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IRON, CALCIUM AND ZINC IN THE DIET OF VEGETARIANS

In today's context of popularizing a healthy lifestyle, vegetarianism is increasingly gaining attention as a style of eating that combines ethical, environmental and health aspects. However, refusal to consume animal products is often accompanied by the risk of deficiency of important biogenic elements such as Iron, Calcium and Zinc, which negatively affects the overall health of a person [1].

A particular danger is the low bioavailability of Iron in plant products due to the presence of antinutrients that reduce its absorption [5].

A lack of Iron intake from food can lead to the development of serious health problems: anemia, immune system dysfunction, decreased work capacity and overall body endurance [5].

Considering these risks, it is of particular importance to find ways to compensate for possible deficiencies of Calcium, Zinc and Iron. One of the most effective methods is careful dietary planning, taking into account food sources of the necessary nutrients [1].

Two forms of Iron can be found in food: heme and nonheme. Vegetarians consume only nonheme Iron, which is found in fruits, vegetables, dried beans, nuts, and cereals, because heme Iron is found only in animal products. Nonheme Iron is absorbed from the intestines with less efficiency than heme Iron. Strict control of Iron absorption from food is important to maintain Iron levels within normal limits to reduce the risk of deficiency. Ascorbic acid is a well-known dietary factor that improves Iron bioavailability, but Calcium, polyphenols, and phytates reduce intestinal absorption of Iron. It is necessary to consider the type of foods in the diet to maintain the balance of Iron in the human body, as lack of Iron absorption leads to Iron deficiency anemia [5].

For the human body to absorb Calcium, the element must be in an accessible form. Dietary Calcium must dissolve in the acidic environment of the stomach or

remain in solution if it is already dissolved. 90% of Calcium absorption occurs in the thin intestine. Calcium is absorbed in its soluble ionized form (Ca^{2+}) or bound to a soluble organic molecule to cross the intestinal wall. To increase the bioavailability of Calcium from plant foods, you should choose sources with a low oxalate content or eat calcium-enriched foods, such as spinach, parsley, nuts, sunflower seeds, dried fruits, figs, soybeans, beans, onions, buckwheat and oatmeal. In case of an increased need for Calcium, supplements may be used under medical supervision [6].

Foods rich in Zinc include beans, sesame seeds, nuts, pumpkin seeds, coffee beans, spinach, onions, carrots, and cereals (wheat germ, rice and oat bran). After eating, digestive processes begin to release dietary Zinc from the food matrix, making it available for absorption. The acidic stomach environment hydrolyzes dietary Zinc, and after passing through the pyloric sphincter into the duodenum, pancreatic juice containing bicarbonate and digestive enzymes mixes with the digested food, neutralizing stomach acid and starting to hydrolyze food protein, thus releasing the dietary Zinc bound to the protein. Pancreatic juice contains significant amounts of Zinc. Several milligrams of Zinc are secreted daily into pancreatic juice, while only about 2.5-3.5 milligrams of Zinc per day are absorbed from food to meet physiological requirements. The kinetics of Zinc in plasma after oral administration corresponds to the intestinal-hepatic recirculation, whereby the absorbed Zinc is excreted with pancreatic juice and reabsorbed. Zinc deficiency in humans is considered the most common nutrient deficiency worldwide. The etiology of zinc deficiency in humans has historically been associated with diets with low zinc bioavailability, e.g., the proportion of dietary Zinc available for zinc-dependent functions, with the focus on diets low in zinc and high in phytic acid [3].

In the vegetarian diet, plant-based foods often contain high levels of phytates, which are powerful inhibitors of Iron, Zinc, and Calcium absorption. Therefore, an important strategy is to use culinary methods that reduce the amount of antinutrients, such as soaking, germination, and fermentation of beans and cereals. These technologies increase the bioavailability of micronutrients and promote better absorption of nutrients [2].

Also, especially for risk groups (pregnant women, children, older people), it is advisable to use specialized Calcium and vitamin D supplements prescribed by a doctor or nutritionist [4].

For vegetarians, Zinc is an essential trace element that is almost everywhere in nature and is necessary for all known aspects of life [2].

An equally important element in the diet of vegetarians is Iron, as it is involved in many functions of the human body, including oxygen transport, immunity, cell

separation and differentiation, and energy metabolism. Iron homeostasis is mainly controlled by intestinal absorption, as Iron has no active excretion mechanisms for humans [5].

Conclusions. Thus, the correct nutritional support of a vegetarian diet can minimize the risks of Iron, Calcium and Zinc deficiency, ensuring a high level of health and quality of life. Systematic consultation, monitoring of biochemical parameters and educational work among vegetarians should become mandatory elements of Iron, Calcium and Zinc deficiency prevention.

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