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AMINO ACID SCORE OF SOME PRODUCTS FOR YOUNGER SCHOOL CHILDREN NUTRITION

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Abstract

Introduction. Wholesome nutrition is one of the most important factors in shaping a person's somatic and mental health. Eating habits are formed in childhood and consolidated in adulthood. They can also have an impact on the development of future chronic diseases, such as metabolic syndrome, type 2 diabetes, cardiovascular diseases. **The purpose** of the work is to evaluate the amino acid score of the main food products of children of primary school age.

Material and methods. The research was carried out during 2016 - 2021. Food menus for 1000 of children aged 6-9 years old living in the South of Ukraine (cities Odessa and Mykolaiv, suburban villages and villages far from the regional centres). The study was carried out during the spring-summer (May-June) and autumn-winter (November-December). Field studies of the amino acid content in 24 products, which were included in the first two deciles in terms of frequency of consumption, were also conducted. **The results.** The distribution of food products was marked by a certain constancy and depended little on the season of the year. Most foods are a major source of carbohydrates. Only 8 out of 24 products were a

source of protein and essential amino acids. The overall consumption of protein-rich foods by younger schoolchildren was low. **Conclusion.** Children 6-10 years old should consume protein in the amount of 0.95 g/kg/day. Our research shows that even such an understated standard of need may not be fulfilled under the current state of affairs. The main sources of protein for children of primary school age in Southern Ukraine are milk, cheese, chicken, river fish and legumes. Dairy products, eggs and chicken have the highest value in terms of amino acid content, and pork has the lowest value. Legumes have a high amino acid content, but they are inferior to products of animal origin.

Key words: children of primary school age; protein-rich food; amino acid score

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Introduction. Nutrition is one of the most important factors in the formation of human somatic and mental health [1, 2]. The role of nutrition in children of primary school age is especially significant. Anatomical and physiological features of the body of a junior high school student are characterized by the relative immaturity of functional systems, significant intensity of metabolic processes and, accordingly, high sensitivity to the deficiency of essential nutrients [1, 3].

Eating habits are formed in childhood and consolidated in adulthood. They may also influence the development of future chronic diseases such as metabolic syndrome, type 2 diabetes, cardiovascular disease and influence mortality rate [4]. Therefore, various institutions, including WHO, recommend the formation of healthy eating habits at an early age as a method of preventing chronic diseases [1, 4, 5]. In addition, unhealthy eating habits are associated with overweight and obesity, including comorbidities such as fatty liver disease, dyslipidemia, diabetes, asthma, obstructive sleep apnea, and cardiovascular disease [4]. In addition to health consequences, childhood obesity can affect children's social and emotional well-being and self-esteem [4, 5], as well as academic performance [6]. In addition, it is associated with a lower quality of life [6] and a higher risk of obesity in adulthood [4, 5, 7].

In many countries, children's consumption of fish, fruits, vegetables, and high-fiber foods has decreased, while amounts of foods rich in sugar and processed alimentary supplements, at the contrary, has increased [8]. For example, in the USA there is a shortage of proteins and amino acids in the daily rations of schoolchildren [9]. At the same time, the consumption of sodium, saturated fats, meat, fast food, and soft drinks is increasing, which causes negative changes in the health of children [10].

In 1985 in the report of Food and Agriculture Organization of the United Nation (FAO/WHO/UN) reference models of amino acid intake were defined for infants based on breast milk, preschool and school-aged children [11] intake was substantiated as well. This report argued that the quality of dietary protein should be assessed by its digestibility adjusted for the amino acid index calculated from the marginal amino acids compared to the reference amino acid structure. therefore, a joint FAO/WHO expert consultation on the evaluation of protein quality (1991) endorsed this evaluation approach with correction for protein digestibility [12]. FAO/WHO/UN report (2007) endorsed the 1985 report, and recommended the amino acid score of breast milk as the best estimate of the infant's amino acid requirements [13]. However, practical studies of the consumption of amino acids, including essential amino acids and their content in the food of children of primary school age have not yet been conducted.

The aim of the work is to evaluate the amino acid score of basic food products for children of primary school age.

Material and methods. The study was carried out on the basis of the Department of Hygiene and Medical Ecology of the Odessa National medical university (Odessa, Ukraine) during 2016-2021. At the first stage, the food menus of 1.000 children of primary school age (6-9 years old) living in Odessa and Mykolaiv, suburban villages and remote from the regional centres villages of the regions mentioned were analyzed. The studies were carried out during the spring-summer (May-June) and autumn-winter (November-December) period. At the same time, field studies of the amino acid score of 24 products, included in the first two deciles in terms of frequency of consumption, were conducted [14].

The study of products used for the preparation of school meals and lunches, prepared meals was carried out according to sanitary and chemical indicators and in accordance with the generally accepted and approved methods of volumetric and chromatographic analysis. The ACQUITY UPLC complex was used to determine the actual content of amino acids [15].

The amino acid score was determined by the formula:

$$AAS = \frac{X}{Y}100\%$$

where X is the content of the limiting amino acid in the food product;

Y is the content of the limiting amino acid in the reference protein [16].

In addition, the adjusted value of the amino acid score was calculated taking into account the bioavailability of this or that food protein:

PSCAAS=AAS*k,

where AAS is the amino acid score;

k is the protein absorption coefficient [17].

The data obtained were analyzed with variance analysis using Statistica 13.0 software (TIBCO, USA) [18]. The null hypothesis was accepted at p=0.05.

Results. When analyzing the menu layouts at our disposal, it turned out that the distribution of food products was characterized by a certain stability and did not depend much on the season of the year. Figure 1 shows the frequency of consumption of various food products for the spring-summer and autumn-winter periods.

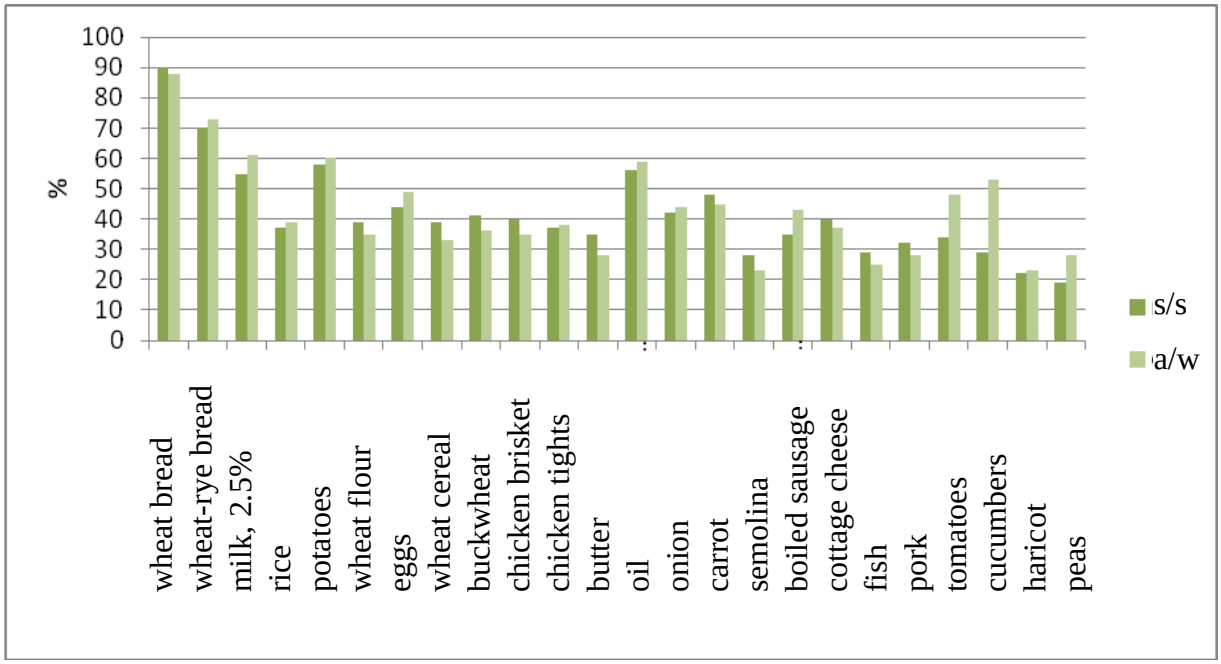

Fig. 1. Structure of consumption of food products (s/s - spring/summer, a/w - autumn/winter)

As it can be seen from the above, most foods are the main source of carbohydrates. Only 8 out of 24 products can be considered a source of protein and essential amino acids.

Table 1 shows the most frequently used by the primary age school children products .and their amino acid score/

Field studies showed that the average protein content in cow's milk was (3.2±0.3) g%, in chicken meat (thighs) - (27.0±0.9) g%. For comparison: the protein content in chicken eggs was (13.1±1.1) g%, in cooked sausage - (14.4±1.1) g%, in fish (carp) – (17.3±1.5) g%. The protein content in pork was (22.2±2.4) g%, and in haricot - (21.3±1.8) g%. Another product

that was often used by children of primary school age is homemade cheese (cottage cheese), in the samples of which an average protein content of (20.8±1.8) g% was determined.

Table 1 - Amino acid score of the products most used by younger schoolchildren

AA	FAO/WHO	Products							
	2007	Milk, 2.5%	Chicken	Eggs	Sausage, cooked	Fish	Pork	Beans	Cheese
Valine	5.0	1.3	3.1	1.1	1.1	1.1	0.2	0.9	1.2
Isoleucine	9.0	0.6	2.8	0.5	0.5	0.5	0.1	0.4	0.6
Leucine	7.0	1.5	5.0	1.2	1.2	1.2	0.3	1.0	1.2
Lysine	5.5	1.7	5.6	1.2	1.6	1.8	0.3	1.1	1.4
Methionine	3.5	0.8	1.7	0.9	0.8	0.9	0.2	0.4	0.6
Threonine	4.0	1.3	2.7	1.1	1.1	1.2	0.2	0.9	1.0
Tryptophan	1.0	4.4	0.5	1.3	1.1	1.2	0.2	1.0	1.3
Phenylamin	6.0	0.8	2.5	0.8	0.7	0.7	0.1	0.8	0.8

Further analysis of the essential amino acids revealed the highest valine content in haricot - 0.984 g% (of the total weight of the product) or 4.5% of the total protein value of the product. The highest content of isoleucine was determined for haricot (0.831 g%) and chicken thighs (0.794 g), leucine - for haricot (1.5 g%) and river fish (carp) - 1.45 g%. The highest content of lysine was noted in fish (1.64 g%) and chicken (1.51 g%). As for methionine, which is a sulfur-containing amino acid, its highest content was in chicken meat (0.446 g%) and eggs (0.418 g%).

Threonine, which is involved in the synthesis of collagen and elastin, in protein and fat metabolism, is found in the largest amount in fish (0.782 g%) and haricot (0.792 g%).

Tryptophan, a precursor of many important biogenic amines and their derivatives, was present in significant amounts in haricot (0.223 g%) and fish (0.2 g%).

Phenylalanine, an aromatic essential amino acid, was found in the highest amounts in haricot (1.02 g%) and fish (0.696 g%).

Thus, the overall consumption of protein-rich foods among younger schoolchildren is low. The highest amino acid content, taking into account the assimilation coefficient, was characteristic of eggs and cottage cheese, the lowest – of pork. We do not consider pork to be a food product that can be recommended for children's nutrition - in addition to not very high quality protein, it contains quite a lot of fat and its consumption can be a reason of potentially dangerous diseases. Pork that does not meet the requirements of epidemiological safety in terms of microbiological and parasitological indicators [19] cannot be allowed for children's food.

The current standards of protein needs for children around the world have been determined on the basis of studies using the nitrogen balance method. This method is deservedly criticized for potentially underestimating protein requirements. Indeed, recent advances in stable isotope techniques suggest that protein requirements are at least 60% higher than current recommendations [20]. In addition, there are no separate recommendations for children who have a higher level of physical activity, such as going in for sports or walking a lot. The data of today suggests that physical activity increases the need for protein to support dry body weight as a result of adaptation to physical exercises. Indicator amino acid and end product 15N oxidation methods represent an alternative to the nitrogen balance method for protein requirements estimation.

Several new methods, such as the virtual biopsy approach and 2H3-creatine dilution method, may also be applied to specify pediatric protein requirements, although their reliability and reproducibility are still being investigated.

Based on current data, the recommended intake for 6–10 years of age children should be at least 0.95 g/kg/day of protein. Our research shows that even such an understated standard of need may not be fulfilled under the current state of affairs.

Conclusions:

1. The main sources of protein for children of primary school age in the South of Ukraine are milk, cheese, chicken, river fish and legumes

2. Dairy products, eggs and chicken have the highest value in terms of amino acid score, and pork has the lowest value. Legumes have a high amino acid score, but according to PSCASS they are inferior to products of animal origin

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