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Analysis of the Compliance of the Actual Nutrition of Athletes during Training Camps

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Annotation: Analysis of the overall adequacy and harmony of the main and key components of the athletes' diet in different seasonal stages of the annual training cycle.

Keywords: nutrition, sports, summer-autumn, winter-spring seasons, road cyclists.

The adequacy of athletes' nutrition was analyzed depending on the season, during training camps. The compliance of actual diets with the principles of rational nutrition was assessed using the integral adequacy index (IAI), which equally took into account the caloric content and balance of diets for all the parameters studied (animal and vegetable proteins, animal and vegetable fats, carbohydrates of varying complexity: polysaccharides, oligosaccharides and indigestible, essential amino acids, fatty acids, vitamins and minerals). The level of balance of individual groups of nutrients in the studied diets was determined by their balance indicators (BI).

The energy balance and adequacy of the actual nutrition were studied using the developed author's automated system "Diet FP", the database of which was compiled and processed on the basis of reference tables of the chemical composition and energy value of products. The algorithm of the automated system is based on a mathematical model (optimal control apparatus - convex quadratic programming), allowing to calculate the IPA, which evaluates the adequacy of the diet in relation to the recommended norms of energy value and chemical composition (%), taking into account all the components of each product, as well as losses during cold and heat treatment, and PS - the balance of each group of components of the analyzed diet.

The mathematical model and computational algorithm implemented in the automated system include the following: mathematical calculations that serve as the basis for deriving the formula for calculating the IPA and PS. → IPA (the characteristic of the proximity of the vector of the studied ration C and the vector of the standard B) within the framework of this task is calculated using the formula:

ИПА = 100 - 100 * F , (1)

P

where P is the number of parameters to be optimized, F is the normalized geometric distance between vectors C and B):

p

F = √Σ ((ci / bi) - 1)^2, (2)

i=1

where ci are the parameters of the studied diet (vector C), bi are the parameters of the physiological norm standard (vector B). The value of F (2) with full compliance of the parameters of the diet and the standard can be equal to 0.

In case of ideal coincidence of the analyzed diet with the reference values for all parameters characterizing the caloric content and chemical composition, the IPA can reach 100%, in other cases the IPA <100%, and as a result of the calculation the deficit (-) and excess (+) deviations from the standard (individual physiological norm) are displayed as a percentage for each studied component. PS is determined step by step and is the result of the balance of the diet for individual groups of components (proteins, fats, vitamins, amino acids, etc.), calculated using the specified formula, but only the nutrients of the selected group are taken into account.

The work determined the energy value of the diet and energy intake due to the consumption of proteins, including animal origin, fats, including vegetable, carbohydrates (poly- and oligosaccharides). Also determined were the content of essential amino acids, fatty acids (saturated, mono- and polyunsaturated), vitamins (retinol, β-carotene, thiamine, riboflavin, niacin, ascorbic acid), macronutrients (sodium, potassium, calcium, magnesium, phosphorus) and iron. The system makes it possible to implement a personalized approach that takes into account energy expenditure, anthropometric data of the athlete and established standards of physiological needs (Methodological recommendations MR 2.3.1.2432-08 "Standards of physiological needs for energy and nutrients for various groups of the population of the Russian Federation").

Statistical processing of the obtained data was carried out using the Statistica 6.0 package. The results of the studies were presented in the format of mean and standard error of the mean (M±m).

The balance of fats of different origin in the analyzed diets of the winter-spring season is only 40.7%; in the summer-autumn season this figure increases to an average of 66.7%. Due to this imbalance, PUFA showed an even lower result (19.0% in the winter-spring season and 58.6% in the summer-autumn season). As can be seen from Table 4, the most significant imbalance in the fatty acid composition was observed in the ratio of saturated: monounsaturated: polyunsaturated fatty acids. At the same time, saturated fatty acids, regardless of the season, were in excess, especially in the actual diets in the winter-spring period. Consumption of monounsaturated fatty acids throughout the year was insufficient. The content of polyunsaturated fatty acids in different periods of the year practically corresponded to the norms, but at the same time there was a deficit of arachidonic acid, especially in the summer-autumn period (48%). However, considering the possibility of synthesizing this fatty acid from linolenic, it can be assumed that in the process of metabolism this deficit will be partially leveled.

Therefore, the imbalance in the fatty acid composition of the diets of road cyclists is primarily due to excessive consumption of saturated and insufficient amounts of monounsaturated fatty acids.

Table 5. Average daily consumption of vitamins by cyclists when eating in an organized format in different seasonal periods of the year

Vitamin	*Content in daily rations*			
	summer-autumn season		*winter-spring season*	
	M±m, мг/*M±m*, mg	% от N*/% of N*	*M±m*, мг/*M±m*, mg	% от N*/% of N*
Vitamin A, retinol equivalent	2,73±0,13	-22,0	2,00±0,10	-33,4
Retinol	2,11±0,11	+83,5	1,77±0,14	-41,0
Thiamine	2,00±0,09	-37,5	1,92±0,06	-40,0
Riboflavin	2,11±0,03	-47,5	2,38±0,12	-40,5
Niacin, niacin equivalents	45,6±2,3	+75,3	47,5±2,0	+76,1
Niacin	25,6±2,0	-1,6	24,2±2,0	-6,9
Ascorbic acid	184±15	-8,0	78±9	-61,1

The assessment of the vitamin content in the actual diets of athletes (Table 5) revealed significant seasonal changes. First of all, this concerned vitamin C, a significant deficiency of which was observed in winter and spring. In the diets of the winter-spring period, a deficiency of vitamin A (in the form of the sum of retinol compounds) was found, which amounted to approximately 1/3, and in summer and autumn - 22.0%. In addition, in the winter-spring diets, an imbalance of retinol and β-carotene was noted, which led to an insufficiency of the sum of retinol compounds with their fairly high absolute amount. The average daily consumption of the other vitamins studied depended less on the seasons. Thus, for the diets of all periods, a deficiency of thiamine and riboflavin was characteristic, which amounted to about 40% both in summer and autumn, and in winter and spring.

When assessing the provision of cyclists with niacin in their actual diets, its formation from the amino acid tryptophan was taken into account (1 mg of niacin is synthesized from 60 mg of tryptophan). Calculations showed that the consumption of vitamin PP in niacin equivalents exceeded the recommended value throughout the year.

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