

Results of conducted experimental studies of the nutritional value of the developed dry soluble gerodietetic product for enteral nutrition are presented. Content of proteins, fats, and carbohydrates (22.8, 11.8, and 56.4 g/100 g of dry product, respectively) was determined and calorific value (422.8 kcal/100 g) and mass fraction of macronutrients in it were calculated (21.5/25.1/53.4 respectively). Their compliance with recommendations of specialists to satisfy nutritional needs of older people, in particular, those with increased physical and neuro-emotional loads, certain dysfunctions, somatic diseases, injuries, and recovering after them were analyzed and determined. Qualitative and quantitative amino acid composition of the product was studied, the rate of its essential and conditionally essential amino acids was calculated on its basis, coefficient of discrepancy of its amino acid composition was found (17.14 %) and biological value of the protein component (82.86 %) was calculated. Experimental studies of the vitamin value of the developed product and its elemental structure were carried out. The dry product has a fairly high content of vitamins (especially ascorbic acid, retinol, thiamine, pyridoxine) and mineral elements (potassium, calcium, phosphorus, magnesium, iron, iodine, selenium). Based on the obtained results, an average level of satisfaction of the daily need for the studied vitamins (on average within 14–41 %), mineral elements (mostly by 10–25 %) from consumption of 100 g of dry product in the prepared liquid state was calculated. The conducted studies have shown high nutritional value, in particular calorific and biological value of the product and conformity of its composition to the needs of the older age groups

Keywords: product for enteral nutrition, dry soluble product, gerodietetic purpose, nutritional value

NUTRITIONAL VALUE OF A DRY SOLUBLE GERODIETETIC PRODUCT FOR ENTERAL NUTRITION

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1. Introduction

The current demographic situation in the world is characterized by a significant rate of population aging. According to forecasts of the World Health Organization [1], the number of people belonging to older age groups will be ap-

proximately 20 % of the total population in 2025 and about 30 % in 2050. When analyzing this situation at the national level of European countries, it is worth noting that it is extremely relevant for many of these countries.

Physiological aging of the human body is characterized by gradual changes in its state, reduced productivity of

organs, worse general metabolism, and increased level of morbidity. The morbidity effect becomes especially noticeable for digestive, immune, nervous, cardiovascular, musculoskeletal (primarily joints) systems [2–4]. At the same time, it was found that it is expedient to exert influence upon the course and degree of these age-related changes using specially adapted diets [2, 3, 5]. For example, the satisfaction of nutritional and physiological needs which will take into account age will significantly improve the human life quality. This issue is especially important for people subjected to high loads, during treatment of diseases and injuries and recovery after them.

Based on analysis of current market trends, growing attention of the population to specialized dietary products for medical purposes was found not only during the treatment and recovery periods but also in everyday life [6]. The study [7] has found that a significant number of consumers including people from older age groups prefer choosing the food products of a certain specialized functional purpose.

It should be noted that satisfaction of nutritional needs for older age groups is especially important in cases of increased physical, nervous and emotional stresses, treatment of body dysfunctions, diseases, and injuries, and recovery after them. Consequently, the use of special products for enteral nutrition has become widespread in Western countries. Some product varieties are of namely gerodietetic purpose. The international market of such products is spreading widely. Its growth rate averaged about 10 % in the past five years [8]. According to the analysis of [6, 9] on the current state and trends in the market of products for enteral nutrition in many countries, including Eastern Europe, growth is constrained by high prices and difficulties in obtaining permits for foreign products. Almost a complete absence of national products is another cause of the inability to satisfy needs for this category of products in many countries [6].

2. Literature review and problem statement

The feature of the diet for older age groups consists in that it must take into account peculiarities of metabolic processes, physiological and age-related changes. A significant amount of scientific works is devoted to the study of the nutritional needs of elderly, senile, and long-lived people.

The author of [2] analyzed how important is to take into account the age-related changes by the food supply system, has studied features of providing rations with required nutrients, and presented recommendations for their optimal provision. Peculiarities of older people's needs for macro- and micronutrients, including during the treatment and recovery periods, are analyzed in [3]. Also, the issue of the influence of enrichment of rations with necessary plastic substrates, in particular, amino acids and antioxidants is considered in [3]. The study [5] analyzed the role and necessary conditions for meeting nutritional needs for healthy aging, identified recommendations for proper organization of nutrition, ensuring its nutritional value, in particular biological value.

Basic principles of appropriate satisfaction of needs for food substrates, their role in optimization of work of organism systems and bodies during aging were investigated and defined in [6]. The authors of [6] have developed recommendations for optimizing the body's functioning through a rationally organized diet in various conditions, in partic-

ular at increased stresses, dysfunctions, diseases, injuries, and recovery after them. Corresponding recommendations concerning rational maintenance of the protein/fat/carbohydrate ratio in food rations and its influence on physiological condition were investigated and developed in [7]. Also, results of the studies on optimization of required qualitative and quantitative ratio of nutrients, in particular in conditions of increased loads on the organism, are presented in [8]. The study presents results of determining the characteristics of nutritional needs in various physiological states of people of older age groups. The authors of [9] have analyzed the state of macro- and micronutrient intake in virtually healthy people and correlations between levels of nutrient intake and their impact on health.

Despite a large amount of scientific information and data on peculiarities of meeting the nutritional needs of the elderly, in particular, in loaded conditions, the development of enteral nutrition products for geriatric purposes is a rare and urgent task. It is especially important to study the nutritional properties of such products in order to meet the needs of the target population groups.

In connection with the identified problems of providing specially designed products of this group, a dry soluble product for enteral nutrition of gerodietetic purpose has been modeled, scientifically substantiated, and prepared on the basis of analyzed scientific information [2–10]. In order to determine the level of meeting the needs of the target category of consumers through consumption of the proposed product in a ready liquid form, it is advisable to study its nutritional value.

3. The aim and objectives of the study

The study objective implied assessing the nutritional value of the developed dry soluble product for enteral nutrition of gerodietetic purpose. This, in turn, will make it possible to determine the level of satisfaction of the needs of the target category of consumers with main nutrients as a prospect for further implementation of the product.

To achieve this goal, the following tasks were formulated:

- determine the content of macronutrients, calorific value, the ratio of proteins, fats, and carbohydrates in the product, and its compliance with the needs of the target category of consumers;
- study the amino acid composition and the score of the protein component of the product as main indicators of its biological value;
- determine vitamin and elemental composition of the dry soluble product;
- draw a comprehensive conclusion about the nutritional value of the developed dry soluble product for enteral nutrition for gerodietetic purposes and its compliance with nutritional needs of older age groups, in particular in heavy conditions.

4. The study materials and methods

Experimental and analytical studies were carried out in research laboratories of the Merchandising, Safety and Quality Management Department of Kyiv National of Trade and Economics University and Academician L. I. Medvid State

Enterprise Scientific Center for Preventive Toxicology, Food and Chemical Safety of the Ministry of Health of Ukraine.

A dry soluble product for enteral gerodietetic nutrition [11] was the study object. An experimental batch of this product was manufactured in production conditions of DelMass LTD (Dudarkiv, Kyiv region, Ukraine). Data on the qualitative and quantitative component composition of the product are presented in Table 1.

Table 1

Qualitative and quantitative component composition of the developed dry soluble product for enteral gerodietetic nutrition

Component, unit	Content in 100 g of dry soluble product
WPC-80 whey protein concentrate, g	25.00
Monodisperse maltodextrin, g	25.00
Glucose, g	20.00
Omega-3 polyunsaturated fatty acids, previously produced from <i>Ulkenia</i> sp. seaweed in a casein-starch matrix (Omega-3 fatty acid content not less than 90 %), g	10.80
Fructose, g	10.00
Dietary fiber, g	5.50
l-glutamine, g	2.00
l-methionine, g	0.50
l-tryptophan, g	0.30
Ginseng root extract, g	0.30
Ascorbic acid (vitamin C), g	0.25
l-cysteine, g	0.10
Glucosamine, g	0.10
Milk calcium, g	0.07
Coenzyme Q ₁₀ , mg	37
Magnesium hydrogen phosphate, mg	36
β-carotene, mg	5
Thiamine (vitamin B ₁), mg	1
Pyridoxine (vitamin B ₆), mg	1
Calciferol (vitamin D ₃), μg	6

The main purpose of consumption of this product: slowing down the aging process, normalizing metabolic metabolism, physical and emotional state, improving the tone of the musculoskeletal, muscular and immune systems, increasing the level of antioxidant protection. The use of this product is also intended to optimize protein metabolism in various diseases and injuries, especially somatic, increase the level of protein in the blood and activate regenerative processes of the body.

The developed recommendations for the preparation of the developed product for consumption provide that its implementation by dissolving a portion (50 g) of the dry mixture in 200 cm³ of boiled water at 15–40 °C. It is also possible to further increase the amount of water by 40 cm³ depending on the preferences of target consumers and their condition.

It is assumed that the proposed product is intended for both oral consumption and feeding through a special tube. The use of the product is focused mainly on the oral route

as an additional source of nutrients, the main source for a short period of time (up to 1 week). Recommended consumption: about 1–3 servings per day of 50 g of dry product in a pre-prepared dissolved state.

The dry soluble product for enteral nutrition Peptamen manufactured by the Nestle Company, Switzerland, was chosen as a control sample.

Samples of dry soluble products for the study were taken and prepared by random sampling in accordance with the requirements of ISO 707:2008 [12].

The following methods were used to determine the content of macronutrients in a dry product: protein content was determined by the Kjeldahl method [13], fats by gravimetric method [14], and carbohydrates by ion-exchange chromatography with pulsed amperometric detection [15]. An average factor of 6.25 was used to convert nitrogen content to protein content [16].

To study the qualitative and quantitative composition of amino acids, the method of liquid-column ion-exchange chromatography [17, 18] using an automatic amino acid analyzer AAA 400 manufactured by Ingos-Laboratory Instruments (Czech Republic) was applied after alkaline hydrolysis for tryptophan and acid hydrolysis for other amino acids. Separation into individual amino acids was performed with the help of a chromatographic column filled with Ostion LG FA ion exchange resin.

The biological value of the protein component was studied by comparison with the reference value developed based on the recommendations of experts from the FAO/WHO Expert Committee [19]. Additionally, this indicator was calculated proceeding from the value of the coefficient of discrepancy of the amino acid score (CDAAS) using the formula from [18, 20]:

$$BV = 100 - CDAAS = 100 - \sum \frac{\Delta RAAS}{n}, \quad (1)$$

where BV is biological value of the protein part of the product, %;

CDAAS is coefficient of discrepancy of amino acid score, %;

$\sum \Delta RAAS$ is the ratio of the amino acid score for each essential amino acid (EAA) to the amino acid score of the essential amino acid which is the lowest (8).

Content of vitamins (ascorbic acid, thiamine, riboflavin, niacin, pyridoxine, pantothenic and folic acids, cyanocobalamin retinol, calciferol) was determined by high-performance liquid chromatography [21–26] using Lumachrome liquid chromatograph (Russian Federation). The content of β-carotene was determined by spectrophotometric method [27] using Specord 210 (Germany) spectrophotometer. The elemental composition of dry products was studied by the mass spectrometry method with inductively coupled plasma [28–30] using the appropriate VARIAN 320MS (Australia) device after corresponding mineralization of samples.

The experiments and analysis were repeated fivefold and threefold, respectively. Mathematical and statistical processing of the obtained results was carried out using computers and MS Excel software (USA). The reliability of the results obtained was not less than 95 % in the study of the content of macronutrients and amino acids, not less than 98 % in the study of vitamins, and not less than 97 % in the study of elemental composition.

5. The results obtained in the study of the nutritional value of the developed enteral nutrition product of gerodietetic purpose

5.1. The results of studies of macronutrient composition

The study of the content of macronutrients is the main factor that makes it possible to assess nutritional value, in particular, calorific value. In this connection, the content of proteins, lipids, and carbohydrates in the developed product was studied. The results of determining the macronutrient composition of the developed dry soluble product are given in Table 2.

Table 2

Content of macronutrients in dry soluble products, g ($P \geq 0.95$, $n = 15$)

Macronutrients	Control sample	Developed product
Proteins	18.49±0.23	22.76±0.27
Fats	17.79±0.15	11.82±0.13
Carbohydrates	56.81±0.49	56.43±0.47

The obtained experimental results of the study of macronutrient composition of the developed dry soluble product (Table 2) show that it contains proteins, fats, and carbohydrates in a fairly significant amount.

To determine compliance of the macronutrient composition to the norms recommended for older age categories [2, 3, 5, 31–33], total calorific value (100 g of the mixture), and mass fraction of macronutrients in it were calculated. The results obtained are presented in Table 3.

Table 3

Total calorific value and mass fraction of main macronutrients in it

Products	Total calorific value, kcal/100 g	Mass fraction of main macronutrients in total calorific value, %		
		Proteins	Fats	Carbohydrates
Control	461.3	16.0	34.7	49.3
Developed product	422.8	21.5	25.1	53.4

Based on the obtained information on the protein/fat/carbohydrate ratio in the developed product (21.5/25.1/53.4, respectively), it can be recommended for consumption by elderly people, people of advanced age, and long-lived people. This is especially true for those who have a high workload and suffer from various somatic diseases and injuries and are in the stage of rehabilitation after them, in particular, due to the increased level of the protein component.

5.2. The results of the study of amino acid composition

The balance and completeness of the amino acid composition of food products are one of the main factors ensuring its biological value. The results of the laboratory study of qualitative and quantitative content of amino acids in the developed product are given in Table 4.

The results obtained in the study of the qualitative and quantitative amino acid composition of the protein component of the developed product presented in Table 4 show the

presence of all essential and conditionally essential amino acids and their sufficiently high content.

Table 4

Qualitative and quantitative amino acid composition of products for enteral nutrition, mg/1 g of protein ($P \geq 0.95$; $n = 5$)

Amino acids	Content, mg/1 g of protein in products	
	Control sample	Developed product
Essential amino acids		
Valine	57.32.3±	51.52.2±
Isoleucine	45.82.2±	44.82.6±
Leucine	79.43.8±	71.43.4±
Lysine	65.63.1±	64.83.2±
Methionine	22.50.9±	33.81.7±
Threonine	48.12.2±	50.12.7±
Tryptophan	14.40.6±	15.80.8±
Phenylalanine	27.91.2±	34.31.4±
Total	361.016.3±	366.318.2±
Conditionally essential amino acids		
Tyrosine	25.71.1±	26.41.2±
Cysteine	13.50.7±	10.80.5±
Total	39.21.8±	37.21.7±
Nonessential amino acids		
Alanine	46.12.1±	47.41.8±
Arginine	39.51.8±	22.10.7±
Asparagine acid	107.55.1±	103.44.3±
Glutamine	237.111.0±	267.111.8±
Glycine	21.00.9±	22.10.6±
Histidine	34.71.2±	15.70.6±
Ornithine	Trace concentration	
Proline	64.02.9±	64.82.4±
Serine	49.91.8±	51.91.9±
Total	599.826.8±	596.524.1±

Based on the study of the amino acid composition of the developed product, it was found that it is characterized by a high content of essential amino acids (366.3 mg/g of crude protein). It was determined that the proposed dry soluble product contains conditionally essential (37.2 mg/g of crude protein) and nonessential amino acids (596.5 mg/g of crude protein).

A generally accepted method that is widely used to assess the biological value of a protein consists in the study of its amino acid score. In turn, this allows us to characterize the protein based on a comparison of the content of each of the essential and conditionally essential amino acids of the test product compared to the reference sample which was determined in accordance with recommendations of the FAO/WHO profile committee [19]. The data obtained in the study of an amino acid score of the protein are presented in Table 5.

It was established that the protein component of the developed product (amino acid score of phenylalanine and tyrosine amino acids limited for the developed product is 101.2 %) is characterized by the high biological value of protein due to the balanced composition of essential and conditionally essential amino acids.

Table 5

The amino acid score of essential and conditionally essential amino acid products for enteral nutrition

Essential amino acids	FAO/WHO scale [29]	Control sample		Developed product	
		mg/1 g of protein	score, %	mg/1 g of protein	score, %
Valine	50	57.3	114.6	51.5	103.0
Isoleucine	40	45.8	114.5	44.8	112.0
Leucine	70	79.4	113.4	71.4	102.0
Lysine	55	65.6	119.3	64.8	117.8
Methionine+cysteine	35	36.0	102.9	44.6	127.4
Threonine	40	48.1	120.3	50.1	125.3
Tryptophan	10	14.4	144.0	15.8	158.0
Phenylalanine+cysteine	60	53.6	89.3	60.7	101.2
Total	–	409.6	–	406.7	–

It is a well-known fact that amount of protein that will be used by the human body to synthesize and recover the necessary zones is limited by the amount of limited amino acid. In this regard, the additional biological value of the protein component was investigated based on the use of the coefficient of discrepancy of the amino acid score (CDAAS) (Table 6).

Table 6

The biological value of the protein component of products for enteral nutrition

Indicator	Reference sample	Control sample	Developed product
CDAAS, %	0	25.49	17.14
Biological value, %	100	74.51	82.86

Proceeding from the results of the study of the biological value of the protein component of the developed product given in Table 6 and based on the use of CDAAS, it was determined that the value of this indicator is 82.86 %.

5. 3. The results obtained in the study of vitamin value and elemental composition

The experimental studies of the developed dry soluble gerodietetic product conducted to determine its vitamin value have made it possible to obtain the information given in Table 7.

The results of studies of vitamin value of the developed dry soluble product (Table 7) have made it possible to establish a fairly high content of thiamine, pyridoxine, ascorbic acid, calciferol, and β-carotene. The special need for the last 3 nutrients for the aging body is primarily explained by their antioxidant properties.

The elemental composition of products is an important factor that determines their nutritional value, in particular biological value. Experimental results of studying the qualitative and quantitative composition of mineral elements contained in the developed dry soluble product for enteral gerodietetic nutrition and in the control sample are given in Table 8.

The results obtained in the study of the qualitative and quantitative elemental composition of the developed dry product (Table 8) make it possible to state the presence of

a fairly balanced composition of macro and microelements. This provides an opportunity to significantly meet the needs of the target consumers of these micronutrients, in particular potassium, calcium, phosphorus, magnesium, iron, zinc, iodine, selenium, and others.

Table 7

Vitamin value of dry soluble products for enteral nutrition (P≥0.97, n=15)

Names of the studied substances that determine the vitamin value	Content, mg/100 g	
	Control sample	Developed product
Retinol (A)	0.056±0.001	0.012±0.001
Thiamine (B ₁)	0.927±0.001	1.063±0.001
Riboflavin (B ₂)	1.097±0.001	0.240±0.001
Niacin (B ₃)	1.024±0.001	0.884±0.001
Pantothenic acid (B ₅)	0.864±0.001	0.957±0.001
Pyridoxine (B ₆)	1.008±0.001	1.023±0.001
Folic acid (B ₉)	0.0540.001±	0.033±0.001
Cyanocobalamin (B ₁₂)	Trace concentration	
Ascorbic acid (C)	65.1±0.1	251.1±0.1
Calciferol (D ₃)	0.0031±0.0001	0.0062±0.0001
β-carotene	Trace concentration	5.024±0.01

Table 8

Qualitative and quantitative elemental composition of products for enteral nutrition (P≥0.97; n=15)

Mineral element	Content in dry soluble products	
	Control sample	Developed product
Macroelements, mg/100 g		
Potassium	575.74±0.46	593.79±0.41
Sodium	364.43±0.14	553.54±0.22
Calcium	357.63±0.44	364.86±0.27
Magnesium	186.41±0.57	172.03±0.29
Phosphorus	324.17±0.52	343.11±0.32
Chlorine	468.82±0.02	165.13±0.01
Sulphur	10.54±0.03	20.56±0.02
Microelements, µg/100 g		
Iron	5,386.27±0.37	3,243.72±0.28
Zinc	6,333.64±0.64	3,157.32±0.36
Manganese	1,214.51±0.23	181.33±0.12
Copper	623.76±0.14	213.84±0.06
Iodine	42.17±0.29	33.45±0.32
Chromium	17.36±0.04	18.57±0.02
Selenium	17.62±0.03	18.33±0.04
Nickel	4.74±0.84	11.12±0.11
Molybdenum	5.65±0.04	9.15±0.07
Aluminum	3.42±0.08	7.18±0.09
Bromine	0.41±0.01	1.69±0.01

5. 4. The results obtained in studying the level of satisfaction of the daily requirement for the studied vitamins and minerals from consumed 100 g of dry soluble products in a ready-to-intake liquid state

Based on the data on recommended daily intake of vitamins for the older age groups [2, 3, 5, 31–33], the level of their provision from consumption of 100 g of the developed dry product was investigated. The results obtained are shown in Fig. 1.

Based on the recommendations on average norms of meeting the needs of older age groups in mineral elements [2, 3, 5, 31, 32, 34], the theoretical level of their satisfaction with the consumption of liquid finished products, in the amount equivalent to 100 g of dry soluble mixture was studied (Fig. 2).

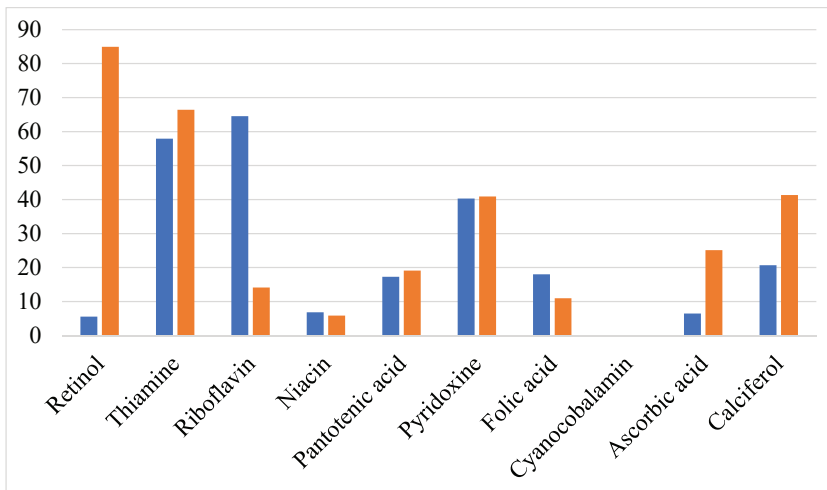


Fig. 1. The calculated average level of satisfaction of daily need for the studied vitamins from consumption of 100 g of dry soluble products, %

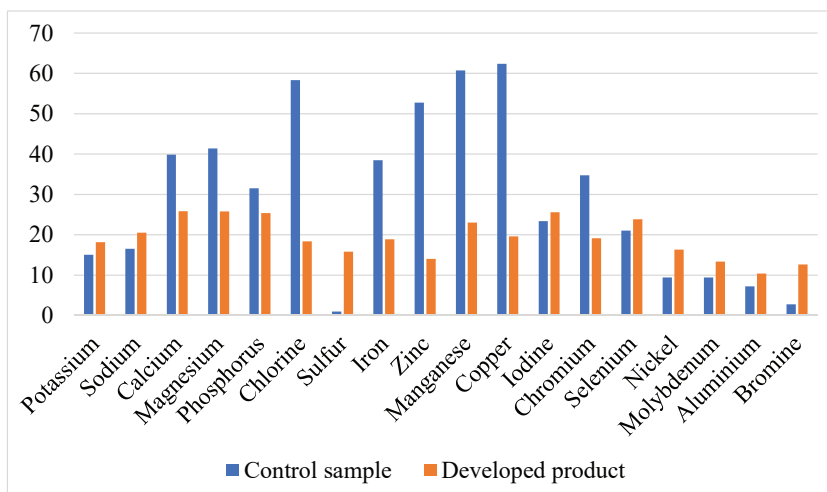


Fig. 2. The estimated average level of satisfaction of daily need for mineral elements from consumption of 100 g of dry soluble products, %

The results of experimental studies of the elemental composition of dry soluble products (Table 8) show that potassium/sodium/calcium/phosphorus ratio in the developed product is 1.07 and 1, 1.06 and 1, respectively (for the control sample, this ratio is 1.58:1 and 1.1:1, respectively). It should be noted that these values are very close to those recommended for optimal fixation (1:1 and 1:1, respectively) [34, 35] which indicates a high degree of absorption of these elements by the body.

6. Discussion of results obtained in the study of nutritional value

The results of the study of macronutrient composition (Table 2) indicate a fairly high protein content. This is due to the fact that it is important to meet metabolic needs of loss recov-

ery, provision with plastic material, and more. Compared to the control sample, there is an 18.7 % higher content of protein in the proposed product, 35.5 % lower content of fat, and almost the same level of carbohydrates. The fatty component of the developed product is represented by omega-3 fatty acids and milk fat and, therefore, will be better assimilated by the organism in comparison with the control sample where fats of a vegetable origin are present.

Based on the results of the analysis of the calorific value of the studied products (Table 3), it was determined that the control sample is characterized by an 8.3 % higher value. Proceeding from the experimental data on the ratio of proteins, fats, and carbohydrates in total calorific value, it was established that the product developed for enteral nutrition for which this ratio is 21.5/25.1/53.4 meets recommendations of [2, 3, 5, 31, 32] to satisfy needs of elderly people having increased workload, injuries and traumas (18–22/25–30/48–7, respectively).

The balance of the amino acid composition of proteins is the most important factor determining their biological value [19, 20]. Analysis of the amino acid composition has shown a significant amount of essential amino acids (366.3 mg/g of crude protein), conditionally essential amino acids (37.2 mg/g of crude protein), and glutamine (267.1 mg/g of crude protein) in the developed product. Based on these results, it was concluded that consumption of the developed product provides necessary conditions for body regeneration and satisfies the needs of plastic materials [20, 32] at a high level. The content of essential, conditionally essential, and non-essential amino acids in the developed product was almost equal to that of the control sample with a difference within the measurement error.

Based on the study of the biological value of the protein component (Table 5), it was determined that tryptophan (amino acid score of the developed product) is the dominant amino acid in the studied samples (158.0 % cf. 144.0 % in the control sample). It was found that phenylalanine and tyrosine (amino acid score of the developed product) are the limiting amino acids (101.2 % cf. 89.3 % in the control sample). This improvement of the amino acid composition is explained by the use of whey protein concentrate WPC-80 having high biological value.

Based on the study results (Table 6), it was found that CDAAS in the developed dry soluble product for enteral nutrition amounts 17.14 % which is 32.7 % higher than that in the control sample. It was established that the biological value of the protein component in the developed product is 10.07 % higher than that for the control sample.

The results obtained in the vitamin value study (Table 7) show that the use of whey protein concentrate WPC-80 contributed to the high vitamin value, in particular in terms of riboflavin, niacin, and pantothenic and folic acids. It should also be noted that additional enrichment of the de-

veloped product with β -carotene (given that the use of 6 mg of β -carotene is equivalent to the use of 1 mg of retinol), thiamine, pyridoxine, and calciferol has significantly increased the vitamin value.

It was found that the use of selected raw materials, in particular whey protein concentrate WPC-80, omega-3 of fatty acids, ginseng root extract, lactic calcium, magnesium hydrogen phosphate has greatly enabled a significant provision of the developed product with macro- and microelements. The full satisfaction of the daily need for mineral elements is provided through the consumption of other foods.

It was experimentally proved that the content of mineral elements in the proposed product is presented in a more balanced way than in the corresponding control sample. In contrast to the control sample where mineral elements are introduced artificially as salts, they are presented in a native form in the developed product which ensures their better absorption by the body.

The conducted experimental and analytical studies established that the developed product corresponds to the specificity of needs of the target category of consumers. Its consumption in a ready liquid form makes it possible to ensure the essential provision of an organism of persons of senior age groups with necessary nutrients. This fact was also confirmed by experimentally established higher indicators of the nutritional value of the proposed product compared to the control one. Conduction of clinical trial of the proposed product and analysis of its results is seen as a prospect of further studies.

7. Conclusions

1. It was determined that the content of proteins, fats, and carbohydrates in the developed dry soluble gerodietetic product for enteral nutrition is 22.76, 11.82, and 56.43 g per 100 g of product, respectively. It was also found that the

calorific value of the product is 422.8 kcal/100 g. The ratio of proteins, fats, and carbohydrates in the total calorific value of the developed product is 21.5/25.1/53.4, respectively. This is in line with the recommendations of specialists (18–22/25–30/48–57) to satisfy the needs of older age groups, in particular, those with increased workload and undergoing medical treatment of somatic diseases, injuries, and recovery after them.

2. Based on the study of the amino acid composition of the developed dry soluble product, high content of essential (366.3 mg/g of crude protein) and conditionally essential (37.2 mg/g of crude protein) amino acids was determined. It was found that tryptophan (amino acid score 158.0 %) is the dominant essential amino acid and phenylalanine and cysteine (corresponding to 101.2 %) is the limited one. Based on the determination of the coefficient of discrepancy of amino acid composition, it was found that the biological value of the protein in the proposed product is 82.86 %.

3. Experimental study of the vitamin and elemental composition of the developed dry product has shown a fairly high content of the studied vitamins, in particular, ascorbic acid (251.1 mg/100 g), calciferol (6 μ g/100 g), thiamine (1.1 mg/100 g), pyridoxine (1.0 mg/100 g), mineral elements (potassium (594 mg/100 g), calcium (365 mg/100 g), magnesium (172 mg/100 g), phosphorus (343 mg/100 g), iron (3,244 μ g/100 g) and zinc (3,157 μ g/100 g).

4. High nutritional value, in particular calorific and biological value, the value of the developed dry soluble product for enteral gerodietetic nutrition have been established. Its compliance with the norms recommended for older age groups in terms of calorific value, the ratio of proteins, lipids and carbohydrates, amino acid composition (biological value of protein component 82.86 %) was established. The average level of satisfaction of the daily need for the studied vitamins (on average within 14–41 %) and mineral elements (mostly by 10–25 %) from consumption of 100 g of dry product in the prepared liquid state was calculated.

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