
Carbohydrates (nitrogen-free extractive substance), %	61.75
Fiber, %	0.30
Ash, %	7.67

Table data show that the semi-product has high content of protein substances which is very important in terms of satisfying of body needs in complete proteins.

As far as the semi-product on the basis of skimmed milk with addition of licorice extract has high protein concentration, amino acid content requires research as presented in the Table 2.

Table 2 **-** Amino Acid Content of the Semi-product Proteins, (X±m, m ≤0,05)

Amino Acid	Test Results		
	for natural substance, mg/100 mg	for protein, mg/g	% to Σ of amino acids
Key amino acids:	7.92	320.00	37.31
threonine	1.01	40.81	4.76
valine	1.22	49.29	5.75
methionine	0.80	32.32	3.77
isoleucine	1.07	43.23	5.04
leucine	1.58	63.84	7.44
phenyl alanine	0.78	31.52	3.67
lysine	1.25	50.51	5.89
tryptophan	0.21	8.48	0.99
Nonessential amino acids:	13.31	537.78	62.69
aspartic acid	1.74	70.30	8.20
serine	1.96	79.19	9.23
glutamine	3.34	134.95	15.73
proline	1.16	46.87	5.46
glycine	0.75	30.30	3.53
cystine	0.83	33.54	3.91
alanine	0.81	32.73	3.82
tyrosine	1.09	44.04	5.13
histidine	0.75	30.30	3.53
arginine	0.88	35.56	4.15
Total amount of amino acids	21.23	857.78	100

Research results prove that there are eighteen amino acids detected in the semi-product proteins, including all key amino acids. Biological value analysis for developed semi-product was carried out according to calculation of amino acid score of the semi-product proteins, as presented in the Table 3.

Table 3 - Amino Acid Score of the Semi-product Proteins

Amino Acid	Content of protein, recommended by FAO/WHO, mg/g	mg/1 g of protein	Amino Acid Score
Lysine	55	125	113.50
Threonine	40	101	126.10
Valine	50	122	122.00
Methionine + cystine	35	163	232.85
Isoleucine	40	107	133.75
Leucine	70	158	112.85
Phenyl alanine + tyrosine	60	187	155.85
Tryptophan	10	21	105
KPAC, %	32.73		
BV, %	67.26		

Considering absence of limiting amino acids, it is possible to make a conclusion that amino acid score of the semi-product score satisfies body needs in key amino acids. Indicators of protein biological value are almost in the same range and this speaks for their high biological value. Therefore, developed semi-product may be referred to high-protein, complete and sufficiently balanced products in terms of amino acid content.

Having analyzed data from the Table 4 it is possible to reach a conclusion that in general amino acid composition of the semi-product proteins is sufficiently balanced according to tryptophan and threonine indexes.

It is worth to mention, that developed semi-product is distinguished by high content of all other basic, necessary for human's body nutrients, in particular calcium (127 mg/100 g), potassium (123 mg/100 g), phosphor (97 mg/100 g) and iron (33.8 mg/kg). The ratio of calcium to phosphor is 1 : 1.5, calcium to magnesium – 1 : 0.5, calcium to phosphor to magnesium – 1 : 1 : 0.5.

Obtained results show that the ratio of macro- and microelements in the semi-product is optimal for calcium assimilation.

The vitamin content analysis showed that developed semi-product contains sufficient amount of ascorbic acid (4.1 mg/100 g), riboflavin (1.8 mg/100 g), niacin (1.2 mg/100 g), carotin (9.2 mg/100 g), vitamin K (1.9 mg/100 g) and others.

The results of microbiological research show that the values do not exceed acceptable hygiene and sanitary conditions and correspond to the requirements of current MBT and DSP 4.4.5.078-2001 and this confirms high quality of developed semi-product and possibility of its implementation into restaurants. In other words, on the assumption of adherence to the sanitary and hygiene requirements concerning compliance of raw materials and manufacturing process with regulations requirements, upon controlled terms and conditions of storage, there are no microorganisms of sanitary indicator, opportunistic groups and pathogenic organisms groups in developed semi-product. Amount of microorganisms of deterioration group and amount of mesophilic, aerobic and optionally anaerobic microorganisms does not exceed acceptable content level during 12 months. Moreover, in storage of developed semi-product, organoleptic, physical and chemical indicators did not change substantially.

On the basis of carried researches it is possible to recommend storage period for semi-product of 12 months at 16…17 °C and air humidity not more that 75% in vacuum package.

Therefore, developed semi-product is characterized by high content of protein substances (24.75%) at low fat content (1.25%). Protein of developed semi-product is balanced by its amino acid content: part of key amino acids amounts to 7.92%, it is well balanced according to tryptophan and threonine indexes. Semi-product contains sufficient amount of ascorbic acid, carotin, vitamins PP and K, as well as the following minerals: calcium, potassium, phosphor and iron.

By microbiological indicators and content of heavy metals, semi-product made of skimmed milk with addition of licorice extract complies with the requirements of current MBT and SN 5061-89. Storage period for the developed semi-product is 12 months at 16…17°C and humidity not more than 75%, which do not lead to significant changes in quality indicators. This allows to recommend it for consumption within this period.

Usage of developed semi-product in technologies of sweet dishes with foamy structure will allow not only to decrease production space and energy resources, but also to improve quality of finished products, to give more attractive look and structure at manufacturing of healthy food products of high quality in modern economically unstable circumstances, as well as to solve problem of shortfall in protein supply in population nutrition.

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