



## Bulgarian pepper (Latin: *Cápsicum ánnuum*)

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

*Alena Tarantul*, nutritionist

*Email:* eliseeva.t@edaplus.info, tarantul.a@edaplus.info

**Abstract.** The article discusses the main properties of Bulgarian pepper 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 bell pepper in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of bell pepper on the human body under certain medical conditions and diseases are analyzed separately. The scientific foundations of diets with its use are considered.

**Key words:** bell pepper, benefits, harm, beneficial properties, contraindications

## Beneficial features

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

Main substances (g / 100 g):	Fresh pepper [1]
Water	91.51
Carbohydrates	6.7
Sugar	3.53
Alimentary fiber	one
Squirrels	0.8
Fats	0.41
Calories (kcal)	29
Minerals (mg/100 g):	
Potassium	202
Phosphorus	29
Magnesium	16
Calcium	12
Sodium	one
Iron	0.46
Zinc	0.3
Manganese	0.204

Copper	0.115
<b>Vitamins (mg/100 g):</b>	
Vitamin C	92.9
Vitamin PP	1.092
Vitamin B6	0.517
Vitamin E	0.48
Vitamin B1	0.079
Vitamin B2	0.055

Fresh bell peppers are mostly (90-92%) water. The rest is carbohydrates, which account for most of its calories, and a small amount of proteins and fats. The carbohydrates here are the sugars that are responsible for the sweet taste of ripe peppers. The fruits of the plant contain a small amount of fiber - about 2% of the total weight.

Sweet pepper includes a complex of various vitamins and minerals with record levels in some positions. So, just one red bell pepper provides 150-170% of the recommended daily intake of vitamin C. But a number of other vitamins are also found in fruits:

- **pyridoxine** (the most common form of vitamin B6) important for the production of red blood cells,
- **phylloquinone** (one of the forms of vitamin K), which plays a significant role in blood clotting and bone strength,
- **vitamin E**, necessary for the functioning of the nervous and muscular systems,
- **vitamin B9**, which performs many tasks, and is of particular importance during pregnancy,
- **beta-carotene** of red sweet pepper (provitamin A), which is responsible for redox processes, metabolism, regulation of protein synthesis, cell membrane functionality.

However, bell peppers of different colors can vary significantly in nutritional and vitamin value. The degree of fruit ripening also plays a role - it is known that bell pepper is rich in various antioxidants, especially carotenoids, but they are much more in ripe specimens than in unripe ones. And the amount of vitamin A in red pepper is 7-8 times higher than its amount in green.

Finally, the way the pepper is grown is important. Polish researchers found that an organic growing system provides a level of bioactive compounds (carotenoids and polyphenols) such that organic bell peppers contain significantly more vitamin C, total carotenoids,  $\beta$ -carotene,  $\alpha$ -carotene, cis- $\beta$ -carotene, total phenolic acids and flavonoids compared to fruits grown in the traditional (inorganic) way. The level of antioxidant compounds in fruits is also affected by the plant variety. <sup>[2]</sup>

Of the active compounds found in bell pepper:

- **capsanthin**, the pigment that makes red peppers red, is considered a powerful antioxidant
- **Violaxanthin** is another carotenoid antioxidant found in abundance in yellow bell peppers.
- **zeaxanthin** - a pigment that gives pepper a yellow color, which, when ingested with food, works to restore visual function,
- **lutein** - a compound that can also improve eye health - it is present in unripe peppers, although it is practically absent in ripe fruits,
- **Quercetin** is a polyphenolic antioxidant that is useful in preventing chronic heart disease and cancer, etc.

## Medicinal properties

Like most plant foods, bell peppers are considered a healthy food. Its regular use is associated with a reduced risk of developing various chronic diseases and pathologies.

- **Eye benefits.** The most common types of visual impairment are macular degeneration and cataracts, the main causes of which are considered to be aging and infections. But adding carotenoid-rich bell peppers (lutein and zeaxanthin) to your diet can improve eye health (when consumed in sufficient amounts). In fact, carotenoids protect the retina - the light-sensitive inner wall of the eye - from oxidative damage, preventing cataract formation and macular degeneration.
- **Prevention of anemia.** Anemia is a common disease characterized by a decrease in the ability of the blood to carry oxygen. One of the most common causes of anemia is iron deficiency, the noticeable symptoms of which are weakness and fatigue. Red bell pepper in the prevention of anemia is not only a source of iron (it contains about 4-5% of the recommended daily intake), but as a product exceptionally rich in ascorbic acid, which improves the absorption of iron from the intestines.
- **Slow down inflammatory processes.** In a study evaluating the anti-inflammatory effect of an aqueous extract of bell pepper leaves on mouse spleen cells, researchers found that the extract significantly suppressed inflammatory cytokine production and cell proliferation without causing cytotoxicity. It also suppressed the expression of inflammatory proteins, which made it possible to conclusion about the anti-inflammatory activity of the extract and its potential in possible therapeutic applications. <sup>[3]</sup>
- **mental health.** The high concentration of vitamin B6 in peppers increases the levels of the hormones serotonin and norepinephrine (sometimes referred to as “happiness hormones”) in the person who eats it. Higher levels of these hormones have been linked to improved mood, concentration, and energy levels, while lower levels have been linked to a number of psychiatric disorders. In addition, a lack of vitamin B6 contributes to memory impairment, reduces brain performance and can increase the risk of Alzheimer's disease, dementia.
- **Pregnancy control.** Sweet peppers contain about 15% of the recommended daily intake of folic acid that pregnant women need. In fact, the recommended daily intake of folic acid is increased by about 50% for pregnant women due to its role in preventing birth defects and keeping unborn children healthy.
- **The condition of the skin.** Sufficient provision of the body with ascorbic acid and carotenoids promotes the production of collagen and is good for the skin. In people who have enough ascorbic acid, the skin is less dry and wrinkled.
- **Reduced risk of cancer and heart disease.** Carotenoids in bell peppers are effective plant antioxidants that reduce the damage that oxidation causes to body cells. In particular, red varieties contain very high amounts of beta- and alpha-carotene, lutein and zeaxanthin.

One way to further boost the antioxidant power of bell peppers is to steam them. Research has shown that this cooking method improves the ability to bind bile acids. This means that in the process of digestion of food, cholesterol is used more efficiently and the absorption of fat is reduced, and, as a result, the likelihood of problems with blood vessels decreases. <sup>[four]</sup>

However, in various epidemiological studies, which consistently find a positive association of regular consumption of fruits and vegetables with a reduction in the risk of developing chronic diseases, they also say that the effect of any one particular phytonutrient in itself does not explain the observed benefit. Only in a combination of compounds can a stable therapeutic effect be obtained. For example, in one study, synergistic growth inhibition of prostate and breast cancer cells only became apparent when using combinations of low concentrations of various carotenoids (or carotenoids with retinoic acid and an active vitamin D metabolite). <sup>[5]</sup> And Bulgarian pepper is just famous for a special combination of medicinal components that show pronounced benefits in combination with each other.

## In medicine

In official medicine, sweet pepper was used as a component of a therapeutic diet. In particular, **table No. 5** (according to Pevzner) with the optimal proportion of carbohydrates, proteins and fats, recommended for chronic hepatitis, cholecystitis, cholelithiasis and other pathologies of the liver and gallbladder, suggested the use of a limited amount of bell pepper. And although in Russia, since 2003, M. Pevzner's tables have not been used in medical institutions, instead of them, an alternative non-numbered diet system has been introduced in hospitals.

In addition, on sale among dietary supplements, you can relatively inexpensively find oil extracts of sweet pepper containing carotenoids in a concentrated form. This extract is recommended by the manufacturer for the treatment of hypertension.

## In folk medicine

In folk medicine, remedies based on hot pepper are much more common, but people have also found use for sweet bell pepper;

- **Fruit.** Sweet pepper in folk medicine treat cardiovascular diseases, anemia, scurvy, diabetes and osteoporosis, sciatica, arthritis, asthma. With its help, they improve digestion, normalize sleep, relieve depression, restore strength and cognitive functions.
- **Juice.** Sweet pepper juice is recommended to drink every day to lower blood pressure. They usually start drinking it with small doses (30-50 ml per day), gradually increasing the volume to 100 ml.
- **Seeds.** Some authors call sweet pepper seeds and whitish pulp near the stalk the most useful part of the fruit because of the high concentration of vitamins in them. These seeds are used to treat asthma, diseases of the heart, blood vessels, liver, they are also used to prevent cancer as a product with a high content of vitamins C and A. To do this, the seeds are first dried and ground into a powder, which is then added to food like a vitamin seasoning.

In folk medicine, there is a division according to the degree of usefulness of fruits of different colors.

- **Red pepper.** It is believed that it has the widest spectrum of therapeutic action. It is recommended to be introduced into the daily diet to protect cells from oxidative stress, prevent problems with the heart, pancreas, prostate and ovaries. As a rich source of vitamins P, C, red sweet pepper carotene can reduce the risk of stroke and overcome the consequences of cerebrovascular accident. It is also used to relieve the symptoms of bronchopulmonary diseases. With its help, they fight stress and normalize sleep.
- **Yellow pepper.** With its help, in home medicine, they regulate the functionality of the thyroid gland, restore the working capacity of the nervous system, treat the heart and musculoskeletal system. It is also referred to as a product that can remove uric acid and thereby alleviate the condition of patients with arthritis and gout.
- **Green pepper.** Chlorophyll of green fruits helps to saturate the blood with oxygen and, by improving nitrogen metabolism, remove toxins from the body, and the presence of coumaric and chlorogenic acids in them gives reason to use such a product in the prevention of cancer.

In addition, traditional healers recommend eating bell pepper regularly to improve the condition of the skin, hair, bones, teeth and gums. It is believed that rinsing the mouth with freshly squeezed bell pepper juice will help get rid of inflammation of the oral mucosa.

## In scientific research

All studies of sweet bell pepper can be divided into several thematic groups. The most numerous of them will be a group of works in which scientists are trying to establish ways to improve the consumer qualities of grown vegetables, reduce the risk of plant infection with diseases, and provide more efficient and cheaper ways to store crops. Among the recent (2015-2020) studies, examples include works with the following headings:

- "Quantitative Trait Loci (QTL) Controlling Fruit Size and Other Horticultural Features of Bell Peppers". <sup>[6]</sup>
- "Polyphenols and carotenoids in organic and traditional pickled bell peppers". <sup>[7]</sup>
- "Uptake and distribution of fluopyram and tebuconazole fungicide residues in tomato and bell pepper plant tissues". <sup>[eight]</sup>
- "A chill tolerant cultivar of bell pepper increases nitrogen excretion and induces stress accumulation of metabolites in roots in response to low root zone temperatures." <sup>[9]</sup>
- "Analysis of coding and non-coding RNA transcriptomes in response to chilled bell peppers". <sup>[ten]</sup>

But there is also a smaller group of research projects in which scientists study the mechanisms and extent of the therapeutic effect of sweet bell pepper on the body. Here are some examples of such studies:

***"Allergy to bell pepper: different profiles of sensitization" <sup>[11]</sup>***

In their work, scientists consider different options for the appearance and increase in human sensitivity to the effects of irritants - compounds present in bell peppers - and the mechanisms for the appearance of an allergic reaction to the product.

***"The short-term effect of bell pepper juice supplementation with an integrated yoga therapy approach on blood glucose levels and cardiovascular function in patients with type 2 diabetes mellitus: a randomized controlled trial". <sup>[12]</sup>***

Here, researchers approached the study of the effect of sweet pepper on the condition of patients with type 2 diabetes in an unconventional way, combining the therapeutic effects of yoga and a dietary supplement. The experiment involved 50 patients aged 34 to 69 years who were randomly divided into study and control groups. The study group received 100 ml of bell pepper juice (twice a day) along with yoga therapy, while the control group received only yoga therapy for 4 consecutive days.

The results of the work showed that although the addition of 100 ml of bell pepper juice twice a day along with yoga therapy was not more effective in lowering fasting blood glucose levels, but after eating in the study group, there was a significant decrease in blood glucose levels, systolic arterial pressure, pulse pressure, velocity pressure product.

***"Sweet pepper inhibits  $\beta$ -secretase activity and  $\beta$ -amyloid aggregation". <sup>[13]</sup>***

In this project, scientists are looking at the problem of amyloid protein deposition in the form of senile plaques, which is considered the main hallmark of Alzheimer's disease. It is formed as a result of sequential cleavage of the amyloid precursor protein by secretases. The scientists decided to test how the effects of polyphenols (which are rich in extracts of ripe and unripe bell peppers) would affect amyloid production and protein aggregation in an in vitro experiment ("in vitro").

As a result, the investigators concluded that ripe pepper fruits had a dose-dependent inhibition of  $\beta$ -secretase ( $2.17 \pm 0.17 \mu\text{g/L}$ ), demonstrating a significantly ( $P < 0.05$ ) higher inhibitory effect than unripe ones ( $3.44 \pm 0.11 \mu\text{g/L}$ ). In addition, thioflavin-T analysis and transmission electron

microscopy showed that pepper fruit phenolic extracts (1 and 10 µg/L) could counteract the initial aggregation of Aβ1-40 as well as prevent further aggregation of preformed fibrils.

**Summarizing the above, the researchers suggested that sweet bell pepper may be a useful dietary supplement in the treatment of Alzheimer's disease.**

## **Weight regulation**

Unlike spicy representatives of the genus, bell peppers do not contain hot capsaicin, which, among other things, controls the metabolic syndrome and related disorders (obesity, lipid profile disorders, etc.). But bell pepper also helps those who lose weight control body weight.

This product has very few calories (from 20 to 32 kcal / 100 g) and a lot of vitamins, which makes it possible to build fasting days and diets on its basis. But mono-diets on bell pepper are not shown to everyone. It is better to choose a different diet for problems with the liver and kidneys, ulcers, gastritis with high acidity. Also, before choosing a pepper diet, it is better to consult a nutritionist for hypertensive patients and people with coronary heart disease.

Below is an example of a 2-week weight loss diet based on a US study of 25 weight loss volunteers:

- **1 day.** The entire diet consists of raw vegetables, the total weight of which should not exceed 1 kg. At the same time, at least 50% of the vegetable set should be bell pepper.
- **Day 2** Vegetables of the “first day” are replaced with fruits (too sweet grapes and bananas are excluded).
- **3-4 days.** Pepper (300 g), fruit (300 g), boiled egg (1 pc.).
- **5-7 days.** Pepper (300 g), boiled meat (200 g), cottage cheese (200 g), unsweetened drinking yogurt.

The second week almost duplicates the first, but on the 13th-14th day you can take the menu of any other day.

## **In cooking**

Bell peppers can be eaten raw or cooked. Like its related chili pepper, sweet varieties are sometimes dried and ground. Such a powdered spice of non-burning varieties is called paprika. Although in Hungarian culinary practice, where paprika is especially widespread, there is also a spicy scalding paprika, which includes pepper seeds containing hot capsaicin. All types of paprika are added to dishes to give them varying degrees of spice and special flavors. In addition, paprika is often used as a dye in the manufacture of sausages and other meat products.

Peppers of any color are used for food, but when choosing fruits, one should take into account that green (unripe) and purple vegetables have a slightly bitter taste, and red, orange and yellow have sweeter, almost fruity “notes”.

Sweet peppers perfectly complement fried meat dishes, go well with stewed pork and chicken. In real French ratatouille, Hungarian and Bulgarian lecho, Hungarian goulash and paprikash, Turkish gouveche, sweet pepper is one of the important ingredients. Especially expressive aroma and taste are acquired by fruits baked in the oven or on a charcoal grill. Fresh and pickled peppers coexist harmoniously with scrambled eggs and scrambled eggs.

One of the oldest and most popular bell pepper recipes, first discovered in a Boston cookbook in 1896, is stuffed peppers:

## Recipe I

- 6 green peppers.
- 3/4 cup hot parboiled rice.
- 1/2 cup cold meat, cut into small cubes
- 1/3 cup stewed and mashed tomatoes.
- 1 tablespoon melted butter.
- A few drops of onion juice.
- Salt and pepper.

Cut pieces off the ends of the pepper stalks. Remove seeds and partitions; steam 8 minutes. Fill with rice, meat, tomatoes and butter, mix well and season with onion juice, salt and pepper. Pour into a skillet, add one and a half cups of water or broth and bake for forty-five minutes in a moderate pressure oven.

## Recipe II.

Prepare peppers in the same way as stuffed peppers I. Fill with equal parts finely chopped cold fried chicken or veal and softened breadcrumbs seasoned with onion juice, salt and pepper. <sup>[fourteen]</sup>

Despite the considerable age of the collection, this is not the earliest mention of the dish known to us. Here, for example, is an even earlier pickled bell pepper recipe from Miss Parloa's New Cookbook of 1880:

“Take a big bell pepper. Cut off the stem, remove it and take out all the seeds. For the filling, use two liters of chopped cabbage, one cup of white mustard seeds, three tablespoons of celery seeds, two tablespoons of salt, half a cup of grated horseradish. Fill each pepper with some of this mixture, and put a small onion and some cucumber in each. Tie up the stem again, put the pepper in a jar and pour cold vinegar over it.” <sup>[fifteen]</sup>

## In cosmetology

Regular consumption of bell pepper improves the condition of the skin and hair. But the main set of cosmetic procedures is associated with the external use of the fruits of the plant as part of anti-aging, whitening, toning, nourishing masks for the skin and lotions for hair shine.

Examples of home cosmetics with bell pepper for facial skin:

- **Rejuvenating mask.** Red (yellow) pepper is ground to a pulp and mixed with a beaten egg (1 pc.) And sour cream (1 tsp). This mass is applied to the face for a quarter of an hour, after which it is washed off with warm water.
- **Moisturizing mask.** Finely grated pitted pepper (1 pc.) Mixed with cabbage (1 tbsp.) And carrot juice (1 tbsp.). To keep this semi-liquid mixture on the skin, it is first distributed over gauze, which is then applied for 15-20 minutes in the face and neck. The rest of the mixture is washed off with water.
- **Whitening mask.** To get rid of age spots on the skin, previously lubricated with olive oil, simply apply red sweet pepper cut into strips. Twenty minutes later, the remnants of the mask are washed off with green tea.

## Dangerous properties of bell pepper and contraindications

Bulgarian pepper is a generally safe product, but it sometimes causes an allergic reaction or intolerance. Among the symptoms of an allergic reaction to sweet peppers are abdominal pain, diarrhea, nausea, vomiting, skin rash, hives, itchy throat, swelling and difficulty breathing.

An allergy to bell pepper is evidence of an immune response to the proteins contained in it. Researchers at the Mayo Clinic have been studying this problem, and according to them, such a reaction to pepper may be correlated with the presence of an allergy to wormwood pollen: if a person has an allergic reaction to wormwood, this increases the likelihood of an allergy to bell peppers.

In addition, an earlier study published in November 2004 in the journal *Clinical & Experimental Allergy* <sup>[16]</sup> indicated that bell peppers should be included in the list of products of the so-called "latex-fruit syndrome": people who are allergic to latex are more degrees run the risk of getting allergic to bell pepper, although in practice such an immune response occurs quite rarely.

The second possible cause of stomach pain after eating bell pepper is food intolerance. (Although intolerance has common symptoms with allergies, it's not quite the same.) Usually, in the case of regular formation of gases, diarrhea and pain after eating pepper, patients are advised to pay attention to the dosage. According to the Cleveland Clinic, an eating disorder can occur after a large amount of eaten pepper and does not manifest itself after a small one.

Sometimes researchers attribute the resulting disorder to fructose hypersensitivity. Sometimes with food poisoning. Sometimes - with a fibrous structure of pepper and the presence of a fairly hard skin. Because of this, pepper is not recommended for people suffering from peptic ulcers and gastritis.

Often, experts warn about the likelihood of an increased concentration of pesticides in the fruits of sweet pepper. So, for example, in the "Dirty Dozen" (an annually updated list of products contaminated with pesticides, which is compiled by the Environmental Working Group - EWG), sweet peppers almost always make it. It often ends up at the bottom of the list, but the EWG warns that pesticides used to treat sweet bell peppers "tend to be more toxic to human health."

### **Selection and storage**

When choosing sweet peppers, preference should be given to fruits that are firm to the touch, bright in color with glossy, dry and smooth skin without damaged areas (without dark putrefactive spots and cracks). On yellow peppers, red, green or orange spots are acceptable, on orange - red or yellow. Bright spotting, as a rule, will indicate incomplete ripening of the fruit, although such peppers can be bought.

The stalk from which the fruit is torn off should not be dried up or black. Its drying is a sign of long-term storage, and the moistness of the skin around the "tail" is a sign of the onset of decay.

Regardless of the degree of ripening, it is better to keep the pepper in the refrigerator, but at the same time, unripe fruits (in the stage of technical maturity) when stored for up to 2-3 months are first placed in a relatively warm compartment of the refrigerator (about + 10 ° C), and then, after acquiring the skin bright uniform color, they are moved to a cold compartment (0-1 °C).

Peppers already ripe at the time of purchase (in the stage of biological maturity) are placed in the cold compartment immediately. They are packed in plastic bags or stacked in trays lined with crumpled porous paper to absorb excess moisture and create air pockets that provide ventilation.

To preserve bell pepper until the next season, freeze in the freezer. To do this, the pepper is washed, the stalk and seeds are removed, and then dried well. You can freeze both whole cups, inserting them



into each other according to the “matryoshka” principle, and fruits cut into slices. But keep in mind that even when frozen, peppers gradually, albeit slowly, lose their flavor.

## Varieties and cultivation

In the modern world, there are hundreds of multi-colored and various varieties of sweet pepper. It is quite difficult to choose from them the most productive large or tasty variety (hybrid), so we will show the “five”, in our opinion, unusual bell peppers that look different from the fruits we are used to.

- **F1 Snowwhite.** An early hybrid from the Hungarian Wax Pepper group. Weight can reach 165 grams. The fruit is sweet and juicy. But it attracts us, first of all, not by its taste, but by its color. At first, the fruits have a milky white color, and then, as they ripen, they become bright orange.
- **Ingrid.** A high-yielding variety with peppers weighing up to 230 grams, having fruits of an unusual shape and color. The color of Ingrid is most reminiscent of chocolate, and the shape is almost a regular cube.
- **Red miracle F1.** The fruits of this hybrid, 220-260 grams each, despite the telling name, by the end of ripening acquire not so much red as maroon color. But this pepper was also called a “miracle” because it has a rather rare, almost round shape with flattened “poles”.
- **Kolobok.** And here the name directly speaks of the shape of the pepper, which, due to its spherical shape, is very similar to a ripe red tomato. In addition, this variety has a good yield, resistance to diseases and pests.
- **Blot.** A purple variety of bell pepper with a high yield. He is not afraid of wilting caused by spores of the fungus *Verticillium albo-atrum*, which other varieties are afraid of, but he will not stand the lack of light.

Peppers can be grown not only in vegetable gardens and open plantations, but also at home. Especially for the decorative effect, small pepper trees or seeds are sold, from which you can grow a bush with many peppercorns on the branches. When transplanted into open ground, such a bush is easy to turn into a solid large plant, if you follow the general requirements for growing peppers.

Pepper is very picky about lighting. It does not tolerate shade during the entire period of its development. Needs nutritious soil. Purchased soil for begonias or violets is suitable for it, and if you prepare it yourself, a mixture of turf, sand and peat in a ratio of 1: 1: 2, respectively. The area of the root system of the plant is not very large, so clay pots about 18-20 cm in diameter can be used for planting at home. In addition, sweet peppers love warmth and do not like drafts. But in general, growing bell peppers is quite a feasible task even for a novice gardener.

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

*Alena Tarantul*, nutritionist

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

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