Vitamin B12 - description, benefits, effects on the body and the best sources

Eliseeva Tatyana, editor-in-chief of the EdaPlus.info project

Anastasia Mironenko, nutritionist

Email: eliseeva.t@edaplus.info, myronenko.a@edaplus.info

Abstract. The article discusses the main properties of the vitamin B12 and its effect on the human body. A systematic review of modern specialized literature and relevant scientific data was carried out. The best natural sources of vitamin B12 are indicated. The use of the vitamin in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of vitamin B12 on the human body under certain medical conditions and diseases are analyzed separately.

Key words: vitamin B12 , vitamin B12 , benefits, harms, beneficial properties, contraindications, sources

Chemical formula:

$C_{63}H_{88}CoN_{14}O_{14}P$

Also known as: *cobalamin, cyanocobalamin , hydroxocobalamin , methylcobalamil , cobamamide , Castle extrinsic factor* .

Discovery history

In the 1850s, an English physician described a deadly form of anemia, attributing it to an abnormal gastric mucosa and a lack of stomach acid. Patients exhibited symptoms of anemia, inflammation of the tongue, numbness of the skin, and abnormal gait. There was no cure for the disease, and it was invariably fatal. The patients were malnourished, hospitalized and had no hope of treatment.

George Richard Minot , M.D. at Harvard, had the idea that substances in food could help patients. Minot teamed up with William Parry in 1923. Murphy , basing his research on previous work by George Whipple . In this study, dogs were brought to a state of anemia, and then they tried to determine which foods restore red blood cells. Vegetables, red meat, and especially liver were effective.

In 1926, at a convention in Atlantic City, Minot and Murphy reported the sensational discovery that 45 patients with pernicious anemia were cured by taking large amounts of raw liver. Clinical improvement was evident and usually occurred within 2 weeks. For this , Minot , Murphy , and Whipple received the Nobel Prize in Medicine in 1934. Three years later, William Castle , also a Harvard scientist, discovered that the disease was due to some factor in the stomach. People with their stomach removed often died of pernicious anemia, and eating the liver did not help. This factor, present in the gastric mucosa, was called "intrinsic" and was necessary for the normal absorption of "extrinsic factor" from food. "Intrinsic factor" was absent in patients with pernicious anemia. In 1948, "extrinsic factor" was isolated in crystalline form from the liver and published by Carl Folkers and co-workers. They called it vitamin B12.

In 1956, British chemist Dorothy Hodgkin described the structure of the vitamin B12 molecule, for which she received the Nobel Prize in Chemistry in 1964. In 1971, organic chemist Robert Woodward announced the successful synthesis of the vitamin after ten years of trying.

The fatal disease could now be easily treated with injections of pure vitamin B12 and without side effects. Patients recovered completely [2] .

Products with the maximum content of vitamin B12 [11]:

Product	Content (µg/100 g)
Beef liver, fried	**83.13**
Beef liver, stewed	**70.58**
Beef liver, raw	**59.3**
Chicken liver, raw	**16.58**
Mussels, raw	**12**
shellfish	**11.28**
Tuna, raw	**9.43**
Sardines, canned in oil	**8.94**
Atlantic mackerel, raw	**8.71**
Rabbit	**7.16**
wild salmon	**3.18**
Swiss cheese	**3.06**
Mutton	**2.39**
Beef	**1.97**
Feta	**1.69**
Shrimp, raw	**1.11**
Chicken egg, raw	**0.89**
Whole cow's milk	**0.45**
Cottage cheese	**0.43**
Yogurt	**0.37**
Chicken breast	**0.34**

See also Top 100 Natural Sources of Vitamin B 12 .

Daily requirement for vitamin B12

The recommended intake for vitamin B12 is determined by the nutritional committees in each country and ranges from 1 to 3 micrograms per day. For example, the norm set by the US Food and Nutrition Board in 1998 is as follows [3] :

Age	**Men: (mcg/day)**	**Women: (mcg/day)**
babies 0–6 months	0.4 µg	0.4 µg
babies 7–12 months	0.5 mcg	0.5 mcg
Children 1–3 years	0.9 mcg	0.9 mcg
Children 4–8 years	1.2 mcg	1.2 mcg
Children 9–13 years old	1.8 mcg	1.8 mcg
Teenagers 14–18 years old	2.4 mcg	2.4 mcg
adults 19-50 years old	2.4 mcg	2.4 mcg
adults 51 years and older	2.4 mcg	2.4 mcg
pregnant any age	-	2.6 mcg
lactating any age	-	2.8 mcg

In 1993, the European Committee on Nutrition established the daily intake of vitamin B12:

Age	**Men: (mcg/day)**	**Women: (mcg/day)**
6–12 months	0.5 mcg	0.5 mcg
1–3 years	0.7 mcg	0.7 mcg
4–6 years	0.9 mcg	0.9 mcg
7–10 years	1.0 mcg	1.0 mcg
11–14 years old	1.3 mcg	1.3 mcg
15–17 years old	1.4 mcg	1.4 mcg
18 years and older	1.4 mcg	1.4 mcg
pregnant	-	1.6 mcg

lactating	-	1.9 mcg

Comparative table of the recommended amount of vitamin B12 per day, according to data in different countries and organizations [4] :

European Union (including Greece)	1.4 mcg/day
Belgium	1.4 mcg/day
France	2.4 mcg/day
Germany, Austria, Switzerland	3.0 mcg/day
Ireland	1.4 mcg/day
Italy	2 mcg/day
Netherlands	2.8 mcg/day
Nordic countries	2.0 mcg/day
Portugal	3.0 mcg/day
Spain	2.0 mcg/day
Great Britain	1.5 mcg/day
USA	2.4 mcg/day
World Health Organization, Food and Agriculture Organization of the United Nations	2.4 mcg/day

The need for vitamin B12 increases in such cases:

- older people often have decreased gastric secretion of hydrochloric acid (resulting in reduced absorption of vitamin B12) and an increased number of bacteria in the gut, which can reduce the level of the vitamin available to the body;
- with atrophic gastritis, the body's ability to absorb natural vitamin B12 from food decreases;
- with malignant (pernicious) anemia, there is no substance in the body that helps absorb B12 from the alimentary tract;
- during gastrointestinal operations (for example, truncation of the stomach or its removal), the body loses cells that secrete hydrochloric acid and contain an internal factor that promotes the absorption of B12;
- in people on a diet that does not contain animal products; and also in infants whose breastfeeding mothers are vegetarian or vegan .

In all of the above cases, vitamin B12 deficiency can occur in the body, which can lead to very serious consequences. To prevent and treat these conditions, physicians prescribe a synthetic vitamin either orally or by injection [5] .

Physico-chemical properties of vitamin B12

In fact, vitamin B12 is a whole group of substances containing cobalt. It includes cyanocobalamin , hydroxocobalamin , methylcobalamin and cobamamide . In the human body, it is cyanocobalamin that is most active . This vitamin is considered the most complex in its structure, in comparison with other vitamins.

Cyanocobalamin has a dark red color, occurs in the form of crystals or powder. Has no smell or color. Soluble in water, resistant to air, but destroyed by ultraviolet rays. Vitamin B12 is very stable at high temperatures (the melting point of cyanocobalamin is from 300°C), but loses its activity in a very acidic environment. Also soluble in ethanol and methanol. Since vitamin B12 is water-soluble, the

body needs to get enough of it at all times. Unlike fat-soluble vitamins, which are stored in fatty tissues and gradually used by our organs, water-soluble vitamins are excreted from the body as soon as a dose above the daily requirement has been received [6,7] .

Scheme of getting B12 into the blood:

Vitamin B12 is involved in the formation of genes, protects the nerves and helps in metabolism. However, for this water-soluble vitamin to function properly, it must be adequately consumed and absorbed. Various factors contribute to this.

In food, vitamin B12 is associated with a certain protein, which, under the influence of gastric juice and pepsin, dissolves in the human stomach. When B12 is released, a binding protein attaches to it and protects it while it is transported to the small intestine. Once the vitamin is in the gut, a substance called "intrinsic factor B12" separates the vitamin from the protein. This allows vitamin B12 to enter the bloodstream and perform its functions. In order for B12 to be properly absorbed by the body, the stomach, small intestine, and pancreas must be healthy. In addition, a sufficient amount of intrinsic factor must be produced in the gastrointestinal tract. Drinking large amounts of alcohol can also affect the absorption of vitamin B12 by reducing stomach acid production. [8,9] .

Useful properties and its effect on the body

Interaction with other elements

While numerous diseases and medications can negatively affect the effectiveness of vitamin B12, certain nutrients can support its effect or even make it possible in general:

- **folic acid** : this substance is the direct "partner" of vitamin B12. It is responsible for converting folic acid back into its biologically active form after various reactions - in other words, it reactivates it. Without vitamin B12, the body quickly suffers from a functional deficiency of folic acid, as it remains in our body in an unusable form. On the other hand, vitamin B12 also requires the presence of folic acid: in one of the reactions, folic acid (more specifically, methyltetrahydrofolate) releases a methyl group for vitamin B12. Methylcobalamin then goes into a methyl group to homocysteine , whereby it is converted to methionine.
- **biotin** : The second biologically active form of vitamin B12, adenosylcobalamin , requires biotin (also known as vitamin B7 or vitamin H) and magnesium to perform its essential mitochondrial function. In the case of biotin deficiency, a situation may arise where there is sufficient adenosylcobalamin , but it is useless because its reaction partners cannot be formed. In these cases, symptoms of vitamin B12 deficiency may occur, although blood levels of B12 remain normal. On the other hand, a urinalysis shows a deficiency of vitamin B12, although in fact it is not. Supplementation with vitamin B12 would also not lead to the cessation of the corresponding symptoms, since vitamin B12 simply remains ineffective due to biotin deficiency. Biotin is very sensitive to free radicals, so getting extra biotin becomes necessary in cases of stress, heavy sports and illness.
- **Calcium** : Intestinal absorption of vitamin B12 by intrinsic factor is directly dependent on calcium. In cases of calcium deficiency, this method of absorption becomes extremely limited, which can lead to a slight vitamin B12 deficiency. An example of this is taking metaphenin , a diabetes drug that lowers intestinal calcium levels to the point where many patients develop a B12 deficiency. However, studies have shown that this can be compensated by the simultaneous administration of vitamin B12 and calcium. As a result of an unhealthy diet, many people suffer from high acidity. This means that most of the calcium consumed is used to neutralize the acid. Thus, excessive acidity in the intestines can lead to B12 absorption

problems. Vitamin D deficiency can also lead to calcium deficiency. In this case, it is advised to take vitamin B12 with calcium to optimize the rate of absorption of intrinsic factor.
- **vitamins B2 and B3** : they help convert vitamin B12 after it has been converted to its bioactive coenzyme form [10] .

Absorption of vitamin B12 with other foods

Foods high in vitamin B12 are good to eat with black pepper. Piperine, a substance found in peppers, helps the body absorb B12. As a rule, we are talking about meat and fish dishes.

Research shows that consuming the right ratio of folic acid and B12 can improve health, strengthen the heart, and reduce the risk of developing Alzheimer's disease; however, if there is too much acid, it can interfere with B12 absorption and vice versa. Thus, maintaining an optimal amount of each is the only way to prevent a deficiency from occurring. Folic acid is found in leafy greens, beans, and broccoli, while B12 is found primarily in animal products such as fish, organic and lean meats, dairy, and eggs. Try to combine them!

Natural B12 or dietary supplements?

Like any other vitamin, B12 is best obtained from natural sources. There are studies that synthetic food additives can harm the body. In addition, only a doctor can determine the exact amount of a substance necessary for health and well-being. However, in some cases, synthetic vitamins are indispensable.

In dietary supplements, vitamin B12 is usually present as cyanocobalamin , a form that the body readily converts to the active forms methylcobalamin and 5-deoxyadenosylcobalamin. Dietary supplements may also contain methylcobalamin and other forms of vitamin B12. Existing evidence does not show any difference between the forms in terms of absorption or bioavailability . However, the body's ability to absorb vitamin B12 from dietary supplements is largely limited by the ability of intrinsic factor. For example, only about 10mcg of a 500mcg oral supplement is actually absorbed by healthy individuals [5] .

Vegetarians and vegans should especially think about the additional intake of vitamin B12 . B12 deficiency among vegetarians depends mainly on the type of diet they follow. Vegans are most at risk . Some B12-fortified cereal products are a good source of the vitamin and often contain more than 3 micrograms of B12 for every 100 grams. In addition, some brands of nutritional yeast and flakes are fortified with vitamin B12. A variety of soy products, including soy milk, tofu, and meat substitutes, also contain synthetic B12. It is important to look at the composition of the product, since not all of them are fortified with B12, and the amount of the vitamin can vary.

Various infant formulas, including those based on soy, are fortified with vitamin B12. Formula-fed newborns have higher vitamin B12 levels than breastfed babies. While exclusive breastfeeding is recommended during the first 6 months of a baby's life, adding a fortified formula with vitamin B12 during the second half of infancy can be quite beneficial.

A few recommendations for those who adhere to vegetarianism and veganism :

- Make sure you have a reliable source of vitamin B12 in your diet, such as fortified foods or dietary supplements. As a rule, it is not enough to consume only eggs and dairy products.
- Ask your healthcare provider to check your B12 levels once a year.
- Make sure your vitamin B12 levels are normal before and during pregnancy and if you are breastfeeding.
- Older vegetarians, especially vegans , may need higher doses of B12 due to age-related issues.

- Higher doses are likely to be needed for people who are already deficient. According to the professional literature, doses ranging from 100 micrograms per day (for children) to 2000 micrograms per day (for adults) are used to treat people with vitamin B12 deficiency [12] .

The following table contains a list of foods that can be included in a vegetarian and vegan diet and are great for maintaining normal B12 levels in the body [13] :

Product	Vegetarianism	Veganism	Comments
Cheese	Yes	Not	Cheese is an excellent source of vitamin B12, but some types contain more than others. Swiss cheese, mozzarella , feta are recommended .
Eggs	Yes	Not	The largest amount of B12 is found in the yolk. The richest in vitamin B12 are duck and goose eggs.
Milk	Yes	Not	
Yogurt	Yes	Not	
Vegetarian Spreads with Nutritional Yeast	Yes	Yes	Most spreads can be consumed by vegans . However, you need to pay attention to the composition of the product, as not all spreads are enriched with vitamin B12.

Application in official medicine

Health Benefits of Vitamin B12:

- Possible preventive effect against cancer: Vitamin deficiency leads to problems with folic acid metabolism. As a result, the DNA cannot replicate properly and gets damaged. Experts believe that damaged DNA can directly contribute to the formation of cancer. Vitamin B12 supplementation along with folic acid is being researched as a way to help prevent and even treat certain types of cancer.
- Promotes Brain Health: Low levels of vitamin B12 have been seen to increase the risk of Alzheimer's in older men and women. B12 helps keep homocysteine levels low , which may play a role in the development of Alzheimer's disease. It is also important for focus and may help reduce ADHD symptoms and poor memory.
- May prevent depression: Numerous studies have shown a correlation between depression and vitamin B12 deficiency. This vitamin is essential for the synthesis of a neurotransmitter associated with mood regulation. One study, published in the American Journal of Psychiatry,

examined 700 women with disabilities over the age of 65. Researchers have found that women with vitamin B12 deficiency are twice as likely to suffer from depression.
- Prevention of anemia and healthy blood formation: Vitamin B12 is essential for the healthy production of red blood cells that are normal in size and maturity. Immature as well as undersized red blood cells can lead to lower blood oxygen levels, general symptoms of weakness and exhaustion.
- Maintain optimal energy levels: As one of the B vitamins, vitamin B12 helps turn proteins, fats and carbohydrates into "fuel" for our body. Without it, people often experience chronic fatigue. Vitamin B12 is also required for neurotransmitter signaling , which helps muscles contract and maintains energy levels throughout the day [1] .

Vitamin B12 in dosage form can be prescribed in such cases:

- with hereditary vitamin deficiency (Immerslud-Grasbeck disease). It is prescribed as an injection, first for 10 days, and then throughout life once a month. This therapy is effective for people with impaired vitamin absorption;
- with pernicious anemia. Usually in the form of injections, oral or nasal preparations;
- with a deficiency of vitamin B12;
- with cyanide poisoning;
- with high levels of homocysteine in the blood. Taken in combination with folic acid and vitamin B6;
- with an age-related eye disease called age-related macular degeneration;
- with skin lesions shingles. In addition to relieving skin symptoms, vitamin B12 may also relieve pain and itching in this disease;
- with peripheral neuropathy [14] .

In modern medicine, three synthetic forms of vitamin B12 are most common - cyanocobalamin , hydroxocobalamin , cobabmamide . The first is used in the form of intravenous, intramuscular, subcutaneous or intralumbar injections, as well as in the form of tablets. Hydroxocobalamin can only be administered under the skin or into muscles. Cobamamide is given by injection into a vein or muscle, or taken by mouth. It is the fastest of the three types. In addition, these drugs exist in the form of powders or ready-made solutions. And, without a doubt, vitamin B12 is often included in multivitamin preparations.

The use of vitamin B12 in traditional medicine

Traditional medicine, first of all, advises taking foods rich in vitamin B12 for anemia, weakness, and a feeling of chronic fatigue. Such products are meat, dairy products, liver.

There is an opinion that vitamin B12 can have a positive effect on psoriasis and eczema. Therefore, folk doctors advise using ointments and creams, which include B12, externally and in the form of courses of treatment.

Vitamin B12 in the latest scientific research

- Scientists from the Norwegian Institute of Science and Technology have determined that a lack of vitamin B12 during pregnancy is associated with an increased risk of preterm birth. The study involved 11216 pregnant women from 11 countries. Premature births and underweight fetuses are responsible for a third of the nearly 3 million newborn deaths each year. The researchers determined that the results also depended on the country of residence of the mother of the fetus - thus, high B12 levels were associated with a high birth weight ratio in low- and

middle-income countries, but did not differ in countries with a high level of residence. However, in all cases, vitamin deficiency has been associated with a risk of preterm birth [15].

- A study based at the University of Manchester shows that adding high doses of certain vitamins to traditional treatment - especially vitamins B6, B8 and B12 - can significantly reduce the symptoms of schizophrenia. Such doses reduced mental symptoms, while low amounts of vitamins were ineffective. In addition, B vitamins have been noted to be most beneficial in the early stages of the disease [16].
- Norwegian scientists have found that low levels of vitamin B12 in infants are associated with a subsequent decline in children's cognitive abilities. The study was conducted among Nepalese children, since vitamin B12 deficiency is very common in South Asian countries. Vitamin levels were first measured in neonates (aged 2 to 12 months) and then in the same children 5 years later. Children who had lower B12 levels performed worse on tests such as putting together a puzzle, recognizing letters, and interpreting the emotions of other children. Vitamin deficiency was most often caused by insufficient consumption of animal products due to the low standard of living in the country [17].
- A first-of-its-kind, long-term study from the Center for Cancer Research at Ohio State University shows that long-term supplementation of vitamins B6 and B12 leads to an increased risk of lung cancer in male smokers. The data was collected from more than 77,000 patients who took 55 micrograms of vitamin B12 every day for 10 years. All participants were in the 50 to 76 age group and were enrolled in the study between 2000 and 2002. As a result of observations, it was revealed that in men who smoke, the risk of developing lung cancer was four times higher than in those who did not take B12 [18].
- A recent study suggests that taking certain vitamins such as B12, D, coenzyme Q10, niacin, magnesium, riboflavin, or carnitine may have a therapeutic effect on migraine attacks. This neurovascular disease affects 6% of men and 18% of women worldwide and is a very serious condition. Some scientists claim that it may be due to a lack of antioxidants or mitochondrial dysfunction. As a result, these vitamins and microelements, having antioxidant properties, can improve the patient's condition and reduce the symptoms of the disease. [19].

The use of vitamin B12 in cosmetology

It is believed that vitamin B12 has a beneficial effect on the condition of the hair. By applying cyanocobalamin topically, you can add beautiful shine and strength to your hair. To do this, it is advised to use pharmacy vitamin B12 in ampoules, adding it to masks - both natural (based on oils and natural products) and purchased. For example, the following masks will benefit the hair:

- mask, which contains vitamins B2, B6, B12 (from ampoules), almond oil and burdock oil (a tablespoon), 1 raw chicken egg. All ingredients are mixed and applied to the hair for 5-10 minutes;
- a mixture of vitamin B12 (1 ampoule) and 2 tablespoons of red pepper. With such a mask, you need to be extremely careful and apply it only to the hair roots. It will strengthen the roots and accelerate hair growth. You need to keep it no longer than 15 minutes;
- mask with vitamin B12 from the ampoule, a teaspoon of castor oil, a teaspoon of liquid honey and 1 raw chicken yolk. This mask can be washed off an hour after application;

The positive effect of vitamin B12 is observed when it is applied to the skin. It is believed that it helps to smooth out the first wrinkles, tone the skin, renew its cells and protect it from the harmful effects of the external environment. Cosmetologists advise using pharmacy vitamin B12 from an ampoule, mixing it with a fatty base - be it oil, sour cream or petroleum jelly. An effective anti-aging mask is a mask of liquid honey, sour cream, chicken egg, lemon essential oil, with the addition of vitamins B12 and B12 and aloe vera juice. This mask is applied to the face for 15 minutes, 3-4 times a week. In

general, vitamin B12 for skin works well with cosmetic oils and vitamin A. However, before using any cosmetic substance, it is worth testing for an allergy or adverse skin reaction.

The use of vitamin B12 in animal husbandry

Like humans, some animals produce intrinsic factor in their bodies, which is necessary for the absorption of the vitamin. Such animals are monkeys, pigs, rats, cows, ferrets, rabbits, hamsters, foxes, lions, tigers and leopards. Intrinsic factor has not been found in guinea pigs, horses, sheep, birds, and some other species. It is known that in dogs only a small amount of the factor is produced in the stomach - most of it is located in the pancreas. Factors affecting the absorption of vitamin B12 in animals - deficiency of protein, iron, vitamin B6, removal of the thyroid gland, hyperacidity. The vitamin is stored mainly in the liver, as well as the kidneys, heart, brain and spleen. As in humans, the vitamin is excreted in the urine, while in ruminants it is mainly excreted in the faeces.

Dogs rarely show signs of vitamin B12 deficiency, however, they need it for normal growth and development. The best sources of B12 are the liver, kidneys, milk, eggs, and fish. In addition, most ready-made feeds are already enriched with essential vitamins and minerals, including B12.

Cats need about 20 micrograms of vitamin B12 per kilogram of body weight to maintain normal growth, pregnancy, lactation, and hemoglobin levels. Studies show that kittens can go without vitamin B12 for 3-4 months without noticeable effects, after which their growth and development slows down significantly to a complete halt.

The main source of vitamin B12 for ruminants, pigs and poultry is cobalt, present in soil and feed. Vitamin deficiency is manifested in growth retardation, poor appetite, weakness, and nervous diseases [20].

The use of vitamin B12 in crop production

For many years, scientists have been trying to find a way to get vitamin B12 from plants, since the main natural source of it is animal products. Some plants are able to absorb the vitamin through their roots and thus enrich themselves with it. For example, barley grains or spinach contained a significant amount of vitamin B12 after fertilizer was added to the soil. Thus, through such research, opportunities are expanding for people who cannot get enough of the vitamin from its natural sources [21].

Myths about vitamin B12

- **Bacteria in the mouth or gastrointestinal tract produce enough vitamin B12 on their own.** If this were true, vitamin deficiency would not be so common. You can only get the vitamin from animal products, artificially fortified foods or nutritional supplements.
- **Sufficient amounts of vitamin B12 can be obtained from fermented soy foods, probiotics , or algae (such as spirulina)** . In fact, these products do not contain vitamin B12, and its content in algae is very controversial. Even though present in spirulina , it is not the active form of vitamin B12 required by the human body.
- **It takes 10 to 20 years for vitamin B12 deficiency to develop.** In fact, deficiency can develop quite quickly, especially with a sudden change in diet, for example, when switching to a vegetarian or vegan diet [12].

Contraindications and warnings

Signs of a vitamin B12 deficiency

Clinical cases of vitamin B12 deficiency are extremely rare, and in most cases they are due to serious metabolic disorders, diseases, or a complete rejection of foods containing the vitamin. Only a doctor can determine whether there is a lack of a substance in your body by conducting special studies. However, if the level of B12 in the blood serum approaches the minimum, some symptoms and discomfort may occur. The most difficult thing in this situation is to determine whether your body really lacks vitamin B12, as its deficiency can masquerade as many other diseases. Symptoms of vitamin B12 deficiency may include:

- irritability, suspicion, personality change, aggression;
- apathy, drowsiness, depression;
- dementia, decreased intellectual abilities, memory impairment;
- in children - developmental delay, manifestations of autism;
- unusual sensations in the limbs, tremors, loss of sense of body position;
- weakness;
- vision changes, damage to the optic nerve;
- incontinence;
- problems of the cardiovascular system (ischemic attacks, stroke, myocardial infarction);
- deep vein thrombosis;
- chronic fatigue, frequent colds, loss of appetite.

As you can see, vitamin B12 deficiency can “mask” as many diseases, and all because it plays a very important role in the functioning of the brain, nervous system, immunity, circulatory system and DNA formation. That is why it is necessary to check the level of B12 in the body under medical supervision and consult a specialist about suitable treatments.

Vitamin B12 is considered to have a very low potential for toxicity, so there is no medical evidence of a borderline intake or evidence of excess vitamin intake. It is believed that excess vitamin B12 is excreted from the body on its own.

Interaction with drugs

Some medicines can affect the level of vitamin B12 in the body. These drugs are:

- chloramphenicol (chloromycetin), a bacteriostatic antibiotic that affects vitamin B12 levels in some patients;
- drugs used to treat stomach ulcers and reflux, these can interfere with B12 absorption by slowing the release of stomach acid;
- metformin , which is used to treat diabetes.

If you are taking these or any other medications on a regular basis, you should consult with your healthcare professional about their effects on your vitamin and mineral levels [22] .

Literature

1. Top 10 Vitamin B12 Foods , source
2. B12 Deficiency and History , source
3. Vitamin B12 Intake Recommendations , source
4. Opinion of the Scientific Committee on Food on the revision of reference values for nutrition labelling, source
5. Groups at Risk of Vitamin B12 Deficiency, source
6. Cyanocobalamin , source
7. Vitamin B12. physical and chemical properties, source

8. Nielsen, Marianne & Rostved Bechshøft, Mie & Andersen, Christian & Nexø, Ebba & Moestrup, Soren. Vitamin B 12 transport from food to the body's cells - A sophisticated, multistep pathway. Nature reviews Gastroenterology & hepatology 9, 345-354, источник
9. How Is Vitamin B12 Absorbed by the Body? источник
10. VITAMIN B12 NUTRIENT COMBINATIONS, источник
11. USDA Food composition Databases , source
12. Vitamin B12 in Vegetarian Diets, Source
13. Vitamin B12-Rich Foods for Vegetarians, source
14. VITAMIN B12 USES & EFFECTIVENESS, source
15. Tormod Rogne, Myrte J. Tielemans, Mary Foong-Fong Chong, Chittaranjan S. Yajnik and others. Associations of Maternal Vitamin B12 Concentration in Pregnancy With the Risks of Preterm Birth and Low Birth Weight: A Systematic Review and Meta-Analysis of Individual Participant Data. American Journal of Epidemiology, Volume 185, Issue 3 (2017), Pages 212–223. doi.org/10.1093/aje/kww212
16. J. Firth, B. Stubbs, J. Sarris, S. Rosenbaum, S. Teasdale, M. Berk, A. R. Yung. The effects of vitamin and mineral supplementation on symptoms of schizophrenia: a systematic review and meta-analysis. Psychological Medicine, Volume 47, Issue 9 (2017), Pages 1515-1527. doi.org/10.1017/S0033291717000022
17. Ingrid Kvestad and others. Vitamin B-12 status in infancy is positively associated with development and cognitive functioning 5 y later in Nepalese children. The American Journal of Clinical Nutrition, Volume 105, Issue 5, Pages 1122–1131, (2017). doi.org/10.3945/ajcn.116.144931
18. Theodore M. Brasky, Emily White, Chi-Ling Chen. Long-Term, Supplemental, One-Carbon Metabolism–Related Vitamin B Use in Relation to Lung Cancer Risk in the Vitamins and Lifestyle (VITAL) Cohort. Journal of Clinical Oncology, 35(30):3440-3448 (2017). doi.org/10.1200/JCO.2017.72.7735
19. Nattagh-Eshtivani E, Sani MA, Dahri M, Ghalichi F, Ghavami A, Arjang P, Tarighat-Esfanjani A. The role of nutrients in the pathogenesis and treatment of migraine headaches: Review. Biomedicine & Pharmacotherapy. Volume 102, June 2018, Pages 317-325 doi.org/10.1016/j.biopha.2018.03.059
20. Vitamin Nutrition Compendium, источник
21. A. Mozafar. Enrichment of some B-vitamins in plants with application of organic fertilizers. Plant and soil. December 1994, Volume 167, Issue 2, pp 305–311 doi.org/10.1007/BF00007957
22. Sally Pacholok, Jeffrey Stuart. Could It Be B12? An Epidemic of Misdiagnoses. Second Edition. Quill Driver Books. California, 2011. ISBN 978-1-884995-69-9.

An extended HTML version of the article is available on the edaplus.info website.

Vitamin B12 - useful properties, composition and contraindications

Eliseeva Tatyana, editor-in-chief of the project EdaPlus.info

Anastasia Myronenko, nutritionist

E-mail: eliseeva.t@edaplus.info, myronenko.a@edaplus.info

Received 03/03/18

Abstract. The article discusses the main properties of the vitamin B12 and its effect on the human body. A systematic review of modern specialized literature and relevant scientific data was carried out. The best natural sources of vitamin B12 are indicated. The use of the vitamin in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse

effects of vitamin B12 on the human body under certain medical conditions and diseases are analyzed separately.