



Spinach (lat. *Spinacia oleracea*)

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Abstract. The article discusses the main properties of spinach and its effect on the human body. A systematic review of modern specialized literature and relevant scientific data was carried out. The chemical composition and nutritional value of the product are indicated, the use of spinach in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of spinach on the human body under certain medical conditions and diseases are analyzed separately. The scientific foundations of diets with its use are considered.

Keywords: spinach , benefits, harm, beneficial properties, contraindications

Beneficial features

Table 1. Chemical composition of spinach (according to [Food+](#)).

Main substances (g / 100 g):	Fresh spinach ^[1]
Water	91.4
Carbohydrates	3.63
Alimentary fiber	2.2
Squirrels	2.86
Fats	0.39
Calories (kcal)	23
Minerals (mg/100 g):	
Potassium	558
Calcium	99
Sodium	79
Magnesium	79
Phosphorus	49
Iron	2.71
Manganese	0.897
Zinc	0.53

Copper	0.13
Vitamins (mg/100 g):	
Vitamin C	28.1
Vitamin E	2.03
Vitamin PP	0.724
Vitamin B6	0.195
Vitamin B2	0.189
Vitamin B1	0.078
Vitamin A	0.469
Vitamin K	0.483
Vitamin B9	0.194

The table shows data for raw spinach. Their analysis shows that the plant:

- one of the best sources of vitamin K (0.483 mg per 100 g at a daily rate of 0.12 mg for an adult male);
- quite rich in vitamin C (28.1 mg at a rate of 75-90 mg per day);
- in the "top ten" of plant foods in terms of vitamin A content (469 mcg per 100 g at a daily rate of 700 mcg for women and 900 mcg for men);
- very rich in vitamin B9 - folates (194 mcg at a daily rate of 200 mcg for an adult and 400 mcg for pregnant women).

It was from spinach that **natural folate was first obtained in 1941** (as vitamin B9, contained in food, is called). However, the bioavailability of spinach-derived folates is markedly lower than the bioavailability of synthetic vitamin B9 (folic acid) and is highly dependent on the cooking method. The amount of 0.6 micrograms of synthetic folic acid corresponds to about 1 microgram of vegetable folate, which should be taken into account when planning a healthy diet.

Also, some adjustment should be made when assessing the content of iron, calcium, zinc and other minerals in spinach. These elements coexist in the leaves of the plant with phytic acid and oxalic acid salts, which should potentially prevent their absorption. However, the actual bioavailability of minerals tested in experiments depends on a number of concomitant factors leading to different results in some experiments.

Thus, one study ^[2] evaluated the effect of concomitant components on the bioavailability of ferrous iron in anemic rats. The relative biological value for iron was first determined at 53%. But adding 2.1% oxalic acid to the diet program increased this figure to 164%. The inclusion of lignin and pectin in various combinations in the diet also led to an increase in digestibility. In general, in their study, scientists came to the conclusion that under the conditions of the experiment, the bioavailability of iron in plant foods depended on the form and neighborhood in which this substance entered the body. They also noted that cellulose, phytate (phytic acid) and oxalate, added to a clarified diet containing ferrous iron, even increased the bioavailability of this element.

Spinach is included in the group of plants-record holders (along with sorrel, rhubarb, oxalis) in terms of the content of oxalic acid, salts and esters of which (oxalates), crystallizing, can clog the renal and urinary ducts, provoke the development of gout and arthritis. According to some reports, the leaves of the plant (depending on the variety, place and methods of cultivation) contain oxalates from 100 mg / 100 g ^[3] to 800 mg / 100 g, which already significantly exceeds the permissible daily intake, subject to complete assimilation. But the absorption of oxalates is greatly influenced by their form, bacterial environment in the gastrointestinal tract and the combination of products, and the formation of stones

is influenced by the characteristics of calcium metabolism. Thus, both dangerous and beneficial properties of plant components can only be assessed with an integrated approach.

Finally, spinach is distinguished by a very high content of carotenoids, in terms of the amount of lutein (11.607 mg), significantly ahead of other garden and horticultural crops ^[4]. There is a lot in it, compared to other vegetables, and zeaxanthin - 331 mcg. It should also be noted high concentrations (in relation to the daily norm) of manganese, boron and silicon in the plant.

Medicinal properties

Phytochemicals and bioactive substances derived from spinach are capable of:

- absorb reactive oxygen species and prevent macromolecular oxidative damage;
- modulate the expression and activity of genes involved in metabolism, proliferation, inflammation and antioxidant protection;
- synthesize proteins that provide a normal level of blood clotting;
- help reduce food intake by secreting satiety hormones;
- exhibit immunostimulatory effects on macrophages and macrophage-like cells. ^[5]

Some medicinal properties of spinach are predicted based on the content of certain components of the plant. Thus, the record concentration of vitamin K in spinach ensures a normal level of blood clotting, promotes metabolism in muscles and connective tissue. In the heart and lung tissues, there are also protein structures synthesized exclusively with the participation of vitamin K.

The abundance of zeaxanthin and especially lutein in the composition makes spinach an effective herbal remedy in improving visual function. Entering the body with food and accumulating in the retina, lutein begins to play the role of a light filter - natural "sunglasses" that can prevent the destruction of the retina and clouding of the lens.

A number of medicinal properties of spinach have been confirmed in laboratories during experiments with cellular material or with the participation of experimental animals. It has been found that different forms of spinach can:

- promote tissue regeneration and healing of ulcers in diabetes mellitus ^[6];
- alleviate postmenopausal osteoporosis and increase the rate of bone fusion in fractures ^[7];
- have a cytotoxic effect on pancreatic tumor cells, colon adenocarcinoma, increase the sensitivity of tumor cells to laser irradiation ^[8], and also serve as an instrumental basis for the delivery of anticancer drugs (due to glycoglycerolipid isolated from spinach) ^[9];
- exhibit a depressant effect on the central nervous system during convulsions ^[10] and prevent neurodegenerative diseases (in particular, Alzheimer's disease); ^[eleven]
- protect against inflammatory processes in the intestines (from colitis and enterocolitis) and reduce the symptoms of diseases ^[12];
- inhibit myocardial necrosis by mitigating inflammation ^[13].

In addition, in an experiment involving several dozen healthy men and women, the ability of nitrate-containing spinach to reduce blood pressure, normalize the function of the endothelium of blood vessels, and generally improve the state of the cardiovascular system, was established. ^[fourteen]

In medicine

At the beginning of the last century, a substance called "spinach-secretin" was obtained from fresh spinach leaves by hydrolysis. It was used to stimulate the pancreatic gland and the glands of the gastric

mucosa. The action of the substance was compared with the manifestations of the alkaloid pilocarpine, which also enhances the secretion of the digestive and bronchial glands, but, in addition, increases the tone of smooth muscles, uterus, intestines, gall and bladder, and also creates a number of therapeutic ophthalmological effects.

Today, vegetable raw materials of spinach are used for deficiency of vitamins and microelements, for anemia, constipation. Spinach is also included in the composition of some choleretic drugs.

- "Holagogum". Spinach leaf extract is part of the dietary supplement, which is declared as a drug for the treatment of chronic cholecystitis, cholangitis, cholelithiasis. However, turmeric and mint, which are present in the composition of Cholagogum, are responsible for these effects. Spinach is introduced into the recipe as an element with multivitamin activity and a means of stimulating the digestive glands and intestinal motility.
- Holaflex. A multicomponent herbal preparation with a choleretic effect also includes spinach leaves. "Holaflex" is produced in the form of dry raw materials for brewing a "tea" drink, which must be drunk three times a day to get the effect.

Some therapists do not recommend combining spinach with blood pressure drugs due to the potassium content of the plant.

In folk medicine

Spinach in folk medicine is mainly treated for diseases of the gastrointestinal tract, chest organs, lumbar pain (lumbago) and inflammation of the larynx. However, some ancient folk recipes and therapeutic practices look outdated today.

So, in the past, for the treatment of insanity and / or melancholic conditions, it was recommended to eat spinach boiled with meat. Moreover, if you use the legs of animals for such a dish, then this should have helped with dizziness and lung diseases (for example, with pulmonary tuberculosis).

It was also believed that spinach juice was able to dissolve and remove stones from the kidneys and bladder, which conflicts with modern ideas about the role of oxalic acid salts in the formation of the most common calcium oxalate stones.

Modern traditional medicine has abandoned some optional "clarifications" in recipes, but still uses spinach for lung diseases, inflammation of the upper respiratory tract (laryngitis, laryngopharyngitis, bronchitis), flatulence as a carminative and laxative, as well as in the treatment of lumbago. In diseases of the throat, gargling with the juice of spinach leaves is practiced. For pain in the lumbar region, first boil the leaves of the plant in water until thickened, and then drink the decoction with the addition of cinnamon powder. To relieve constipation, spinach is most often mixed and drunk with sugar.

A little less often, spinach is used in the treatment of cardiovascular diseases, inflammation of the colon mucosa, and in the healing of ulcers and burns. Sometimes there are recommendations to take spinach boiled with mung beans (mung or Asian beans) for the treatment of gonorrhea.

Decoctions and infusions

In decoctions and infusions, spinach leaves are prepared for both external and internal use:

- **Infusion for the treatment of burns and eczema.** To prepare it, spinach leaves are crushed and poured with boiling olive (sometimes soy) oil. The mixture is infused until cool, after

which it is used as a poultice applied to burns and eczema. The compress is fixed with a loose bandage and changed 3 times a day. The treatment lasts until the wound heals.

- **Infusion to increase the volume of urination.** To create a diuretic effect, an infusion is prepared from crushed leaves, filled with a glass of boiling water in a 1: 1 ratio. Under the lid, the infusion is aged for 15 minutes, and then, after straining, it is drunk during the day.
- **Decoction to strengthen hair.** Fresh, heavily chopped spinach (120 g) is poured with water (0.5 l) and boiled for a quarter of an hour. After cooling, the gruel is rubbed onto the scalp and aged on the hair for about an hour, after which it is washed off.

in oriental medicine

Spinach occupies the extreme Yin position on the "grocery" Yin-Yang scale. This means that if the plant is eaten daily, it will cause a strong imbalance and become a threat to health.

In the system of traditional Chinese medicine, all foods are divided into two groups according to the content of the two fundamental principles of Yin and Yang: food from one group enhances Yang, food from the other strengthens Yin. The degree of manifestation of one or another beginning is reflected on a scale from -3 (the highest degree of Yin content) to +3 (the highest degree of Yang-beginning).

The most neutral and useful in the daily diet are foods with a low degree of onset (-1 or +1), and foods with indicators of -3 and +3 are not recommended. They are used cautiously, temporarily, with a strong initial imbalance of energies and exclusively for medicinal purposes. The same restrictions apply to spinach.

So with spinach, basically:

- compensate for the lack of blood and elements, the deficiency of which arose due to blood loss;
- eliminate constipation in debilitated and elderly people;
- reduce blood pressure in arterial hypertension;
- normalize the functioning of the liver (especially in diseases characterized by hyperactivity of the Yang-liver).

Spinach is also prescribed for headaches, disorders of the nervous system, and externally for eczema and dermatitis.

Tibetan medicine uses the softening and moisturizing properties of spinach, the leaves of which are used to treat coughs and the seeds to treat chest pain. It is believed that spinach is well absorbed by the body without the formation of gases, and its harmful qualities can be easily eliminated by adding cinnamon.

In scientific research

Spinach research is conducted mainly on laboratory animals, and only in some cases, experiments are carried out with the participation of people. Scientists are interested in the ability of various forms of spinach to suppress the growth of cancer cells, affect the state of the cardiovascular system, relieve intestinal inflammation, regenerate tissues, and fight the effects of oxidative stress. The following are examples of such studies.

Spinach consumption reduced serum total and glucose levels and liver cholesterol levels in rats fed a high-fat diet. ^[fifteen]

The researchers evaluated the effects of dietary carotenoids from spinach on inflammatory and oxidative stress biomarkers, liver lipid profiles, and liver transcriptome and metabolic profiles in rats with fatty liver (steatosis) induced by a high-fat diet.

Two concentrations of spinach powder (2.5% and 5%) were used in the experiment in the standard diet and in the high fat diet. Although fatty-fed rats showed hepatocyte fat accumulation, comparison of the results showed no difference in adiponectin hormone, tumor necrosis factor alpha (TNF- α) and free radical activity compared with standard diet animals.

At the same time, the scientists found that the consumption of spinach and the accumulation of α -, β -carotenes and lutein in the liver were inversely correlated with total cholesterol and glucose in the blood serum and cholesterol in the liver. With an increase in the concentration of spinach powder to 5%, the content of monounsaturated fatty acids and polyunsaturated fatty acids increased, but the level of cholesterol in the liver of rats decreased.

In addition, there were changes in the expression of genes associated with the condition of fatty liver, and increased expression of genes involved in the metabolism of fatty acids and cholesterol.

Spinach extract slows the progression of osteoarthritis and subchondral bone changes in rats. ^[16]

In this laboratory experiment, scientists first artificially induced osteoarthritis in rats by injecting sodium iodoacetate into the knee joint of the animals, and then evaluated the anti-osteoarthritic potential of two doses of spinach extract for various inflammatory markers for 28 days. In parallel with this, and for the same purpose, experiments were carried out "in a test tube".

Histological analysis, X-rays, micro-CT analysis of the subchondral bone showed that spinach extract acts as a strong antioxidant and anti-inflammatory agent. It has the ability to alleviate the manifestations of osteoarthritis by increasing bone volume to tissue volume (BV / TV), which leads to a decrease in trabecular structure factor (Tb.Pf) by more than 200%. In addition, the extract stimulated the expression of chondrogenic marker genes with a decrease in pro-inflammatory markers. Together, this led to a significant improvement in motor function in laboratory animals.

Daily oral consumption of spinach has an attenuating effect on markers of oxidative stress and muscle damage in trained healthy young adults after a half marathon. ^[17]

The effect of spinach supplementation on exercise-induced oxidative stress was tested in an experiment on 20 volunteers from trained healthy athletes who ran a 21-kilometer distance. The participants in the experiments were divided into two groups, one of which received a placebo, and the other received a spinach supplement at the rate of 1 g per 1 kg of body weight for 14 days before the start.

Before and after the half marathon, the researchers measured:

- as a marker of muscle damage - the level of creatine kinase;
- as a marker of oxidative stress - malondialdehyde, protein carbonyl and uric acid;
- as plasma antioxidant capacity - TAC (total antioxidant capacity).

According to the results of the measurements, it was found that the total antioxidant capacity in the "spinach" group increased significantly, and the indicators of stress markers remained at lower levels than in the "placebo" group. This led scientists to believe that daily spinach consumption reduced muscle damage in healthy athletes during significant aerobic exercise.

Weight regulation

Spinach has only 23 calories per 100 grams of raw greens, making it a popular choice in weight loss programs. However, not only low-calorie spinach is able to ensure the effectiveness of the weight loss process.

Indian researchers have found that consumption of the plant extract (especially when combined with aerobic exercise) controls obesity in rats fed a high-fat diet through an inhibitory effect on animal pancreatic lipase.^[eighteen]

In the experiment, scientists added 200 and 400 mg/kg of garden spinach extract to animals in a fat-rich diet for 3 weeks, then comparing the results with the indicators of rats from the control group, as well as with the results from the group of animals that combined extract nutrition with aerobic exercises.

On its own, spinach extract was highly effective in maintaining a normal lipid profile and controlling obesity, but when combined with exercise, the result was even better. The antihyperlipidemic effect of the extract was due to an inhibitory effect on pancreatic lipase comparable to that of orlistat (a weight loss drug with a similar mechanism of action).

Another study showed that spinach may help reduce food intake by secreting satiety hormones.^[19] The constituents of spinach help release short-term satiety signals that regulate the balance between food intake and energy expenditure to maintain body weight.

To test the appetite-suppressing effect, laboratory rats were given a flavonoid-rich plant leaf extract (200 and 400 mg/kg, orally) and the stimulant antidepressant fluoxetine (6 mg/kg, intravenously) for 2 weeks before meals. In rats treated with this therapy, against the background of a significant reduction in food intake, there was a decrease in weight gain compared with animals from the control group. Rats that received spinach extract (400 mg/kg) with fluoxetine in the experiment ate about twice as fast.

In cooking

Some culinary specialists believe that spinach should be added to dishes, if only because it stimulates the appetite by activating the salivary and pancreas glands. For this property in France, cooks call it "gastric broom." But spinach also has an independent culinary value, which allowed it to gain a foothold in the traditional recipes of different peoples of the world.

So, in Sweden cutlets are prepared from this vegetable crop, in Britain - omelettes and casseroles, in Italy - salads, in Spain - mashed potatoes, in Greece - pies, in the USA - soufflés and puddings. Bulgarian banitsa, Polish ravioli, Greek moussaka, Caucasian chikhirtma, Slavic cabbage rolls with plant leaves, etc. are made with a large amount of spinach.

In most cases, spinach in dishes is combined with other products (potatoes, rice, pasta, eggs). But this stewed vegetable can also act as an independent side dish for fish and meat. Spinach coexists especially harmoniously with bacon, cheese, cream, nutmeg and pine nuts, chickpeas.

In addition to taste properties, chefs value spinach for its stable emerald color, which does not disappear during heat treatment. It is characteristic that water is not even added to the pot to cook the vegetable - the plant is simply thoroughly washed and cut, and the pan is covered with a lid for several minutes. Spinach, which is 90% water, begins to actively release moisture itself - during cooking, you just need to mix it several times and then, taking it out, squeeze it using a sieve.

In cosmetology

Cosmetic companies use the ability of spinach:

- fight early signs of skin aging;
- whiten and reduce the visible manifestations of pigmentation;
- moisturize, eliminate dryness and peeling of the epidermis.

Recently, spinach has been especially loved by Korean skincare manufacturers, who include its extracts in creams, serums, lotions, foams, and gels. Although, as a rule, in this case, spinach becomes only one of the many plant components of the combined remedy.

In homemade face masks, spinach is also rarely used on its own. Usually it is combined with egg, honey, sour cream, potato starch, butter.

Dangerous properties of spinach and contraindications

The dangerous properties of spinach are associated primarily with the high content of oxalic acid salts (oxalates) in the leaves of the plant. An increased concentration of calcium oxalate in the urine leads to the formation of kidney stones from this salt. In addition, an increase in the level of oxalate in food leads to a decrease in the degree of absorption of calcium in the intestine.

The presence of certain diseases and pathological conditions requires a strict restriction of oxalates. These conditions include absorptive hypercalciuria type 2, intestinal hyperoxaluria, and primary hyperoxaluria. Limiting dietary oxalates to 50 mg per day is recommended for kidney disease, rheumatoid arthritis, gout, stomach ulcers, and cystitis. Moreover, when choosing a diet, it should be taken into account that the heat treatment of spinach can reduce the content of oxalic acid salts by only 5-15%.

Spinach easily accumulates pesticides and toxins. He, along with celery, peppers, cucumbers, cherry tomatoes and potatoes, is included in the group of vegetable crops, to the pulp of which American experts who monitor the safety of products on the shelves recommend applying test strips to determine the level of harmful chemicals in general and pesticides in particular before buying. . There is information that spinach greens can accumulate the toxic heavy metal thallium.

[20] appeared on the website of the EWG (a non-profit organization for the protection of the environment) , which details the results of pesticide contamination of spinach over the past few years. It turned out that since the penultimate inspection in 2008-09, the pesticide content in the tested spinach samples has increased dramatically (which was not typical for any other product). In particular, in the composition of one sample, the researchers found traces of, on average, 7 types of chemicals, and in the most contaminated samples, the content of 19 pesticides.

Most often and more than other poisonous substances, the vegetable contained traces of three fungicides (mandipropam, fluopicolide and amethoctradine), as well as permethrin, a neurotoxic insecticide that in high doses affects the nervous system and causes tremors and convulsions (since 2000, the drug has been banned in the European Union for use). on food crops). Moreover, in spinach, unlike other crops, even DDT residues were found. Although this pesticide was banned back in the 1970s, its degradation products are still pulled out of the soil by susceptible crops such as spinach.

Washing the leaves of the plant before consumption reduces the risks, although it does not completely eliminate the danger of pesticide poisoning. However, thoroughly washing spinach helps fight another food hazard - bacterial contamination. When 3 people died in the US in 2006 due to the O157:H7

strain of *Escherichia coli* bacteria, poorly washed California spinach was the cause. And the very next year, 2007, due to the risk of salmonella infection, several thousand packages of spinach were withdrawn from retail chains. To prevent new episodes of infection, the FDA has allowed greens to be pre-treated with antimicrobial ionizing radiation.

Finally, spinach can provoke an allergic reaction. Its main allergenic protein is profilin. It is not uncommon for people with hypersensitivity to spinach protein to also be allergic to molds and latex due to similar epitopes.

Selection and storage

The freshness of spinach can be judged by the elasticity of the leaves and the crunch that occurs with gentle pressure. Too thick a stem may indicate that the plant is overripe and will be bitter when cooked (although even "adult" leaves, after steaming, stewing or frying, can be a good side dish).

The bright color of the leaves can also indicate the quality of the product. The color should be even without dark or light spots. But shades of green can vary depending on the variety of spinach. For example, in the retail chains of our country, you can most often find 3 varieties, of which:

- **"Victoria"** is characterized by rounded thick leaves of a dark green tone;
- **"Giant"** is distinguished by elongated oval leaves of light colors;
- **'Godry'** is described as a cultivar with an ovoid leaf blade, slightly wrinkled surface, green or light green with yellow coloration.

In supermarkets, spinach is usually already washed and packaged. But, despite this, it is still better to wash the leaves of the vegetable before use and eat them within 1-2 days. However, if this cannot be done immediately, then the spinach should be stored in the refrigerator without washing it, so as not to provoke the onset of rotting.

Spinach does not tolerate storage well, and loses some of its beneficial properties even at low temperatures. For example, in one study, scientists found that a third of the ascorbic acid was lost when spinach was stored at 4°C for 2 weeks. ^[21]

Moreover, you should not store ready-made spinach dishes, since this leads to the release of a large amount of nitrogenous substances, and when they enter the blood, they provoke the formation of methemoglobin, which cannot carry oxygen to the tissues.

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Spinach - useful properties, composition and contraindications

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