

Functions of vitamins

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Vitamins are a group of organic nutrients of various nature required in small quantities for multiple biochemical reactions for the growth, survival and reproduction of the organism, and which, generally, cannot be synthesized by the body and must therefore be supplied by the diet. The most prominent function of the vitamins is to serve as coenzymes (or prosthetic group) for enzymatic reactions. The discovery of the vitamins began with experiments performed by Hopkins at the beginning of the twentieth century; he fed rats on a defined diet providing the then known nutrients: fats, proteins, carbohydrates, and mineral salts. The animals failed to grow, but the addition of a small amount of milk to the diet both permitted the animals to maintain normal growth and restored growth to the animals that had previously been fed the defined diet.

He suggested that milk contained one or more —accessory growth factors— essential nutrients present in small amounts, because the addition of only a small amount of milk to the diet was sufficient to maintain normal growth and development. The first of the accessory food factors to be isolated and identified was found to be chemically an amine; therefore, in 1912, Funk coined the term *vitamine*, from the Latin *vita* for life and *amine*, for the prominent chemical reactive group. Although subsequent accessory growth factors were not found to be amines, the name has been retained— with the loss of the final ‘-e’ to avoid chemical confusion. The decision as to whether the word should correctly be pronounced “vitamin” or “veitamin” depends in large part on which system of Latin pronunciation one learned – the Oxford English Dictionary permits both. During the first half of the twentieth century, vitamin deficiency diseases were common in developed and developing countries. At the beginning of the twenty-first century, they are generally rare, although vitamin A deficiency is a major public health problem throughout the developing world, and there is evidence of widespread subclinical deficiencies of vitamins B2 and B6. In addition, refugee and displaced populations are at risk of multiple B vitamin deficiencies, because the cereal foods used in emergency rations are not usually fortified with micronutrients.

6 Vitamins are grouped together according to the following general biological characteristics:

1. Vitamins are not synthesized by the body and must come from food. An exception are vitamin B3 (PP), which active form NADH (NADPH) can be synthesized from tryptophan and vitamin D3 (cholecalciferol), synthesized from 7- dehydrocholesterol in the skin. Amount of those ones and vitamins partially synthesized by intestinal microflora (B1, B2, B3, B5, B6, K, and others) is normally not sufficient to cover the body's need them.

2. Vitamins are not plastic material. Exception is vitamin F.

3. Vitamins are not an energy source. Exception is vitamin F.

4. Vitamins are essential for all vital processes and biologically active already in small quantities.

5. They influence biochemical processes in all tissues and organs, i.e. they are not specific to organs.

6. They can be used for medicinal purposes as a non-specific tools in high doses for: diabetes mellitus - B1, B2, B6; colds and infectious diseases - vitamin C; bronchial asthma - vitamin PP; gastrointestinal ulcers - vitamin-like substance U and nicotinic acid; in hypercholesterolemia - nicotinic acid. Since only a few vitamins can be stored (A, D, E, B12), a lack of vitamins quickly leads to deficiency diseases (hypovitaminosis or avitaminosis). These often affect the skin, blood cells, and nervous system. The causes of vitamin deficiencies can be treated by improving nutrition and by administration vitamins in tablet form. An overdose of vitamins leads to hypervitaminosis state only, with toxic symptoms, in the case of vitamins A and D. Normally, excess vitamins are rapidly excreted with the urine. Lack of vitamins leads to the development of pathological processes in the form of specific hypo- and avitaminosis. Widespread hidden forms of vitamin deficiency have not severe external manifestations and symptoms, but have a negative impact on performance, the overall tone of the body and its resistance to various adverse factors.

Avitaminosis is a disease that develops in the absence of a particular vitamin. Currently avitaminosis are not commonly found, but hypovitaminoses are observed with vitamin deficiency in the body. Numerous examples you can see in the table 1.

Table 1. Vitamin functions and manifestations of hypo- and avitaminoses

Vitamin		Functions	Hypovitaminosis symptoms
B ₁	Thiamin	Functional part of coenzyme TPP in pyruvate and α -ketoglutarate dehydrogenases, transketolase; poorly defined function in nerve conduction	Peripheral nerve damage (polyneuritis beriberi) or central nervous system lesions (Wernicke-Korsakoff syndrome) Concentration of pyruvate is increased in the patient's blood, the most of which is excreted with urine
B ₂	Riboflavin	Functional part of coenzymes FAD, FMN in oxidation-reduction reactions	Epithelial, mucosa, cutaneous, corneal lesions: lesions of corner of mouth, lips, and tongue; seborrheic dermatitis
B ₃ (PP)	Niacin, nicotinic acid, nicotinamide	Functional part of coenzymes NAD ⁺ , NADP ⁺ in oxidation-reduction reactions	Pellagra: photosensitive dermatitis, glossitis (tongue inflammation), alopecia (hair loss), edema (swelling), diarrhea, depressive psychosis, aggression, ataxia (lack of coordination), dementia, weakness
B ₅	Pantothenic acid	Functional part of coenzyme CoA (universal acyl carrier in Krebs cycle, fatty and other carboxylic acid metabolism) and phosphopantetheine (acyl carrier protein in fatty acid synthesis)	Numbness in the toes, burning sensation in the feet, the defeat of mucous membranes of internal organs, early graying, hair loss, various disorders of the skin: the development of small cracks in the corners of the mouth, the appearance of white patches on various parts of the body. There may also be depressed mood, fatigue.
B ₆	Pyridoxine, pyridoxal, pyridoxamine	Functional part of coenzyme PLP in transamination and decarboxylation of amino acids and glycogen phosphorylase	Dermatitis of the eyes, nose, and mouth. There is mental confusion, glossitis and peripheral neuropathy, convulsions (due to lack of inhibitory neurotransmitter GABA)
B ₇ (H)	Biotin	Coenzyme in carboxylation reactions in gluconeogenesis and fatty acid synthesis	Seborrheic dermatitis, anemia, depression, hair loss, high blood sugar levels, inflammation or pallor of the skin and mucous membranes, insomnia, loss of appetite, muscle aches, nausea, sore tongue, dry skin, high blood cholesterol
B ₉	Folic acid	Functional part of coenzyme THFA in transfer of one-carbon fragments	Megaloblastic anemia: red tongue, anemia, lethargy, fatigue, insomnia, anxiety, digestive disorders, growth retardation, breathing difficulties, memory problems. Deficiency during pregnancy is associated with neural tube defects