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Dynamics of Amino Acids Excretion in Children and Adolescents using a new milk product 'Standard Growth Formula'.

The investigation of amino acids content in urine and assessment of effectiveness of the product «Growth Formula Standard» in nutrition of students was done. As it is shown the lack of basic amino acids in body slows down growth, mental capacity, development and hormonal maturation of organism. This is especially important during adolescence. The minerals and vitamins contained in the product «Formula Growth Standard» undoubtedly affect the change in the digestibility of amino acids. The introduction of a specialized product with the composition of amino acids in combination with vitamins and minerals resulted in height and weight increase, which indicated the efficiency of its use among schoolchildren.

Keywords: amino acids, children with growth retardation, specialized dairy products.

INTRODUCTION

Properly organized nutrition is very important for the normal physical and psychological development of the student. With food the child should receive the substances necessary for the construction of tissue - protein, fat, carbohydrates, minerals, vitamins [5]. Amino acids (AA) are the basic building blocks of every living cell. AA - the most important component of plant and animal origin, which play an important role in metabolism in the body: the formation of proteins and peptides in the biochemical synthesis of vitamins, hormones, enzymes. A particularly important role is played in the formation of the AA growing organism and adolescents in puberty. Skeletal muscle accounts for 50% of the total amount of free AA. Maintaining a constant concentration of amino acids in between meals depends on how balanced the power of the child in school and at home. It is important to the quality of the incoming protein.

Hitherto amino acid analysis in clinical diagnostics is mainly used for the detection of inherited diseases and metabolic disorders. However, the study of the amino acid composition of the urine is of great importance, especially in medicine, pharmaceuticals. Amino acid analysis gives an accurate value of the content of AA in the protein, whereas the protein determination according to the amount of nitrogen may lead to erroneous results. [1]. Objective: To investigate the levels of AA in the urine, and to evaluate the effectiveness of the product "Formula Growth Standard" in the nutrition of students.

MATERIALS AND METHODS

The study involved 58 students 12 - 13 years who were studying in the school health number 1998 "Lukomorye" Moscow. Among the surveyed children were divided into 3 groups: Group 1 - 20 (normal weight) got milk "Formula Growth Standard" Group 2 (control) - 10 children did not receive "Formula Growth Standard." Group 3 - 14 children (with decreased body weight) were surveyed in the dynamics before and 1 month after the start of the product "Formula Growth Standard." Composition dairy product number given in Table 1.

Table number 1

The composition of the milk product "Formula Growth Standard"

Structure	100 ml of the product	Interconnection constituents active substances with the functions of the body
Vit A, mkg-eq	56	He takes part in the exchange of AK sulfur. Takes part in the synthesis of proteins, lipids, support normal skin and mucosal epithelium. It is a part of many enzymes. With the lack of this vitamin is related metabolic disorders, stunted growth, developing xerophthalmia.
Vit D, mkg	0,3	Participates in the absorption of calcium and phosphate in the intestine. Along with the two essential AA, lysine and L-arginine. Engaged with PTH release of calcium ions from the bone tissue, promotes the differentiation of monocytes and stimulates the immune system in terms of production of macrophages. Vitamin D increases the mineralization of bone matrix. It suppresses parathyroid hormone secretion indirectly via the increase in the concentration of calcium in the blood. It enhances calcium reabsorption in the distal tubules of the kidneys. Deficiency of vitamin D leads to the development of osteoporosis.
Vit E, mg	0,8	It has a strong antioxidant effect especially in the muscles. It participates in the metabolism of proteins, fats, carbohydrates, mineral salts. With a lack of vitamin E in the body muscle myosin is replaced by collagen, violated exchange of minerals, especially calcium and phosphorus metabolism. Increases levels of AA reduces the need for vitimine E.
Vit C mg	4,4	Participates in the regeneration of tissues and bleeding in the formation of collagen, serotonin from tryptophan, catecholamines, and in the synthesis of corticosteroids in immunomodulation (interferon synthesis), in



		the metabolism of phenylalanine and tyrosine proteins. It has antioxidant and antiplatelet properties.
Vit B1, mkg	80	The lack of thiamine leads to the defeat of the central nervous system and peripheral nervous system. Reduced conditioned reflex activity. It participates in the synthesis of methionine.
Vit B2, mkg	90	Lack of riboflavin leads to disruption of metabolism in tissues and organs, the formation of a number of enzymes. Vitamin B2 is needed in the conversion of tryptophane into niacin (vitamin PP).
Niacin, mg	1,0	Normalizes blood cholesterol from the body fills the lack of tryptophan niacin.
Pantothenic acid, mkg	490	Participates in the metabolism of carbohydrates, proteins and fats, it is important to maintain and restore tissue cells, is involved in the reactions which provide energy cell.
Vit B6, mkg	120	Lack of leucine and valine in an organism depends vit B6 shortage.
Vit B12, mkg	0,2	Associated with the exchange of folic acid. Deficiency leads to megaloblastic anemia.
Folic acid, mkg	19	The conversion of serine and glycine play a major role, enzyme cofactors, which are derivatives of folic acid. Lack of folate leads to the development of megaloblastic anemia.
Biotin, mkg	4,5	Coenzyme for carboxylase enzyme involved in the synthesis of fatty acids, isoleucine and valine, and gluconeogenesis. Biotin deficiency leads to alopecia (hair loss), may develop conjunctivitis, scaly dermatitis, neurological development symptomov-depression, apathy, hallucinations, numbness and tingling in the extremities.
Choline, mg	22	The source of methyl groups (in particular, in the biosynthesis of methionine). In the formation of glycine from serine choline used as a donator of methyl groups along

		with other sources of these compounds.
Taurine, mg	12,5	It is an amino acid. Relieves irritability, anxiety, aggression, promotes the development of the central nervous system in children, reduces the convulsive compensates for heart failure and arrhythmia.
Carnitine, mg	20	The source of energy for muscle tissue, increases the processing of fat into energy and prevents the deposition of fat in the body, enhances the antioxidant action of vitamin C and E. The disadvantage carnitine leads to degeneration, impaired consciousness, appearance heart pains, weakness in the muscles.
Inositol, mg	23	Participates in protein synthesis, amino acid methionine (which is a supplier of methyl groups), necessary for the growth of muscle and bone, it is especially important for children and adolescents. Deficiency leads to deterioration of vision, and hormonal maturation, and further to infertility.
Phosphorus, mg	53	Participates in the enzyme that provides an energy favorable conditions for the reaction. It participates in the formation of phosphoserine that. then serine phosphorylated form.
Magnesium, mg	22	It takes part in the synthesis of aspartic acid. He is an active participant in the work of more than 300 enzymes, including respiratory, membrane transport
Iron, mg	0,8	Iron and histidine are included in the structure of a molecule of hemoglobin. AK cysteine, histidine, lysine digestibility increased Fe.
Zinc, mg	0,8	Zn deficiency leads to disruption of protein synthesis, dwarfism, ovoloseneniyu can cause acrodermatitis, psoriasis, anemia, delayed puberty. Isolation element depends on the cysteine and histidine.
Copper, mg	100	Lack of Cu deficiency is twofold gain

		peroxide processes, impaired transport of ATP. Copper is necessary for the mobilization of the tissue Fe Depot. At deficiency of Cu increased cholesterol, triglycerides, increases the risk of coronary heart disease. AK glycine, histidine, lysine Cu controlled delivery into cells.
Manganese, mg	100	It is essential for brain function and bone formation. It is necessary for normal insulin secretion. Interacts with choline Se - a powerful antioxidant that has anti-cancer effect, improves cardiovascular activity.
Chrome, mkg	2,2	Cr plays a role in lipid metabolism, lack of it can lead to the development of atherosclerosis involved in the metabolism of nucleic acids.
Molybdenum, mkg	3,8	It participates in the formation of enzyme complexes with proteins and oxo complexes. Catalyzes reactions associated with the exchange of complex proteins.
Selenium, mkg	3,8	Involved in the formation of proteins and nucleic acids and enzymes. Included in particular in the active site - glutathionpiroksidazy (selenocysteine). Selenomethionine - the main natural source of selenium for the human organism. Vitamin C and vitamin E contribute to a better absorption of selenium. Lack of selenium leads to disruption of cellular integrity, disruption of thyroid hormone metabolism, enhance the toxic effect of heavy metals.

The daily urine amino acid spectrum was analyzed at the children involved in the study. The urine was collected by conventional rules. A portion of the acidified urine sulphosalicylic acid (SSA) and left in the refrigerator to stabilize the amino acids in the sample. Then it was centrifuged for 10 minutes at 3000 g in a centrifuge speed with cooling company Beckman Coulter (USA). The supernatant solution was diluted sample diluent in a ratio of 1: 1. 1 ml samples were prepared and placed in an amino acid analyzer firm KNAUER (Germany). In automatic amino acid analyzer AA reaction occurs with ninhydrin, wherein the color intensity is

directly proportional to the number of AA in the sample. The principle of the method is based on liquid chromatography-tandem mass spectrometry. Value indicators AA urine expressed in mol / mol creatinine.

RESULTS

When comparing the data obtained from the urine of adolescents groups 1 and 2 (see table number 2) found that students who received the product, decreased urinary excretion of AA, as aspartic acid, glutamic acid, alanine, valine, isoleucine, phenylalanine, homocysteine, arginine. This may indicate a better absorption AA body under the influence of trace elements and vitamins that are part of the specialized dairy product.

Table 2

Effect of receiving product "Standard Growth Formula" amino acids excretion

Amino acids	Group 1 received M ± m	Group 2 received no M ± m	confidence index
	product "Formula Growth Standard"		
Aspartic acid	0,5±1,5	1,02±0,1	p ≤ 0,1
Threonine	10,8±0,8	9,1±0,9	-
Serin	24,5±4,0	23,0±1,5	-
Glutamic acid	5,5±0,8	6,7±0,3	P ≤ 0,1
Glutamine	144,0±13,8	158,2±10,2	-
Alanine	16,7±1,9	19,8±1,9	P ≤ 0,1
Valine	3,4±0,4	4,1±0,3	p ≤ 0,1
Cystine	4,4±0,7	4,6±0,4	-
Methionine	2,5±0,3	1,9±0,2	-
Isoleucine	2,8±0,5	4,6±0,4	p ≤ 0,05
Leucine	6,6±0,9	2,8±0,1	p ≤ 0,05
Tyrosine	9,9±0,9	11,1±1,4	-
Phenylalanine	5,5±0,4	6,8±0,3	p ≤ 0,01
Homocystine	1,0±0,4	3,5±1,6	p ≤ 0,05
Ethanolamine	32,1±2,6	30,9±1,6	-
Tryptopan	4,8±0,4	5,8±0,5	-
Ornithine	2,5±0,4	2,8±0,4	-
Lysine	15,8±3,3	9,0±1,8	p ≤ 0,05
Histidine	103,7±24,8	53,9±8,2	p≤ 0,05
Aginine	119,3±31,0	161,5±29,0	p ≤ 0,05
Glycine	77,4±11,2	68,0±14,0	-

AA urine excretion was higher in adolescents who did not receive milk, which may indicate a lack of digestibility of AA in children and adolescents in the period of active growth (and / or children with growth retardation) may also associated with a deficit of trace elements and vitamins. Since it is known that valine is an energy source for muscle cells, it affects the level of serotonin in the body. In insufficient intake of vitamin B6 the level of valine in the body was reduced.

Lack of valine in an organism in turn causes ataxia, hyperesthesia. [4]. With a low content in the body of isoleucine somnolence, may decrease blood sugar (hypoglycemia), and the deficit as a consequence of lost muscle mass, impaired kidney function and thyroid. Glycine is required for the formation of connective tissue. With a lack of glycine connective tissue weakens. It participates in the brain and throughout the nervous system. With a lack of glycine, there is irritability, undue anxiety, nervousness and irritability. Phenylalanine accelerates the production of protein stimulates the removal of metabolic products of the liver and kidneys, controls the rate of metabolism and many other processes are also involved in the formation of replaceable AA - tyrosine. Furthermore, phenylalanine is involved in the formation of thyroid hormones, which is especially important during adolescence at the school.

In the group of students who did not receive specialized product, it was reduced urinary excretion of leucine. The main purpose of leucine is the construction and growth of muscle tissue, the formation of the protein in muscle and liver. Leucine prevents destruction of the protein molecules, it can also serve as an energy source for the organism. The lack of leucine, this is the result of poor nutrition or lack of vitamin B6 in the body. Lowering the excretion of Aa may be indicative of a general shortage of AA in these children. The third group included 14 adolescents ($n = 14$) underweight. This group conducted a study of excretion in the urine AA before and 1 month after receiving the "Formula Growth Standard." Table 3 shows the number of amino acids excretion in the urine. It was found that the additional inclusion in the diet of children's product "growth formula Standard" has led to a change in most of excretion AA, especially essential AA (Table number 3).

Table 3

The dynamics of the renal excretion of essential AA in patients receiving specialized dairy product "Formula Growth Standard"

Amino acids irreplaceable	Before receiving M ± m	After receiving M ± m	Significance differences of
	product "Formula Growth Standard"		
Methionine	3,6±0,5	2,0±0,2	P ≤ 0,01
Leucine	7,9±0,8	3,7±0,4	P ≤ 0,05
Lysine	13,4±3,4	8,1±0,9	P ≤ 0,05
Isoleucine	1,9±0,3	5,5±0,8	P ≤ 0,05
Histidine	99,9±20,4	54,4±6,8	P ≤ 0,05

There was a significant increase in essential digestibility of AA: methionine, leucine, lysine, directly involved in bone growth and increase in muscle mass of an organism. Methionine is known to help rapidly growing organism to extract energy from fat and ensures normal functioning of the liver. With lack of methionine in the body the development of atherosclerosis, adrenal insufficiency, deficiency of choline and adrenaline are detected. Leucine, moreover, prevents the decrease in the level of serotonin, causing the body is less prone to fatigue. Thus, reducing the excretion of leucine can be attributed to positive results. At the same time the excretion of essential AA increases isoleucine, which prevents lethargy and sleepiness, which is also a welcome sign, and indicates sufficient supply of isoleucine in the baby food. Teenage body between hormonal aging and difficult adjustment of all functions and systems become more employable as a sufficient absorption of sugar, which is also dependent on the performance of pupils isoleucine increases during the training, activating the functional efficiency of the brain. In

children, there is increased activity of mental activity, improves mood, marked by activity in the behavior. There were no changes in the urinary excretion of essential AA is tryptophan, phenylalanine, valine, threonine.

The study revealed some change in the excretion replaceable AA. After 1 month in the group 3 after receiving the product "Formula Growth Standard" in urine excretion of AA decreased, as serine, glutamine acid, alanine, cysteine, tyrosine, glycine, which may indicate their better digestibility. Simultaneously slightly increased urinary excretion: aspartic acid, valine, isoleucine, arginine. This may indicate a sufficient supply of AA in the body of schoolchildren (Table 4).

Table 4

Effect of receiving product "Formula Growth Standard"
on the urinary excretion of replaceable AA

Amino acids interchangeable	Before receiving the M ± m	After receiving the M ± m	The significance of differences
	product "Formula Growth Standard"		
Glycine	107,8±16,6	68,3±7,2	P ≤ 0,05
Carnosine	12,9±1,2	9,4±0,8.	P ≤ 0,05
Aspartic acid	0,0±0,0	1,6±0,3	P ≤ 0,05

As can be seen from the table number 4, as a result of months of supplementation product "Formula Growth Standard" decreased urinary excretion of AA-essential such as glycine and carnosine. An increased excretion of aspartic acid. Before receiving this milk AA is detectable in urine. This fact may indicate that the elimination of the deficit of the AA in the body. It is known that the aspartic acid is a neurotransmitter necessary for normal functioning of the brain, particularly in children during the training period, increased teaching load and assimilation of large amounts of educational material. Another feature of the aspartic acid is its ability to increase cell membrane permeability to potassium ions and magnesium. Aspartic acid is a kind of "pulls" potassium and magnesium inside the cell. As a result, increases physical endurance and performance of the body. Aspartic acid is particularly advantageous effect on the heart muscle.

RESULTS AND DISCUSSION

Essential AA only enter the body with food. They can not be synthesized by the body but are essential for the normal life of the child. With a lack of protein in the diet of the child there is a weakness, it becomes sluggish, poorly gaining weight and growth, reduced its resistance to infections. [3,4]. Reduced working capacity, which is reflected in its performance.

The disadvantage, especially essential, AA in the body slows down growth, mental capacity, development and maturation of the body's hormonal. This is especially important during adolescence. [3].

The role of glutamic acid in children is the formation of enzymes to restore functionality tired muscles, and metabolism in the brain. Glutamic acid has the ability to bind and neutralize the ammonia, which is a strong poison for the nervous tissue.

The change in the digestibility of AA, of course, affect the minerals and vitamins contained in the product "Formula Growth Standard." Product Introduction specialized, with the composition of AA in conjunction with minerals and vitamins resulted in an increase in height and weight, which indicates the efficiency of its use among schoolchildren (Table №5).

Table 5

Changing length and weight of students in dynamics on the background of the product "Standard Growth Formula "

Children underweight, take the product (n = 14) group number 3			
Index	Before receiving the $M \pm m$	After receiving the $M \pm m$	reliability
body length , cm	155,85±1,8	161,83±2,0	$P \leq 0,01$
Body weight, cm	40,5±0,9	46,3±1,67	$P \leq 0,01$

AA are of great importance and considered to be the main products in the development of the organism. For normal operation, the liver and the intestine into the child's body are needed in large quantities of alanine and glutamine and methionine, i.e. AA supplied from the bloodstream into muscle and released from the muscle tissue. For normal kidney function are serine, alanine, glutamine, proline and glycine. For normal operation of the brain valine, phenylalanine is needed. A sufficient number of incoming AC to the baby helps to overcome physical and psychological stress and become children and adolescents to stress.

References:

1. Bakanov M.I. Basic biochemical parameters of blood and urine of healthy children // Physiology of growth and development of children and adolescents" (theoretical and clinical issues) / Ed. by A.A.Baranov, L.A.Scheplyagina. - M.: Publishing Group "GEOTAR-Media", 2006.- V. 2 – P.464.
2. Baranov AA, L.A.Scheplyagina. The problems of adolescence (selected chapters) // Russian Academy of Medical Sciences, the Union of pediatricians, Center for Information and training – 2003. – P. 480.
3. A.S. Zaichik, L.P. Churilov. Basis of pathochemistry // Pathophysiology of protein metabolism. Chapter 5. - Publishing Group "ELBI", - St. Petersburg: 2000. - P.53-103
4. Kuchma V.R. Modern trends of physical development of the Moscow school // V.R. Kuchma, L.M. Sukharev, N.A. Skoblina and et.al. Proceedings of the International scientific and practical conference "Circumpolar medicine: the impact of environmental factors on the formation of human health." 27-29 June 2011. Arkhangelsk. - P.180

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