



## **Boron (B) - importance for the body and health + 25 sources**

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**Abstract.** The article considers the main properties of boron ( B ) 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 boron are indicated . The use of the mineral in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of boron on the human body under certain medical conditions and diseases are analyzed separately.

**Keywords:** boron , B, boron, useful properties, contraindications, sources

Boron is found in the environment, natural foods, and nutritional supplements. It is not classified as an essential nutrient for the body - scientists have not yet determined its main biological function. But experts acknowledge that it may be one of the most complex minerals on earth. Interest in it is gradually growing and more and more studies confirm its benefits for humans: it supports bone health, steroid hormone function, strengthens muscles and improves brain activity.

### **Boron functions in the body**

In total, human organs and tissues contain approximately 20 mg of the mineral. Of these, 10 mg is concentrated in bone tissue, and the second half - in the thyroid gland, teeth, nails, kidneys, liver, muscles, adipose tissue. Most of the substance consumed is hydrolyzed in the gastrointestinal tract, but little is known about the absorption process. The body absorbs up to 90% of the component that comes with food.

The compound is excreted mainly with urine, partly with sweat and bile. The absence of changes in its level in the blood with an increase in consumption indicates a good maintenance of homeostasis due to an increase in excretion. But all stages of this process have not yet been determined. <sup>[1, 2, 3]</sup>

Every year, there is growing evidence that the nutrient has enormous benefits, ranging from anti-inflammatory effects to effects on various body systems. With additional intake improves immunity, the work of the central nervous system. Research also confirms the effect on metabolism of several enzymes and minerals. But the benefit is manifested only if the consumption does not exceed the allowable rate. <sup>[four]</sup>

## Analyzes to determine the lack or excess of boron

Mineral status is not usually measured in clinical practice. Its level in the urine correlates with consumption, therefore, the concentration of the substance in the blood plasma on an empty stomach is checked. The test is usually done by people who are at risk of deficiency or excess while taking boron medications, supplements.

## Boron in food - where it is contained and how it is absorbed

In nature, the mineral is not found in its pure form, but only in the forms of its salts (borates, polyborates), boric acid, aspartate, boron gluconate, calcium fructoborate and others. Scientists don't know which species are best absorbed, but their highest concentrations are found in plant foods. <sup>[5, 6]</sup>

## Healthy foods with the highest boron content

Infants receive the mineral from breast milk and infant formula, adults from vegetables, fruits, and berries. The concentration in plant food depends on the composition of the soil in which it was grown. The more precipitation, the more borates are washed out of the earth. The maximum accumulations are found in arid regions. <sup>[7]</sup>

## 25 Plant and Animal Foods High in Boron <sup>[8]</sup>

No.	Product	mg / 100 g
one	Honey	0.5–6
2	Raisin	4.51
3	dried peaches	3.24
four	Almond	2.82
5	Hazelnut	2.77
6	Avocado	2.06
7	Peanut butter	1.92
eight	Prunes	1.88
9	Currant	1.74
ten	Red beans	1.4
eleven	figs	1.26
12	Dates	1.08
13	<a href="#">Lentils</a>	0.74
fourteen	chickpeas	0.71
fifteen	Peach	0.52

16	grapes red	0.5
17	Plum	0.45
eighteen	Eggs	0.4
19	Dill	0.38
twenty	Red apple, pear	0.32
21	Broccoli	0.31
22	Carrot	0.3
23	Kiwi	0.26
24	Orange	0.25
25	Banana	0.16

The concentration of the compound in water varies depending on the source. The norm is the content of not more than 0.5 mg / l.

### **Daily intake of boron and the maximum allowable dose**

There are no recommendations for the use of the substance per day, since science has not established its main biological role. Researchers believe that the average person receives 1-2 mg of the trace element per day. <sup>[9, 10]</sup>

The maximum safe dose of boron per day <sup>[11]</sup>

Life period	Age	Men and women (mg)
babies	0–12 months	Not installed
Children	1–3 years	3
Children	4–8 years	6
Children	9–13 years old	eleven
Teenagers	14–18 years old	17
adults	19+ years old	twenty

If the daily intake is less than 0.2 mg, a mineral deficiency develops, and if more than 13 mg, an excess develops. It is not recommended to take more than 20 mg per day, as this increases the risk of serious complications. The exact dosage when taking dietary supplements varies, but tests show that the optimal amount to increase testosterone levels is 6 mg once a day. Scientists claim that the effect will be noticeable within a week. <sup>[12]</sup>

### **Top 5 Health Benefits of Boron**

## **1. Acts as an Antioxidant and Protects Against Cancer**

The mineral can function as an antioxidant agent. Experiments in rats have shown that it reverses damage caused by oxidative stress after arsenic ingestion. Human studies have confirmed that it reduces the risk of cancer and DNA damage. Some studies show that insufficient intake increases the likelihood of developing prostate cancer in men and lung and cervical cancer in women. [13, 14, 15]

## **2. Regulates the body's natural production of testosterone and estradiol**

The idea that boron helps with erectile dysfunction is based on its effect on free testosterone. If the problem has developed due to a hormonal imbalance (low testosterone, high estradiol, etc.), the mineral can help. Experiments have confirmed that taking 6 mg increases the level of free testosterone in men by almost 25% and almost halves the amount of estradiol. [16]

## **3. Reduces indicators of inflammation**

Taking the supplement for 1–2 weeks reduces concentrations of inflammatory biomarkers. Indicators of interleukin and C-reactive proteins are reduced by more than half, which brings undeniable benefits - their excess production causes autoimmune reactions, tissue damage. [17]

## **4. Reduces Symptoms of Osteoarthritis**

The component in the form of calcium fructoborate prevents and fights against chronic progressive bone disease. Observational data and results from several human studies show that the effect is achieved through the suppression of inflammation. Taking as little as 6 mg for two months reduces symptoms of osteoarthritis in the elderly. [18, 19, 20]

## **5. Improves Cognitive Function**

People who receive 3.25 mg of the compound daily from their diets boast better memory and hand-eye coordination than people with low intakes of the mineral. Scientists have also confirmed that with its lack, short-term memory and manual dexterity deteriorate. [21]

## **The connection of boron with other minerals and vitamins**

Numerous studies show that the mineral interacts with several beneficial substances and regulates their absorption. For example, a diet with a minimum content of an element of about - 0.25 mg per 2000 kcal - accelerates the excretion of magnesium and calcium in the urine. It also participates in the metabolism of phosphorus, increases the effectiveness of vitamin D. [22]

Boron tends to form complexes with vitamins B2 and B12, which reduces their absorption and increases urinary excretion. Therefore, separate intake of substances is recommended, unless the binding is intentional, as in the case of poisoning. [23]

## **The use of boron in medicine**

Dietary supplements typically contain 0.15–6 mg of the mineral. Most of them are designed to improve the condition of bones and joints. The component is also used in radiation therapy, for irradiating tumor cells with heavy particles. [24]

Boric acid has bactericidal properties. It is traditionally used as a local astringent, a mild anti-infective agent - for the treatment of inflammation of the external ear canal, the treatment of damaged areas with

purulent skin infections. The antiseptic is toxic after excessive doses. There is evidence of a patient's death after accidental instillation of 30 g of boric acid.

### **Boron in scientific research**

- In the 1990s, researchers found a positive relationship between boron intake and brain activity. The researchers assessed changes in cognitive function in response to dietary manipulation of the substance: they divided healthy older men and women into two groups who were given 0.25 and 3.25 mg of the mineral per day. In the group with a deficiency of the substance, the brain began to work as badly as with general malnutrition, heavy metal poisoning. [25]
- Taking calcium fructoborate twice a day for 2 weeks reduces knee discomfort in the elderly. The natural plant borate complex shows the greatest potential in the fight against joint pain. However, the inflammatory markers it targets and its mechanism of action are still unknown. [26]
- Scientists have found a link between boron consumption and prostate cancer - the mineral inhibits the growth of prostate tumors. They showed that men consuming about 6 mg/day had significantly smaller prostates than those consuming 0.64–0.88 mg/day. The lack of prophylactic and therapeutic agents is a short half-life, low bioavailability. [27]
- The reproductive toxicity of boric acid and borates is of concern to scientists. There is a linear relationship between the dose received and the concentration of compounds in the reproductive organs. In the environment, there are no such high indicators that could cause such an effect. High levels of exposure are possible in the workplace, in some countries due to the geological situation: China, Argentina, Turkey. [28, 29]

### **Side effects and toxicity of boron**

Borates are safe for pregnant women if their amount does not exceed the established threshold. Effects when taken while breastfeeding have not been studied, so supplementation should be discussed with a physician.

### **Boron deficiency symptoms**

The lack of a mineral in the body is associated with poor immunity, increased risk of mortality, osteoporosis. Deficiency has not been studied enough, since it is very rare, but doctors identify several signs:

- increased fatigue;
- developmental delay in children;
- tooth decay;
- fragility of bones, poor healing of fractures;
- pain in the joints;
- sexual dysfunction.

### **Signs of excess boron**

The chemical element can be a potent toxin in large quantities. Fortunately, you cannot get an excess of it through food - there are no data on the side effects of high consumption with food or water. Overdose may be associated with accidental consumption, harmful work. High doses can be obtained in the production of glass, leather, cosmetics, soap, detergents, fuels, fire retardants. Areas near boron mines or factories may be at risk of soil and water contamination. [thirty]

### **Overdose symptoms:**

- loss of appetite, nausea, vomiting, diarrhea;
- pain in the upper abdomen;
- dermatitis;
- headache;
- peeling of the skin.

At very high doses, renal failure develops. Extremely high doses are lethal. <sup>[31]</sup>

### **Interaction of boron with drugs**

It is believed that the mineral does not have serious drug interactions. But experiments show that it enhances the effects of alcohol and can interact with hormonal medications to cause excess estrogen.

### **Expert comment**

#### **Tatyana Eliseeva, nutritionist, nutritionist**

Naturally occurring boron is beneficial in small amounts and dangerous in large doses. Studies prove its role in the development of healthy bones and muscles, immune function, the formation of steroid hormones. To increase its consumption in a natural way without dietary supplements, it is enough to include prunes, raisins, dried apricots, avocados, nuts in the regular diet. People who follow a healthy diet should not worry about deficiency - the mineral is found in sufficient quantities in healthy whole foods.

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