ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Innovative Approaches To The Development Of New Food Products Based On Secondary Raw Materials Of Animal Origin.

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ABSTRACT

This article presents the development of new functional products with the use of extracts from raw materials of plant origin, containing many biologically active components. Of particular interest is the production of protein-containing drinks, while along with traditional milk drinks, products using the blood plasma of slaughter animals deserve special attention. This article contains the results of a study on the possibility of using hydrolyzed blood plasma as an extractant in obtaining the bases for the production of functional beverages. The modes of carrying out the extraction and the amount of dry substances passing from the plant raw material to the extract are specified. The organoleptic indicators of the bases obtained for the production of beverages, their amino acid, vitamin and mineral compositions, were studied, and the relative biological value was estimated.

Keywords: functional drinks, extraction, blood plasma, plant extracts.

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ISSN: 0975-8585

INTRODUCTION

Drinks are excellent objects for the enrichment of biologically active components, acquiring the ability to provide an effective preventive and health effects on the human body.

The development of functional beverages with the use of extracts from raw materials of plant origin, containing many biologically active components, remains the most promising direction in the creation of healthy foods. Inclusion in the composition of drinks of plant extracts with antioxidant properties has a tonic effect on the body, increases the adaptability of the nervous system and the body's resistance to adverse external factors. Technological methods of processing plant materials allows to obtain extracts and concentrated bases containing protein components, products of hydrolysis of non-starch polysaccharides, and bioactive substances.

Of particular interest is the production of protein-containing drinks, while along with traditional milk drinks, drinks based on the blood plasma of slaughter animals deserve special attention. This secondary raw materials of animal origin, characterized by the full value and high digestibility of proteins that make up its composition, finds its application in the manufacture of food, medical, feed and technical products. Plasma-based drinks do not contain any indigestible or hardly digestible nutrients, have a low calorie content and can be used for disorders of protein metabolism, digestive functions, recommended for postoperative patients, children, and elderly people [2, 4, 5].

In addition, the deep processing of secondary protein raw materials from the meat industry will not only find an additional source of high-quality animal protein, but also reduce the discharge of slaughtered blood into sewage systems, thereby reducing the environmental burden on the environment [6].

The purpose of the work is to study the feasibility of using blood plasma of slaughter animals for the production of plant extracts as a basis for the production of functional beverages.

MATERIALS AND METHODS

The studies were conducted in the conditions of the laboratories of the department of production technology and processing of agricultural products of the Stavropol State Agrarian University.

As objects of research, peppermint, carcade, lentils, chickpeas, hydrolyzed blood plasma and extracts obtained on its basis were used.

Hydrolyzed blood plasma of farm animals was obtained by pretreatment with collagenase enzyme preparation in accordance with the developed recommendations: the protein concentration in the system was 4.0–4.5%, the concentration of the enzyme preparation in the system was 0.37% (with an activity of 900 units PA / g), the temperature of the hydrolysis is 37-42 °C, the pH of the system is 6.6-7.1, the duration of hydrolysis is 2.5 hours, the degree of hydrolysis of plasma proteins is about 82%. This treatment allowed to increase the temperature of extraction, providing a more complete extraction of extractive substances and increase the digestibility of the extract - the basis for the production of beverages [1].

Plant material was used in the amount of 2.5 g per 100 ml of hydrolyzed animal blood plasma.

In the course of the research, the main indicators were determined by the following methods: protein content - by the Kjeldahl method; fat - soxhlet method; carbohydrates - by Bertrand method; mineral composition - spectrophotometrically according to GOST R 55484-13; vitamin composition - on the LCMS-10EV liquid chromatograph according to the instructions; amino acid composition - on the AAA-400 amino acid analyzer by standard methods; amino acid fast and biological value - by calculation method according to N.N. Lipatov [3].

The studies were conducted in triplicate, with the subsequent processing of the results obtained by standard statistical methods in the program Microsoft Office Excel 2007.

ISSN: 0975-8585

RESULTS AND DISCUSSION

It is known that the amount of extracted substances is directly related to the degree of grinding of the material and temperature regimes. In this regard, it was decided to chop the caracada and peppermint to a particle size of 1-3 mm with a characteristic lamellar form. The designated grinding degree provides the minimum amount of dust particles and is best for carrying out the extraction. The temperature range of extraction was in the range of 60–70 °C, since the temperature of the hydrolyzed plasma shifted to higher values led to a clouding of the system and a flocculent precipitate due to protein denaturation. The effectiveness of the experiment factors was evaluated by quantitative change in the mass fraction of dry substances in the extraction system.

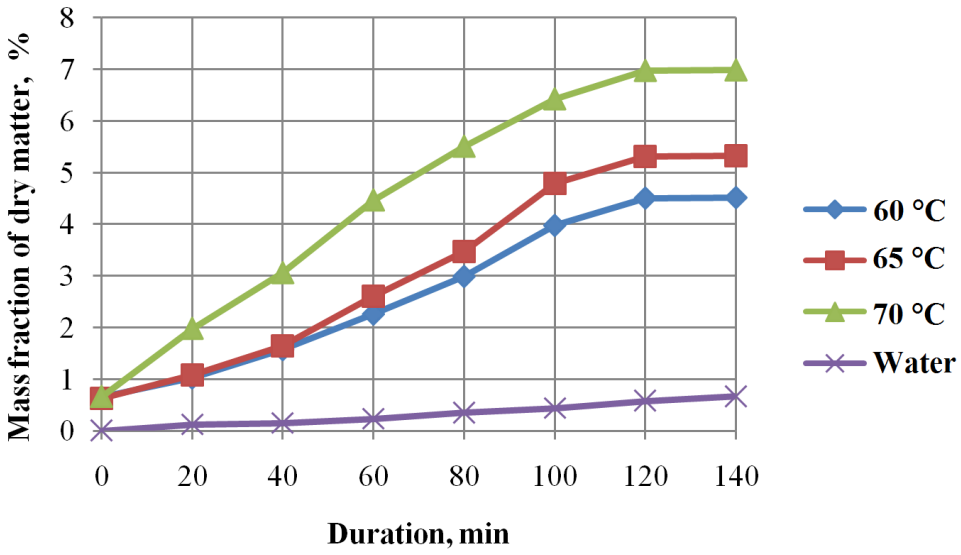

Figure 1: Dynamics of extraction of dry substances of peppermint hydrolyzed blood plasma in the temperature range of 60 - 70 °C

The graph in Figure 1 shows that the mass fraction of dry substances in the extract is directly dependent on the time of extraction, and the highest value is achieved at a shutter speed of 120 minutes.

As a control experiment, extraction was performed in parallel with water at a temperature of 70 °C. As a result, it was found that under identical conditions, biomodified plasma is a significantly better extractant.

The minimum concentration of extractive solids in hydrolyzed plasma at 60 °C is 4.6%, which is about 10 times higher than the result of the water system (0.5%). An increase in the temperature of the "hydrolyzed blood plasma-peppermint" system to 65 °C led to an increase in the dry matter extracted from the raw materials to 5.3%, which is 11 times higher than this indicator when using water. A further increase in the temperature of extraction to 70 °C was characterized by an increase in the solids content to 7.0%, which is 14 times higher than the similar indicator of the "water - peppermint" system.

Thus, the highest content of extractive substances in the system "hydrolyzed blood plasma-peppermint" is observed when kept for 120 minutes at a temperature of 70 °C. At the same time, the use of water as an extractant could not provide a solids content above 0.6%, even with an increase in exposure time to 140 minutes.

Further, by analogy, studies were conducted on the conditions for extraction of solids from the carcade (Figure 2).

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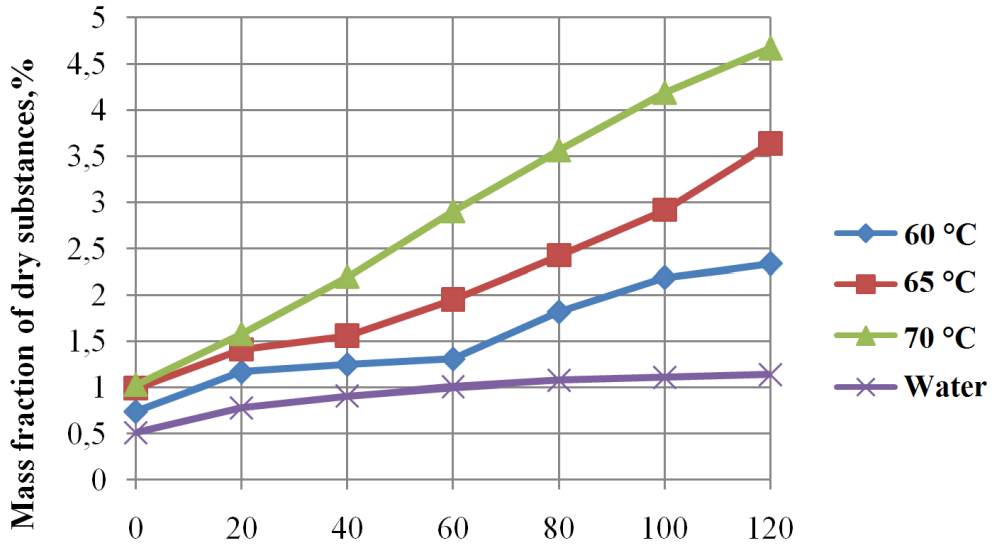

Figure 2: Dynamics of extraction of dry substances by carcade of hydrolyzed blood plasma in the temperature range of 60 - 70 °C

Experimental data presented in Figure 2 confirms the validity of the established dependence of the efficiency of extraction of dry substances on the exposure time for the water system, and for hydrolyzed plasma. The peculiarities of the chemical composition and properties of the carcade as a raw material led to a slightly better efficiency of aqueous extraction in comparison with mint, and somewhat less in experiments with hydrolyzed plasma.

The minimum proportion of extractives for hydrolyzed blood plasma at 60 °C is 2.4%, which is 3 times higher than when using water. At the same time, as in the previous experiment, the best results of the extraction with hydrolyzed blood plasma were achieved at a temperature of 70 °C and a holding time of 120 minutes, at which the mass fraction of dry substances was 4.6%.

Blood plasma hydrolyzate consists of more than 90% of water, but the presence in it of a significant amount of protein components, which are surface-active substances, significantly changes its properties as a solvent. Presumably, the present surfactants activate the extractability of dry substances, increasing their transition to the liquid phase of the system, and, at the same time, affect the permeability of the solid phase. Probably, this can explain the significantly higher extraction ability of the blood plasma hydrolyzate of slaughter animals in comparison with water.

Further studies were related to the study of the efficiency of hydrolyzed blood plasma extraction of the components of proteinaceous plant raw materials - chickpea and lentils. In order to avoid denaturation of proteins of raw materials, the temperature factor was studied in the range of 45-55 °C. Extrapolating the pattern of previous experiments and on the basis of preliminary studies, the maximum permissible extraction temperature of 55 °C was chosen for the study. The interval of the system exposure factor ranged from 20 to 120 minutes. The conducted studies allowed to establish that the greatest degree of extraction of dry substances is achieved at an extraction time of 100-120 minutes (Figure 3).

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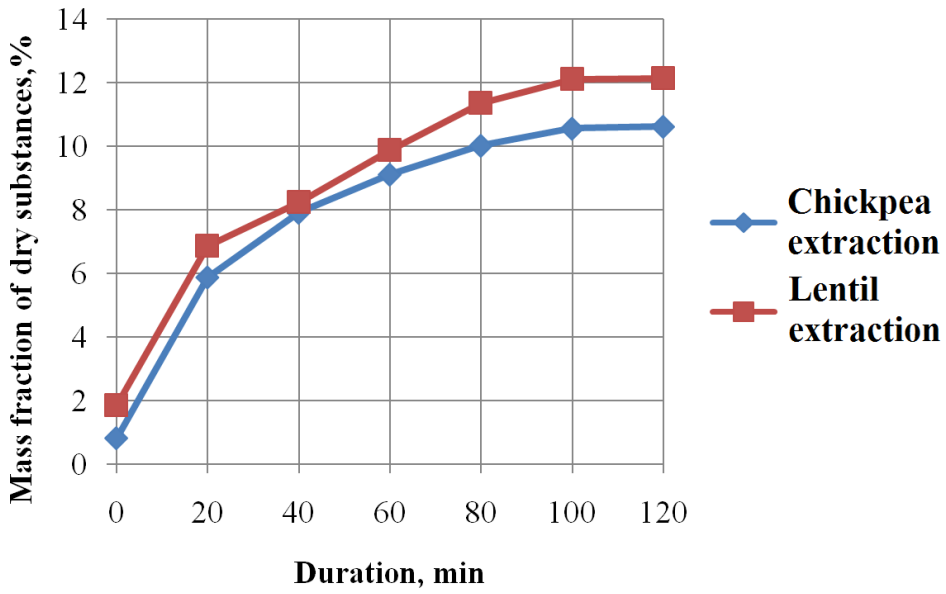

Figure 3: Dynamics of extraction of dry substances of chickpea and lentils by hydrolyzed blood plasma of farm animals at 55 °C

The results of the experiment made it possible to establish that at 55 °C and a holding time of at least 100 minutes, the mass fraction of extractable dry substances was 10.4% for chickpea and 12.0% for lentils. This exceeds the same indicator at a temperature of 45 °C by 12 and 5%, respectively.

The use of such an unconventional extractant as hydrolyzed blood plasma certainly requires the study of the organoleptic parameters obtained for the production of beverage extracts (Table 1).

Table 1: Results of the evaluation of organoleptic characteristics of extracts based on hydrolyzed blood plasma of slaughter animals

Indicators	Peppermint Extract	Carcade Extract	Chickpea extract	Lentil Extract
Taste	Cooling, refreshing	Sweet and sour	Sweet	
Appearance	There is an insignificant amount of sediment or suspension characteristic of the product.			
Aroma	Mint	Weak floral	Light bean flavor, characteristic of the raw materials used	

Evaluation of organoleptic indicators showed that the extracts obtained can be used to prepare drinks, however, the taste characteristics will require some adjustment due to the addition of additional flavor ingredients.

The obtained extracts for reasons of improving their usability and storage capacity were further dried on a spray dryer. The solubility of the obtained dry product is not less than 97%.

The obtained dry extracts were subjected to a thorough qualitative and quantitative study of the composition. It is difficult to overestimate the role of vitamins in the course of metabolic processes in the human body, ensuring normal metabolism and maintaining homeostasis. Avitaminosis inevitably leads to violations of all processes and functions of the body, undermining human health. In this regard, we investigated not only the chemical composition, but also the content of vitamins and minerals in the extracts (table 2).

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Table 2: Results of a study of the composition of dry plant extracts based on blood plasma hydrolyzate

Indicators	Lentils	Chickpea	Karkade	Mint
Protein,%	20,01	19,72	7,01	6,83
Lipids,%	0,50	1,02	-	-
Carbohydrates,%	18,23	15,03	11,25	15,05
Minerals and vitamins, mg%				
Sodium (Na)	23,82	25,81	18,23	32,05
Potassium (K)	504,34	752,06	7,31	3,14
Calcium (Ca)	56,83	80,40	25,11	40,67
Phosphorus (P)	212,84	276,30	94,48	72,18
Iron (Fe)	11,34	1,89	1,12	1,25
Magnesium (Mg)	72,65	86,37	34,00	29,60
Retinol (A)	0,004	0,007	0,013	0,042
Thiamine (B1)	0,053	0,062	0,053	0,361
Riboflavin (B2)	0,041	0,057	0,289	0,236
Pyridoxine (B6)	0,008	0,012	0,009	0,005
Cyanocobalamin (B12)	0,011	0,023	0,023	0,013
Ascorbic acid (C)	2,781	2,067	23,346	7,832
Tocopherol (E)	6,257	7,812	5,786	4,739
Calciferol (D)	0,008	-	-	-
Niacin (PP)	0,058	0,065	0,052	0,065

The research results showed that the dry product contains a significant amount of proteins, vitamins E and C (which have a pronounced antioxidant effect and are deficient in the diets of most people) and mineral components, in particular potassium and phosphorus, and are recommended for the production of functional beverages.

The human diet should contain essential amino acids not only in sufficient quantities, but also their ratios in total protein and the timing of intake are important. It is these conditions that ensure the normal course of protein synthesis processes.

The amino acids such as tryptophan, methionine and lysine are considered the most deficient in human nutrition. In this regard, the quality of the protein in the diet is most often assessed precisely by its saturation with these essential amino acids.

Amino acid analysis of the obtained plant extracts (table 3) led to the conclusion that they have a high biological value due to the high content of essential amino acids, including the most scarce ones.

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Table 3: Results of the analysis of the amino acid composition of the obtained dry extracts of peppermint (1), carcade (2), chickpea (3), lentils (4)

Name of the amino acid	Amino acid content in FAO / WHO reference protein	Amino acid content in the product, g / 100 g				Amino acid score, %			
		1	2	3	4	1	2	3	4
Isoleucine	0,40	0,23	0,31	0,40	0,85	57,5	77,5	100,0	212,0
Valin	0,50	0,27	0,29	0,98	1,04	54,0	58,0	196,0	198,0
Methionine + cystine	0,35	018	0,19	0,63	0,59	51,4	54,3	178,0	168,0
Leucine	0,70	0,77	0,87	2,5	2,54	110,0	124,3	357,0	363,0
Lysine	0,55	0,60	0,65	2,00	2,02	109,0	118,2	364,0	367,0
Threonine	0,40	0,35	0,46	1,16	1,17	87,5	115,0	290,0	203,0
Tryptophan	0,60	0,11	0,14	2,11	2,37	110,0	98,3	352,0	395,0
Phenylalanine + tyrosine	0,10	0,68	0,59	0,36	0,34	113,0	140,0	360,0	340,0
Biological value,%	-	-	-	-	-	96,48	95,61	82,7	87,5

By calculation, it was established that the plant extracts under study have a high biological value, which confirms a good balance of amino acid composition.

The study of storage ability revealed the absence of pathogenic microflora in a dry product with a shelf life of up to 12 weeks at a temperature not higher than 4 °C. The indicator of the total microbial number remained in the range of 2.4×10^3 CFU in 1 g of the product.

The obtained plant extracts based on hydrolyzed blood plasma have a high biological value and can be recommended for use as a basis for the production of functional beverages.

CONCLUSION

Studies have shown that the use of hydrolyzed blood plasma of slaughter animals as an extractant of plant raw materials allows obtaining biologically valuable extracts characterized by a balanced amino acid composition, rich in vitamins and minerals, as well as acceptable organoleptic characteristics and persistence. Thus, they can be recommended as the basis for the production of functional beverages with high biological value.

ACKNOWLEDGEMENT

This research was made possible by a grant of the President Russian Federation #МК 2274.2017.11 and grant of the Russian Science Foundation # 15-16-10000, NIIMMP.

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