



## **Chlorella: one of the best superfoods and the main competitor of spirulina**

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

**Keywords:** chlorella, useful properties, contraindications, composition, calorie content

Chlorella is an emerald green freshwater algae. It was first studied after World War II as an alternative source of protein for the population. It is very similar in composition and properties to spirulina, but contains more vitamins and minerals. Here's everything you need to know about superfood, including research backing up its benefits and how to take the supplement.

The calorie content of chlorella is 250–400 kcal per 100 g, depending on the form of release (powder, tablets, etc.). The plant contains up to 70% complete protein by dry weight, which consists of all nine essential amino acids. Also, the product can be a good source of vitamin C, [B12](#) and iron - covering 6-40% of the daily requirement for the mineral. Like all algae, the supplement contains omega-3s and disease-fighting antioxidants. <sup>[1, 2, 3, 4]</sup>

## **Top 12 Health Benefits of Chlorella for Men and Women**

### **1. Removes toxins**

The rich composition reduces the toxicity of heavy metals to the brain, liver and kidneys. The components neutralize many highly toxic substances found in food. These include dioxin, which

causes hormonal disorders. Also in one study, *Chlorella fusca* supplementation neutralized 90% of Bisphenol A (BPA) found in food from plastic utensils. [5, 6, 7, 8, 9]

## **2. Fights Chronic Disease, Oxidative Stress, and Reduces DNA Damage**

*Chlorella* contains vitamin C,  $\beta$ -carotene, chlorophyll, lycopene and other antioxidants that reduce the production of advanced glycation end products (AGEs). The latter provoke inflammation, chronic diseases, complications of diabetes. Seaweed supplements increase antioxidant defenses in heavy smokers and in people at high risk of cancer. [10, 11, 12, 13, 14, 15]

## **3. Supports Liver Health**

Supplements improve the condition of people with various liver diseases - they reduce the level of enzymes that harm the organ. But it's unclear whether they benefit healthy people. [16, 17]

## **4. Stimulates the immune system**

When taking *chlorella*, more antibodies are produced in the body to fight foreign agents, and immune defenses in healthy people increase. However, one study found that supplementation mimics immunity in men and women aged 50–55, but does not help adults over 55. [18, 19, 20, 21]

## **5. Lowers Cholesterol**

Taking the product in any form lowers bad cholesterol, triglycerides in people with high blood pressure. Scientists suggest that the condition improves a complex of beneficial compounds - fiber, antioxidants, vitamin B3. [22, 23, 24]

## **6. Normalizes blood pressure**

*Chlorella* supplements protect the heart and kidneys, which play an important role in normalizing blood pressure. In addition, they reduce the stiffness of the arteries. The researchers suggest that nutrients such as omega-3s, potassium, calcium, and the amino acid arginine help protect arteries from hardening. [25, 26, 27]

## **7. Reduces blood glucose**

Taking *chlorella* reduces blood sugar levels in men and women at high risk for diabetes and increases insulin sensitivity in liver disease. Scientists do not yet advise placing high hopes on dietary supplements and abandoning traditional treatment, but they believe that it is effective in combination with drugs. [28, 29, 30]

## **8. Accelerates recovery from respiratory diseases**

Some components of superfood, including antioxidants, reduce inflammation in respiratory diseases, asthma. They improve antioxidant status in patients with chronic lung disease but do not improve respiratory capacity. [31, 32, 33]

## **9. Increases aerobic endurance**

*Chlorella* increases the ability to resist fatigue during exercise, which is beneficial for athletes. This effect can be provided by branched chain amino acids, which improve performance, oxygen saturation of the lungs. [34, 35, 36]

## **10. Protects the eyes**

Antioxidants such as lutein and zeaxanthin protect the eyes from strain and fatigue and reduce the risk of age-related macular degeneration. Lutein is one of the powerful carotenoids synthesized in plants with dark green leaves. It protects your eyes from harmful blue light emitted by digital devices such as smartphones, computers, etc. [37, 38, 39]

## **11. Reduces PMS Symptoms**

According to anecdotal evidence, the plant relieves the symptoms of premenstrual syndrome (PMS). This conclusion was made by scientists studying the composition of algae. The main positive effect on women's health is provided by B vitamins and calcium. [40, 41]

## **12. Reduces the risk of anemia and edema in pregnant women**

The iron, folic acid, and vitamin B12 found in the formula may lower high blood pressure and have other benefits during pregnancy. This was confirmed by studies conducted with the participation of 32 and 70 pregnant women. They had fewer signs of hypertension and were less likely to experience anemia. [42]

## **Why chlorella is dangerous: contraindications and risks associated with taking dietary supplements**

For most people, algae does not pose a serious risk, but the characteristics of the organism and the disease should be taken into account:

- rarely provokes nausea, abdominal discomfort;
- affects the immune system and is not suitable while taking medications for the immune system;
- not compatible with blood products, as it contains a lot of iron.

Many nutritionists are also wary of taking supplements during pregnancy, although there is no evidence to indicate their danger.

## **How Much Chlorella Can You Drink Every Day - A Safe Daily Dose**

The current scientific literature does not indicate the optimal dosage, as the nutrient content of algae is influenced by various factors, from growing conditions to processing. It is only important not to exceed the dose recommended by the manufacturer. It is better to start "therapy" with a minimum dose, gradually increasing it to the recommended one over 10 days. [43, 44]

Some studies have found benefits at 1.2 g/day, while others have looked at doses of 5–10 g/day. Most dietary supplements indicate a daily dose of 2-3 g/day for adults, which seems to be the most correct. It is also important to consider weight. For example, a child weighing 20 kg is allowed to take no more than 1 g of chlorella. As for tablets, the average daily intake for adults is 10-15 tablets per day, which corresponds to 2-5 g of powder.

## **How to choose and take chlorella?**

Chlorella has a tough cell wall, making it difficult to digest in its natural form. Processing not only makes it easier to consume, but also makes the nutrients easily digestible.

## **Forms of chlorella:**

- **Powder** . Can be added to avocado toast, smoothies, spaghetti, smoothies, orange juice, soups, vinaigrette, salad dressings, and even dips like guacamole or hummus.
- **Capsules and tablets** . This is the easiest form to use as it is easy to control and there is no risk of overdose.
- **Juices, bottled drinks** . In juices, smoothies and other drinks, the concentration of a beneficial ingredient is usually very low.

It is advisable to consume a superfood one hour before or after taking any medications. The daily dose can be divided into 2-3 doses during the day, if convenient. It is advisable to take tablets and capsules half an hour before meals with a large glass of water. Since the product is rich in bioabsorbable iron, you should not drink it with tea, which interferes with the absorption of iron.

## Expert comment

### Tatyana Eliseeva, nutritionist, nutritionist

A nutritional dietary supplement can address some of the nutritional deficiencies commonly encountered by vegetarians and vegans. Scientific evidence also confirms that it is healthier than spirulina and better protects against inflammation, boosts immunity, and promotes detoxification. Before taking the supplement, it is advisable to consult with a specialist - a nutritionist will help you choose the right dose, a form that has been tested and is safe for health.

## Literature

1. Chlorella powder, <https://fdc.nal.usda.gov/fdc-app.html#/food-details/1064099/nutrients>
2. Chlorella seeds, <https://fdc.nal.usda.gov/fdc-app.html#/food-details/1959053/nutrients>
3. Broken cell wall chlorella tablets, <https://fdc.nal.usda.gov/fdc-app.html#/food-details/1950375/nutrients>
4. Panahi, Y., Darvishi, B., Jowzi, N., Beiraghdar, F., & Sahebkar, A. (2016). Chlorella vulgaris: a multifunctional dietary supplement with diverse medicinal properties. *Current pharmaceutical design*, 22(2), 164-173. DOI: 10.2174/1381612822666151112145226
5. Uchikawa, T., Kumamoto, Y., Maruyama, I., Kumamoto, S., Ando, Y., & Yasutake, A. (2011). The enhanced elimination of tissue methylmercury in Parachlorella beijerinckii-fed mice. *The Journal of toxicological sciences*, 36(1), 121-126. DOI: 10.2131/jts.36.121
6. Queiroz, ML, Rodrigues, AP, Bincoletto, C., Figueirêdo, CA, & Malacrida, S. (2003). Protective effects of Chlorella vulgaris in lead-exposed mice infected with *Listeria monocytogenes*. *International immunopharmacology*, 3(6), 889-900. DOI: 10.1016/S1567-5769(03)00082-1
7. Nakano, S., Takekoshi, H., & Nakano, M. (2007). Chlorella (*Chlorella pyrenoidosa*) supplementation decreases dioxin and increases immunoglobulin a concentrations in breast milk. *Journal of Medicinal Foods*, 10(1), 134-142. DOI: 10.1089/jmf.2006.023
8. Sears, M.E. (2013). Chelation: harnessing and enhancing heavy metal detoxification—a review. *The Scientific World Journal*, 2013. doi: 10.1155/2013/219840
9. Hirooka, T., Nagase, H., Uchida, K., Hiroshige, Y., Ehara, Y., Nishikawa, JI, ... & Hirata, Z. (2005). Biodegradation of bisphenol A and disappearance of its estrogenic activity by the green alga *Chlorella fusca* var. *vacuolata*. *Environmental Toxicology and Chemistry: An International Journal*, 24(8), 1896-1901. doi: 10.1897/04-259R.1
10. Yamagishi, S., Nakamura, K., & Inoue, H. (2005). Therapeutic potentials of unicellular green alga *Chlorella* in advanced glycation end product (AGE)-related disorders. *Medical hypotheses*, 65(5), 953-955. DOI: 10.1016/j.mehy.2005.05.006

11. Merchant, RE, & Andre, CA (2001). A review of recent clinical trials of the nutritional supplement *Chlorella pyrenoidosa* in the treatment of fibromyalgia, hypertension, and ulcerative colitis. *Alternative therapies in health and medicine*, 7(3), 79-92. PMID: 11347287
12. Lordan, S., Ross, R.P., & Stanton, C. (2011). Marine bioactives as functional food ingredients: potential to reduce the incidence of chronic diseases. *Marine drugs*, 9(6), 1056-1100. doi:10.3390/md9061056
13. Makpol, S., Yaacob, N., Zainuddin, A., Yusof, Y., & Ngah, W. (2009). *Chlorella vulgaris* modulates hydrogen peroxide-induced DNA damage and telomere shortening of human fibroblasts derived from different aged individuals. *African Journal of Traditional, Complementary and Alternative Medicines*, 6(4). DOI: 10.4314/ajtcam.v6i4.57210
14. Panahi, Y., Mostafazadeh, B., Abrishami, A., Saadat, A., Beiraghdar, F., Tavana, S., ... & Sahebkar, A. (2013). Investigation of the effects of *Chlorella vulgaris* supplementation on the modulation of oxidative stress in apparently healthy smokers. *Clinical Laboratory*, 59(5-6), 579-587. DOI: 10.7754/clin.lab.2012.120110
15. Ozguner, F., Koyu, A., & Cesur, G. (2005). Active smoking causes oxidative stress and decreases blood melatonin levels. *Toxicology and Industrial Health*, 21(10), 21-26. DOI: 10.1191/0748233705th211oa
16. Azocar, J., & Diaz, A. (2013). Efficacy and safety of *Chlorella* supplementation in adults with chronic hepatitis C virus infection. *World Journal of Gastroenterology: WJG*, 19(7), 1085. doi: 10.3748/wjg.v19.i7.1085
17. Ebrahimi-Mameghani, M., Aliashrafi, S., Javadzadeh, Y., & AsghariJafarabadi, M. (2014). The effect of *Chlorella vulgaris* supplementation on liver enzymes, serum glucose and lipid profile in patients with non-alcoholic fatty liver disease. *Health promotion perspectives*, 4(1), 107. doi: 10.5681/hpp.2014.014
18. Otsuki, T., Shimizu, K., Iemitsu, M., & Kono, I. (2011). Salivary secretory immunoglobulin A secretion increases after 4-weeks ingestion of chlorella-derived multicomponent supplement in humans: a randomized cross over study. *Nutrition journal*, 10(1), 1-5. DOI: 10.1186/1475-2891-10-91
19. Kwak, JH, Baek, SH, Woo, Y., Han, JK, Kim, BG, Kim, OY, & Lee, JH (2012). Beneficial immunostimulatory effect of short-term *Chlorella* supplementation: enhancement of Natural Killer cell activity and early inflammatory response (Randomized, double-blinded, placebo-controlled trial). *Nutrition journal*, 11(1), 1-8. DOI: 10.1186/1475-2891-11-53
20. Halperin, SA, Smith, B., Nolan, C., Shay, J., & Kralovec, J. (2003). Safety and immunoenhancing effect of a *Chlorella*-derived dietary supplement in healthy adults undergoing influenza vaccination: randomized, double-blind, placebo-controlled trial. *Cmaj*, 169(2), 111-117. PMID: 12874157
21. Halperin, SA, Smith, B., Nolan, C., Shay, J., & Kralovec, J. (2003). Safety and immunoenhancing effect of a *Chlorella*-derived dietary supplement in healthy adults undergoing influenza vaccination: randomized, double-blind, placebo-controlled trial. *Cmaj*, 169(2), 111-117. PMID: 12874157
22. Ryu, NH, Lim, Y., Park, JE, Kim, J., Kim, JY, Kwon, SW, & Kwon, O. (2014). Impact of daily *Chlorella* consumption on serum lipid and carotenoid profiles in mildly hypercholesterolemic adults: a double-blinded, randomized, placebo-controlled study. *Nutrition Journal*, 13(1), 1-8. DOI: 10.1186/1475-2891-13-57
23. Mizoguchi, T., Takehara, I., Masuzawa, T., Saito, T., & Naoki, Y. (2008). Nutrigenomic studies of effects of *Chlorella* on subjects with high-risk factors for lifestyle-related disease. *Journal of medicinal food*, 11(3), 395-404. DOI: 10.1089/jmf.2006.0180
24. Sano, T., Kumamoto, Y., Kamiya, N., Okuda, M., & Tanaka, Y. (1988). Effect of lipophilic extract of *Chlorella vulgaris* on alimentary hyperlipidemia in cholesterol-fed rats. *Artery*, 15(4), 217-224. PMID: 3136759
25. Shimada, M., Hasegawa, T., Nishimura, C., Kan, H., Kanno, T., Nakamura, T., & Matsubayashi, T. (2009). Anti-hypertensive effect of  $\gamma$ -aminobutyric acid (GABA)-rich

- Chlorella on high-normal blood pressure and borderline hypertension in placebo-controlled double blind study. *Clinical and Experimental Hypertension*, 31(4), 342-354. doi:10.1080/10641960902977908
26. Otsuki, T., Shimizu, K., Iemitsu, M., & Kono, I. (2013). Multicomponent supplement containing Chlorella decreases arterial stiffness in healthy young men. *Journal of Clinical Biochemistry and Nutrition*, 53(3), 166-169. DOI: 10.3164/jcbrn.13-51
  27. Sansawa, H., Takahashi, M., Tsuchikura, S., & Endo, H. (2006). Effect of chlorella and its fractions on blood pressure, cerebral stroke lesions, and life-span in stroke-prone spontaneously hypertensive rats. *Journal of nutritional science and vitaminology*, 52(6), 457-466. DOI: 10.3177/jnsv.52.457
  28. Ebrahimi-Mameghani, M., Sadeghi, Z., Farhangi, MA, Vaghef-Mehrabany, E., & Aliashrafi, S. (2017). Glucose homeostasis, insulin resistance and inflammatory biomarkers in patients with non-alcoholic fatty liver disease: Beneficial effects of supplementation with microalgae *Chlorella vulgaris*: A double-blind placebo-controlled randomized clinical trial. *Clinical nutrition*, 36(4), 1001-1006. DOI: 10.1016/j.clnu.2016.07.004
  29. Ebrahimi-Mameghani, M., Aliashrafi, S., Javadzadeh, Y., & AsghariJafarabadi, M. (2014). The effect of *Chlorella vulgaris* supplementation on liver enzymes, serum glucose and lipid profile in patients with non-alcoholic fatty liver disease. *Health promotion perspectives*, 4(1), 107. DOI: 10.5681/hpp.2014.014
  30. Panahi, Y., Ghamarchehreh, M.E., Beiraghdar, F., Zare, M., Jalalian, H.R., & Sahebkar, A. (2012). Investigation of the effects of *Chlorella vulgaris* supplementation in patients with non-alcoholic fatty liver disease: a randomized clinical trial. *Hepato-gastroenterology*, 59(119), 2099-2103. DOI: 10.5754/hge10860
  31. Qu, J., Do, DC, Zhou, Y., Luczak, E., Mitzner, W., Anderson, M.E., & Gao, P. (2017). Oxidized CaMKII promotes asthma through the activation of mast cells. *JCI insight*, 2(1). DOI: 10.1172/jci.insight.90139
  32. de Boer, A., van de Worp, WR, Hageman, GJ, & Bast, A. (2017). The effect of dietary components on inflammatory lung diseases—a literature review. *International Journal of Food Sciences and Nutrition*, 68(7), 771-787. DOI: 10.1080/09637486.2017.1288199
  33. Panahi, Y., Tavana, S., Sahebkar, A., Masoudi, H., & Madanchi, N. (2012). Impact of adjunctive therapy with *Chlorella vulgaris* extract on antioxidant status, pulmonary function, and clinical symptoms of patients with obstructive pulmonary diseases. *Scientia Pharmaceutica*, 80(3), 719-730. DOI: 10.3797/scipharm.1202-06
  34. Qu, J., Do, DC, Zhou, Y., Luczak, E., Mitzner, W., Anderson, M.E., & Gao, P. (2017). Oxidized CaMKII promotes asthma through the activation of mast cells. *JCI insight*, 2(1). DOI: 10.1172/jci.insight.90139
  35. de Boer, A., van de Worp, WR, Hageman, GJ, & Bast, A. (2017). The effect of dietary components on inflammatory lung diseases—a literature review. *International Journal of Food Sciences and Nutrition*, 68(7), 771-787. DOI: 10.1080/09637486.2017.1288199
  36. Panahi, Y., Tavana, S., Sahebkar, A., Masoudi, H., & Madanchi, N. (2012). Impact of adjunctive therapy with *Chlorella vulgaris* extract on antioxidant status, pulmonary function, and clinical symptoms of patients with obstructive pulmonary diseases. *Scientia Pharmaceutica*, 80(3), 719-730. DOI: 10.3797/scipharm.1202-06
  37. Gille, A., Trautmann, A., Posten, C., & Briviba, K. (2016). Bioaccessibility of carotenoids from *Chlorella vulgaris* and *Chlamydomonas reinhardtii*. *International journal of food sciences and nutrition*, 67(5), 507-513. DOI: 10.1080/09637486.2016.1181158
  38. Cai, X., Huang, Q., & Wang, S. (2015). Isolation of a novel lutein–protein complex from *Chlorella vulgaris* and its functional properties. *Food & function*, 6(6), 1893-1899. DOI: 10.1039/c4fo01096e
  39. Miyazawa, T., Nakagawa, K., Kimura, F., Nakashima, Y., Maruyama, I., Higuchi, O., & Miyazawa, T. (2013). Chlorella is an effective dietary source of lutein for human erythrocytes. *Journal of Oleo Science*, 62(10), 773-779. DOI: 10.5650/jos.62.773

40. Dietary supplements and herbal remedies for premenstrual syndrome (PMS): a systematic research review of the evidence for their efficacy, <https://www.ncbi.nlm.nih.gov/books/NBK72353/>
41. Chocano-Bedoya, PO, Manson, JE, Hankinson, SE, Willett, WC, Johnson, SR, Chasan-Taber, L., ... & Bertone-Johnson, ER (2011). Dietary B vitamin intake and incident premenstrual syndrome. The American journal of clinical nutrition, 93(5), 1080-1086. doi:10.3945/ajcn.110.009530
42. Nakano, S., Takekoshi, H., & Nakano, M. (2010). Chlorella pyrenoidosa supplementation reduces the risk of anemia, proteinuria and edema in pregnant women. Plant foods for human nutrition, 65(1), 25-30. <https://link.springer.com/article/10.1007/s11130-009-0145-9>
43. Bito, T., Bito, M., Asai, Y., Takenaka, S., Yabuta, Y., Tago, K., ... & Watanabe, F. (2016). Characterization and quantitation of vitamin B12 compounds in various chlorella supplements. Journal of agricultural and food chemistry, 64(45), 8516-8524. DOI: 10.1021/acs.jafc.6b03550
44. Watanabe, F., Yabuta, Y., Bito, T., & Teng, F. (2014). Vitamin B12-containing plant food sources for vegetarians. Nutrients , 6(5), 1861-1873. doi : 10.3390/nu 6051861

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