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Influence of Fast Food Products on Amino Acid Status of Laboratory Animals

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Abstract

The features of the amino acid composition of the liver and the biochemical parameters of the blood of animals under conditions of food stress were studied. The study was conducted on male Wistar rats from two months of age. Consumption of fast food products was accompanied by significantly lower values of hemoglobin, total protein, triiodothyronine, and higher values of AST and ALT in serum. Among the essential amino acids in the liver of the animals of the experimental group, a significant increase in 4.2 times of valine, 1.7 times of leucine content was observed, and a decrease in the phenylalanine and threonine content by 1.5 and 1.3 times, respectively was observed. Significant increase in 5 times of the arginine content and decrease in 1.7 times of cysteine content were shown. Also significant decrease in 3.2 times in the level of triiodothyronine, substrate for which is conditionally indispensable amino acid tyrosine, was revealed.

Keywords: food stress, amino acids, fast food

INTRODUCTION

Nutrition plays a leading role in ensuring normal growth of development and functioning of the body. One of the most acute problem of modern nutrition is the use of instant food. Many authors defined abuse fast food as food stress, and in people who often consume fast food stress becomes chronic [1, 2, 3, 4]. Analysis of the questionnaire survey data of students of Orenburg State University showed that the frequency of consumption of fast food and semi-finished products averaged from 1.6 times a day to 3.4 times a week. One of the popular representatives of such products is instant noodles. It is known that most types of instant noodles are characterized, on the one hand, by a low content of dietary fiber and protein, on the other - high content of saturated and trans fats, carbohydrates and sodium. Wheat flour used to make noodles contains a small amount of protein (usually 10% to 15%) and does not contain some essential amino acids, such as lysine, threonine and methionine [5, 6]. With insufficient intake of protein with food, liver proteins are primarily consumed, and changes in the biochemical pattern of blood are also observed [7].

The aim of the work was to study the effect of fast food products on certain biochemical parameters and the amino acid composition of the liver of laboratory animals.

MATERIALS AND METHODS

Animals

The study was conducted on male Wistar rats from two months of age. (N = 20, weight=180±10.2 g). The animals were kept in clinical and biological laboratory “Vivarium” (Orenburg State University). They were maintained in controlled environment (12:12 h light/dark cycle). The experiment was conducted in compliance with the principles presented by the Directive of the European Parliament and the Council of the European Union 2010/63 / EU [8].

Treatment Design

During the accounting period (8 weeks), the animals were divided into 2 groups. The first experimental group consumed a semi-synthetic diet consisting of a mixture of the main food (50%), a mixture of instant food products (50%) and water, the second group was a control, and received basic diet and water without restrictions. The main diet was compiled in accordance with the recommendations of the Institute of Nutrition of the Russian Academy of Sciences and contained corn starch (carbohydrate source - 58 g), casein (25 g protein source), unrefined sunflower oil and lard (fat sources per g), 4% salt mixture, 1% mixture of vitamins, 2% microcrystalline cellulose. The composition of the rations was the same in terms of the quantitative content of protein, fat and carbohydrates.

Analytical procedures

The functional state of laboratory animals was assessed by an integral measure, including the study of the dynamics of body weight (weekly), the volume of daily intake of food and liquid, changes in external signs and the degree of activity of laboratory animals. The serum analysis was carried out using a biochemical analyzer Clima MC-15 A / O Unimed. For a general blood test, the hematology analyzer MEDONIC CA-620 A / O Unimed (Moscow, 2002) was used. The study of the amino acid composition of liver tissue and animal food was carried out at the Central Scientific Research Institute of the Russian Academy of Sciences (accreditation of the Test Center No. Ross RU.0001.21 PF59 dated 19.05.2011) using capillary electrophoresis on the Kapel-105M device (Lumex).

Statistical Analysis

Mathematical processing of data was carried out using the program "Statistica 10.0". Parameters of descriptive statistics for quantitative indicators are given in the form of a median (Me) and interquartile latitude (25th, 75th percentile - Q1; Q3). Since n does not exceed 30, the Mann-Whitney U test was used to estimate the significance of the similarity (difference) of two independent samples. The significance level was considered reliable at $p < 0.05$.

RESULTS

When assessing the effect of food stress on body weight, it was revealed that weight of animals of the experimental group was significantly less by 24% then control by the third week of the experiment, and at the end of the experimental period it was significantly less by 35.5%.

In biochemical indicators of blood, in comparison with the recommended values, an increase in activity of AST and decrease in the level of total protein were revealed in the experimental group (Table 1). Feeding of fast food products was accompanied by reliably lower values of hemoglobin, total protein, triiodothyronine and higher values of AST and ALT in blood serum.

When comparing the amino acid composition of the liver tissue of the control and experimental groups, the following features were revealed (Table 2). Among the essential amino acids in the liver of the animals of the experimental group, a significant increase in 4.2 times of valine, 1.7 times of leucine content was observed, and a decrease in the phenylalanine and threonine content by 1.5 and 1.3 times, respectively was observed. Phenylalanine is part of all proteins, in addition, its metabolic pathway is associated with the conversion into tyrosine [9].

An increase in 3 times of histidine content of liver tissue of the animals of the experimental group was observed ($p < 0.01$) at the same time with decrease of hemoglobin, which was a reserve source of histidine [10], which may indicate a metabolic disorder of this amino acid. Histidine is called a super-catalyst according to its purpose in acid-base enzymatic catalysis, since it enters the active sites of most enzymes [9].

It is known that interchangeable amino acids can be formed in the body, but due to endogenous biosynthesis only a minimal body requirement is provided [11]. Moreover, it was found that with a small consumption of protein the substitutable amino acids become limiting [12, 13]. Such amino acids as arginine, proline and cysteine are not indispensable, but in many ways provide growth of the body. The lack of arginine also leads to increase in mutational processes, and high reactivity has determined its important role in the activity of enzymes [9]. Significant increase in 5 times of the arginine content and decrease in 1.7 times of cysteine content were shown. An increase in 1.6 times in the serine content of the liver tissue of the animals of the experimental group was found. Serine is involved in the synthesis of coenzyme acetylation [9].

The decrease in tyrosine content in liver tissue was not reliable, however, a significant decrease in the level of triiodothyronine (the substrate for which is conditionally indispensable amino acid tyrosine) in 3.2 times was observed [12].

Table 1 Statistically significant differences in blood test values of laboratory animals,(Me (Q_1-Q_3)

Indices	Units	group		
		Experimental	Control	p
Hemoglobin	g/l	143.3 (138.6 - 159.2)	162.3 (157.0 - 167.5)	0.007
Total protein	g/l	74.1 (74.0 - 74.4)	84.9 (78.0 - 87.0)	0.026
ALT	U/l	149.0 (94.5 - 165.0)	21.5 (20.1 - 31.0)	0.003
AST	U/l	363.2 (268.0 - 387.0)	144.3 (114.0 - 181.0)	0.001
Triiodothyronine	nmol / l	0.9 (0.7 - 1.3)	2.9 (2.8 - 3.1)	0.000

Table 2 Amino acid content in the liver of laboratory animals (Me (Q_1-Q_3), g/kg

Indices	Group		p
	Experemental	Control	
Valine	1.34 (0.49 - 1.93)	0.32 (0.25 - 0.43)	0.0058
Leucine	1.96 (1.63 - 2.10)	1.15 (0.41 - 1.40)	0.0080
Lysine	0.60 (0.53 - 0.63)	0.54 (0.44 - 0.68)	0.4720
Methionine	0.43 (0.21 - 0.74)	0.29 (0.25 - 0.38)	0.5196
Threonine	0.40 (0.25 - 0.48)	0.51 (0.50 - 0.55)	0.0336
Phenylalanine	0.70 (0.67 - 0.71)	1.07 (0.83 - 1.12)	0.0252
Alanin	1.27 (1.19 - 1.32)	0.48 (0.27 - 0.76)	0.0002
Arginine	2.19 (2.15 -2.31)	0.44 (0.24 - 0.60)	0.0002
Histidine	0.83 (0.67 -0.99)	0.27 (0.21 - 0.36)	0.0028
Glycine	0.96 (0.37 - 1.22)	0.46 (0.42 - 0.56)	0.1121
Proline	0.69 (0.34 - 0.79)	0.44 (0.42 - 0.47)	0.1402
Serin	0.84 (0.82 - 0.85)	0.53 (0.31 - 0.69)	0.0028
Tyrosine	0.52 (0.31 - 0.68)	0.69 (0.31 - 0.87)	0.3840
Cysteine	0.21 (0.14 -0.30)	0.36 (0.35 - 0.37)	0.0027

CONCLUSION

Thus, a diet containing fast food products significantly influenced the growth of laboratory animals, as well as the amino acid composition of the liver. Also consumption of fast food products was accompanied by significantly lower values of hemoglobin, total protein, triiodothyronine, and higher values of AST and ALT in serum.

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