

Healing and Health Benefits of Spirulina

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STORY AT-A-GLANCE

- Spirulina is a freshwater and saltwater, blue-green algae with powerful health benefits. Often confused with chlorella, the fundamental difference between the two is that spirulina is thousands of years older and does not possess the hard cell wall that makes chlorella closer to a plant than algae
- Spirulina is a sustainable food source with potential to end world hunger. Unlike most plants, it is able to withstand extreme temperature variations and neglect and still thrive
- It has been found in studies to successfully treat a wide range of ailments, including arsenic poisoning, Candida overgrowth and allergic rhinitis, and may lower your risk of stroke and cancer
- The recommended daily dose is typically 3 to 5 grams, taken two or three times a day. Start with a small dose and work your way up to see how your body responds to spirulina
- This article lists potential adverse reactions to spirulina, and what you can do to alleviate them
- Imagine a plant that can provide most of the protein you need for health, help prevent the sniffing and sneezing of allergies, reinforce your immune system, combat

inflammation, help you control high blood pressure and protect against stroke and cancer. Does such a “superfood” exist? Yes. It’s called spirulina. As noted in a 1993 scientific review of spirulina’s benefits in the Journal of Applied Phycology:¹

“Many preclinical studies and a few clinical studies suggest several therapeutic effects ranging from reduction of cholesterol and cancer to enhancing the immune system, increasing intestinal lactobacilli, reducing nephrotoxicity by heavy metals and drugs and radiation protection.”

Unlike plants you may grow in your garden, this “miracle” plant is a form of blue-green algae that grows in warm, freshwater and saltwater. It’s a simple, one-celled organism that got its name from the Latin word for helix, meaning spiral, because of its spring-like physical characteristic. Its scientific name is *Arthrospira platensis*, and it belongs to the cyanobacteria family.

A Quick History of Spirulina

The use of spirulina as a food source dates all the way back to ninth century Chad and it is believed spirulina was used by the Aztecs in 16th century Mexico.² Historical records report the selling of cakes made from spirulina harvested from Lake Texcoco. The dried flat cakes called “dihé” were a staple for many meals.

Spirulina didn’t come into commercial production until the 1970s, when a French company began the first large-scale spirulina production plant. Within a few years, America and Japan began producing their own spirulina.

Today, spirulina is being seriously considered as a

sustainable food source with the potential to end world hunger, due to its nutritional profile and unique ability to withstand extreme temperature variations and neglect. The United Nations has identified it as a primary ingredient in the fight against malnutrition worldwide.³

In the report “Sustainable Approaches to Combat Malnutrition,”⁴ economist Urs Heierli, Ph.D., a former country director of the Swiss Agency for Development and Cooperation in Bangladesh and India, notes that a [single gram of spirulina per day can correct malnutrition](#) in a child within a matter of a few weeks.

Spirulina is so nutritionally dense, NASA and the European Space Agency are researching the benefits of incorporating spirulina into astronauts’ diets on spaceships and possible missions to Mars.^{5,6,7}

Beyond nutrition, spirulina also offers multiple environmental advantages. For instance, producing spirulina requires 10 times less water than other vegetables, and harvests occur year-round.

Spirulina Nutrition Facts

Although spirulina is often described as blue-green algae, it is technically a type of cyanobacteria. Cyanobacteria are classified as bacteria because their genetic material is not organized in a membrane-bound nucleus. Unlike other bacteria, they have chlorophyll and use the sun as an energy source, in the way plants and algae do.

One of the special traits of spirulina is its rich protein content. It’s 50 to 70 percent protein by weight (which is even better than red meat, which is about 27 percent protein). You would need to consume only 2

tablespoons of spirulina as a protein substitute for a meal. Fifteen to 20 percent of its weight is carbohydrates.

It also contains 18 different amino acids, including all of the essential amino acids and 10 of the 12 nonessential ones, as well as sulfolipids, which may be protective against HIV infection of T-helper cells.⁸ Spirulina also contains:

- Vitamins and minerals, including B vitamins and [vitamin K](#), calcium, iron, magnesium, selenium, manganese, potassium and zinc
- Iodine
- Gamma-linolenic acid (GLA), an important fatty acid for heart and joints
- Antioxidant chlorophyll and carotenoids
- Metallothionein compounds (proteins combined with metals that bind heavy radioactive isotopes) and the phytopigment phycocyanin – a pigment protein complex from that light-harvesting phycobiliprotein family; an accessory pigment to chlorophyll, and a close chemical relative to bilirubin (see next section).

Aside from imparting spirulina's distinctive bluish color, phycocyanin is also a nitrogen storage molecule. The nitrogen atoms bind with heavy metals, such as radioactive caesium-137, strontium-90 and potassium-40, hence aiding in the elimination of these radioactive metals from your body

The Spirulina-Bilirubin Connection

James DiNicolantonio, coauthor of my upcoming book, "[Superfuel](#)," recently published a groundbreaking

paper, ["Antioxidant Bilirubin Works in Multiple Ways to Reduce Risk for Obesity and Its Health Complications."](#)

He notes that in mammalian cells, phycocyanobilin is converted into phycocyanorubin, a compound nearly identical to bilirubin, a breakdown product of red blood cells (heme) and the chemical responsible for the yellow color of bruises, urine and jaundice.

When a newborn baby gets jaundice, he is placed under "bili lights" in the hospital nursery to prevent brain damage (kernicterus), should his bilirubin levels become too high. The lights break down the bilirubin so it can be excreted.

However, at appropriate levels, bilirubin has a strong free radical scavenging effect. Until recently, scientists were unaware that bilirubin may actually have anti-inflammatory, antioxidant and atheroprotective properties, and there is a growing body of scientific and clinical evidence to support this.

From an evolutionary/biological perspective, it makes sense that nature would have created a way for your body to break down heme,⁹ which can be toxic if it accumulates. The way bilirubin is thought to provide these health benefits is through its ability to inhibit NADPH oxidase, a metabolic enzyme activated in a large number of pathological conditions that generates a great deal of oxidative stress.

In fact, NADPH overactivity appears to play a significant role in a wide range of health conditions, including but not limited to vascular diseases and vascular complications of other diseases ([diabetes](#), kidney failure, blindness and [heart disease](#), for example), [insulin resistance](#), neurodegenerative disorders such as [Alzheimer's](#) and [Parkinson's](#), cancer, glaucoma, [pulmonary fibrosis](#) and [erectile dysfunction](#).

NADPH appears to be a chemical that can be helpful or harmful depending on how much of it is circulating at the time, so it needs to be carefully regulated by your body. For example, NADPH oxidase plays a key role in helping your immune system fight bacteria, and helps your T-cells to function properly.

It follows then that preventing many chronic diseases would require finding a means of inhibiting or modulating NADPH oxidase. Bilirubin is believed to assist with this modulating effect.

People with Gilbert Syndrome comprise 5 to 10 percent of the population and illustrate this phenomenon quite nicely, as they are genetically predisposed to chronically elevated levels of unconjugated bilirubin. These individuals, having two to three times as much bilirubin as the rest of us, enjoy a greatly reduced risk for [coronary artery disease](#), [hypertension](#), carotid atherosclerosis and overall mortality, and this protection is thought to be related to their high bilirubin levels.

Since phycocyanobilin is a very close relative of bilirubin – and spirulina is a great source of phycocyanobilin – spirulina has enormous clinical potential due to its NADPH oxidase inhibiting effect. This is why phycocyanobilin has been the focus of a large amount of research.

Phycobilin extracts have been shown to inhibit NADPH oxidase activity in human aortic endothelium, aortic smooth muscle and renal cell cultures. And bilirubin protects against diabetic nephropathy via downregulation of NADPH oxidase in rats.

Bilirubin Lowers Risk for Obesity and Related Health Problems, Including Type 2 Diabetes

Recent research published by DiNicolantonio¹⁰ has also found that bilirubin reduces the risk for [obesity](#) and related health problems through a number of mechanisms, but primarily by inhibiting NADPH oxidase complexes, and that downregulating NADPH oxidase activity – which can be done with spirulina, thanks to its bilirubin-mimicking phycocyanobilin – could potentially have “profound implications for preservation of metabolic and vascular health.” As further explained by the authors:

“Expression of inducible form of heme oxygenase, HO-1, can be boosted by oxidative stress – often derived from NADPH oxidase activity; the resultant production of bilirubin feeds back to quell this oxidative stress ...

[Phycocyanobilin, which is covalently attached to phycocyanin] is readily converted by biliverdin reductase to the bilirubin analogue phycocyanorubin, which appears to share bilirubin’s ability to inhibit NADPH oxidase complexes. Arguably, this may largely explain the versatile antioxidant and anti-inflammatory properties of oral spirulina ... in rodent studies ...

A recent cross-sectional epidemiological study evaluating subjects with [Gilbert Syndrome] has discovered that [Gilbert Syndrome] is associated with a reduced tendency to gain body fat in later life ... A reasonable deduction is that chronically elevated free unconjugated bilirubin – and perhaps an upregulation in intracellular bilirubin generation – somehow opposes age-related gain in body fat.

Of related interest is a study showing that intraperitoneal administration of bilirubin – administered daily for 14 days – inhibits weight gain in rats fed a diet high in fats and sugar. Bilirubin

injections were also found to prevent deterioration of glucose tolerance ...

A credible case can be made that the favorable impact of elevated bilirubin on risk for undesirable weight gain reflects preservation of hypothalamic leptin sensitivity ...

Activation of NADPH oxidase is a key mediator of proinflammatory microglial activation; hence, elevated bilirubin might be expected to support effective leptin function in the arcuate nucleus, thereby aiding appetite control.

Oxidative stress in adipocytes, stemming largely from NADPH oxidase activity, appears to play a key role in the induction of insulin resistance and the skewing of adipokine and cytokine production in hypertrophied adipocytes.

Hence, bilirubin and heme oxygenase activity could be expected to aid maintenance of adipocyte insulin sensitivity. Indeed, plasma levels of unconjugated bilirubin have been found to correlate inversely with risk for metabolic syndrome and diabetes in prospective epidemiological studies, as confirmed in a recent meta-analysis.

In both cross-sectional and prospective studies, higher plasma bilirubin levels are associated with better insulin sensitivity and decreased risk for metabolic syndrome and Type 2 diabetes – independent of BMI ... A direct protective effect of bilirubin on adipocyte function may be largely responsible for this phenomenon.”

In addition to inhibiting systemic inflammation, which is a hallmark of insulin resistance,¹¹ spirulina also benefits diabetics by improving your lipid profile (reducing serum triglycerides and increasing high-density lipoprotein or HDL cholesterol), and improving vasodilation in those who are obese as a result of high-sugar diets.

Other Unique Properties of Spirulina

In addition to this rich nutritional blend, spirulina has the following special properties:

- The proteins in spirulina are of a highly digestible type (83 to 90 percent digestible), due to the fact that it does not have cellulose walls like yeast and [chlorella](#) do. Therefore, the net protein utilization is high (between 53 and 61 percent) and requires no cooking to increase the bioavailability of its proteins.
- Studies confirm a very high “protein efficiency ratio” for spirulina, meaning your body will be able to efficiently use these amino acids.
- GLA – a powerful anti-inflammatory – is rarely this high in any food and normally has to be synthesized by your body from linoleic acid. GLA is a precursor to important biochemicals such as prostaglandins, leukotrienes and thromboxanes, which serve as chemical mediators for inflammatory and immune reactions.
- Spirulina has no fatty acids with uneven carbon numbers and very low-level branched-chain fatty acids – two types of lipids that higher order animals, like you and me, cannot metabolize.
- Spirulina has about the same calcium, phosphorus and magnesium content as milk, with a vitamin E (tocopherol) level comparable to wheat germ.

Spirulina Versus Chlorella – Similarities and Differences

Chlorella is another form of algae that is sometimes confused with spirulina. The fundamental difference between spirulina and chlorella is that spirulina is millions of years older and does not possess the hard cell wall that makes chlorella closer to a plant than algae.

[Chlorella is an excellent way to detoxify your body from mercury](#), a common problem if you have amalgam dental fillings, have received a thimerosal-containing vaccine or regularly eat [contaminated fish](#). Spirulina is unable to remove heavy metals, as it lacks a cell membrane. It can, however, protect your liver against the toxic effects of heavy metals, and help eliminate toxins such as arsenic. Spirulina also protects against radiation.

Spirulina in the Treatment of Arsenic Poisoning

Most of us take clean, healthy drinking water for granted. Unfortunately, many countries struggle with severe arsenic contamination, and up until the mid-1990s, little could be done to treat patients dying from arsenic poisoning. As noted in a 2006 study:¹²

“Millions of people in Bangladesh, India, Taiwan and Chile are consuming high concentration of arsenic through drinking water, and thousands of them have already developed chronic arsenic poisoning. There is no specific treatment ...

The present placebo-controlled double-blind study was conducted to evaluate effectiveness of spirulina extract plus zinc in the treatment of chronic arsenic poisoning ... Results show that spirulina extract (250 mg) plus zinc (2 mg) twice

daily for 16 weeks may be useful for the treatment of chronic arsenic poisoning."

Bangladeshi researchers also conducted a hospital-based study¹³ where spirulina was given to 33 patients while 17 received a placebo. Eighty-two percent (27 of 33) of those taking spirulina showed tremendous improvement after taking 3 grams of spirulina per day for three months and drinking filtered water to avoid re-exposure.

How Spirulina Protects Against Radiation

There is also a great deal of research showing spirulina's effectiveness in insulating you from the effects of radiation. Spirulina was actually used to treat children exposed to chronic low-levels of radiation after the Chernobyl nuclear disaster.

Radiation causes hematopoietic syndrome, marked by a three-way drop in blood cells: The result is infection (related to insufficient white cells), anemia (inadequate red blood cells) and bleeding (diminished platelets). Spirulina helps with these symptoms.¹⁴

Soviet physicians at the Research and Clinical Institute of Radiation Medicine and Endocrinology in Minsk administered 5 grams of spirulina daily to some of the radiation-exposed children for 45 consecutive days.¹⁵

Compared to those who did not receive spirulina, the treated children showed rapid improvements, and there was evidence of bone marrow, spinal fluid, blood cell and liver regeneration. Dangerously low white blood cell counts of about 1,000 (typical of leukemia) rose to 3,000 in 20 days, and urine radioactivity levels decreased by 50 percent in 20 days.

The Belarus Ministry of Health concluded that spirulina

accelerates the evacuation of radionuclides from the human body, without adverse side effects. Spirulina was particularly efficient at deactivating and eliminating radioactive cesium from their bodies.

Spirulina also helps shield cells from gamma radiation, as shown by a 1989 study¹⁶ on the bone marrow of mice. It also protects and supports the health of your kidneys, which are some of the first organs to suffer damage after significant radiation exposure. Research¹⁷ suggests spirulina also protects against the nephrotoxicity of cancer treatments.

Spirulina Enhances Immune Function

Spirulina also enhances health by acting as a powerful immune booster. In a study¹⁸ by investigators at the department of aquaculture at National Taiwan Ocean University, white shrimp were exposed to seawater containing a hot-water extract of spirulina before transferring them to seawater with a pH level of 6.8. The control group was not exposed to spirulina.

The shrimp exposed to the spirulina seawater showed a faster and more promising recovery rate to the high levels of pH than those not given the dose of spirulina first. In other words, the spirulina boosted immune recovery and had a beneficial impact on gene expression after exposure to environmental stress.

Other studies confirm and support spirulina's reputation as a powerful immune booster, showing it can combat Candida overgrowth and encourage a [healthy gut microbiome](#).¹⁹

Controlling Candida is particularly important if you have an autoimmune disease such as Crohn's disease, chronic fatigue syndrome, [Lupus](#) or fibromyalgia, as chronic [Candida yeast](#) can worsen your symptoms. Spirulina has also been shown to inactivate the human immunodeficiency virus associated with

Other Research-Based Health Benefits of Spirulina

The health benefits of spirulina are truly far-ranging and continue to be widely researched. As a result, there is really no way to cover all of the literature related to its potential benefits because there is so much. That said, here's a sampling of scientific studies demonstrating spirulina's potential usefulness in preventing and/or treating a number of common health conditions:

Eye health – As the population ages, the prevalence of age-related macular degeneration (ARMD) is on the rise. ARMD refers to the deterioration of your macula (the region in your eye that controls acute vision), and is the leading cause of blindness.

Your eyes' macular membranes contain several carotenoid pigments called xanthophylls: lutein, zeaxanthin and possibly astaxanthin, if you're getting it as part of your diet. These pigments help protect your eyes from damage by slowing down ultraviolet-induced oxidation of lipid membranes, thereby helping prevent degeneration of your macula. Xanthophylls may also help prevent cataracts.

Spirulina provides 3,750 to 6,000 micrograms (mcg) of zeaxanthin per 3-gram serving. Eggs are another excellent source of both lutein and zeaxanthin (200 mcg zeaxanthin per yolk). Astaxanthin is also another marine-based nutrient that is in the carotenoid family and is also a potent preventer of ARMD.

Cardiovascular health, including blood pressure – Diabetes and cardiovascular health are intimately connected, so it's no

surprise that spirulina shows great potential for people with cardiovascular disease, in terms of creating better lipid profiles, controlling hypertension and increasing blood vessel elasticity.

Diabetic patients given 2 grams of spirulina per day showed improved glycosylated hemoglobin and better lipid profiles in one 2001 study.²¹ In another study,²² 4.5 grams of spirulina per day for six weeks significantly reduced serum triglyceride levels and total cholesterol, while boosting HDL. It also regulated blood pressure among both women and men between the ages of 18 and 65 without any other dietary changes being made.

In another randomized double-blind, placebo-controlled study²³ done on elderly male and female patients between the ages of 60 and 87, those given 8 grams of spirulina per day for 16 weeks experienced significant reductions in total cholesterol compared to controls who were given a placebo.

It is thought that the lipid action of spirulina may be due to its phycocyanin content, which inhibits pancreatic lipase activity, which in turn causes higher excretion of triglycerides through your feces.

In one animal study,²⁴ spirulina increased synthesis and release of nitric oxide and inhibited vasoconstriction in rats fed a fructose-rich diet. In another, spirulina protected hamsters from developing atherosclerosis.²⁵

Brain health and stroke prevention – An Indian study²⁶ found that a dosage of 180 mg of spirulina had a protective effect on the brain and nervous system of rats exposed to high amounts of free radicals, compared to rats not given the spirulina before the experiment. This lab test shows the

promising effect of spirulina for stroke prevention.

Two other studies (one in the Journal of Agricultural and Food Chemistry,²⁷ the other in the British Journal of Nutrition²⁸) showed that spirulina reduces platelet aggregation, which plays an important role in vascular diseases by reducing your risk for thromboembolism.

Other research²⁹ has shown a combination of spirulina, blueberries and spinach led to “a significant reduction in the volume of infarction in the cerebral cortex and an increase in post-stroke locomotor activity” in mice.

Oxidative stress is one major source of inflammation, and in your brain, it can result in loss of dopamine neurons and lead to neurodegenerative disorders such as Parkinson’s and Alzheimer’s. As explained above, NADPH oxidase has been shown to play a role in these diseases, and by suppressing NADPH oxidase, the phycocyanin in spirulina can lower your risk for these age-related brain diseases.

Animal research³⁰ has also shown that diets enriched with spirulina can reverse inflammation associated with diminished neurogenesis (i.e., the inhibition of production of new neurons), which is another factor in degenerative diseases of the brain.

Liver health – The accumulation of fats in your liver is closely associated with metabolic syndrome and strongly raises your risk for dying from cardiovascular disease. Nonalcoholic fatty liver disease is the most common cause of chronic liver disease in North America and is notoriously difficult to treat with conventional medical measures.

Animal studies suggest spirulina can protect your liver in number of ways – preventing the buildup of triglycerides,

inhibiting lipid peroxidation, reducing liver inflammation and protecting it from damage by heavy metals – probably as a result of its high antioxidant properties and its ability to synthesize or release nitric oxide.

Allergy relief – According to one double blind, placebo controlled study,³¹ patients treated with spirulina reported relief of symptoms commonly associated with allergic rhinitis, such as nasal discharge and congestion, sneezing and itching.

According to the authors, “Spirulina is clinically effective on allergic rhinitis when compared with placebo. Further studies should be performed in order to clarify the mechanism of this effect.”

Reduced pain sensitivity – By inhibiting prostaglandins, which contribute to pain and inflammation, the phycocyanin in spirulina may also be helpful against chronic pain conditions.³²

Anticancer activity – Spirulina has a number of blood-strengthening properties, as found by this 2001 animal study³³ from China. The study concluded that spirulina has chemoprotective and radioprotective capabilities and shows potential for fighting cancer.

Immune cells in your blood are highly radiosensitive and considered to be good indicators for biological effects taking place at the molecular level. A 2009 study³⁴ also found spirulina extract enhanced the activation of natural killer cells, which have antitumor activity.

Antiviral and antiretroviral activity – Research³⁵ published in 1998 found aqueous extract of spirulina effectively inhibited replication of the HIV-1 virus. An extract concentration between 0.3 and 1.2 micrograms per milliliter reduced viral production by 50 percent.

Blood and bone marrow health – Research³⁶ published in 2006 found spirulina extracts enhanced proliferation of bone marrow cells and stimulated spleen cells, resulting in higher ratios of neutrophils (a type of immune cell) and lymphocytes (a form of white blood cell) in the peripheral blood and bone marrow.

Muscle strength and endurance – Research³⁷ also suggests spirulina can boost isometric muscle strength and endurance, thanks to its high protein and essential amino acid content, which are necessary for muscle growth. Athletic performance is also improved courtesy of the nitric oxide boost spirulina provides. Spirulina is also a good source of iron, necessary for oxygen transport and energy production in your muscles.

Do keep in mind, however, that excessive iron is a serious health threat, and is more common than anemia (iron deficiency). Ideally, check your iron level annually to make sure you're in a healthy range.

Optimal Spirulina – Types and Dosing

There are many types of spirulina out there so it is important to do your homework before making a purchase. Since spirulina grown in an uncontrolled environment has the potential to become contaminated with heavy metals and other toxins, it is

important to choose organic spirulina from a reputable source.

Spirulina comes in capsules, tablets, powders and flakes. Dosing depends on what you plan to use spirulina for and to whom it is given. Here are some typical recommendations. Also remember to increase your intake of spring water or filtered water when taking spirulina to help it absorb into your system.

Starting dose for children – 100 to 1,500 mg (0.5 to 1.5 grams)

Child's maintenance dose – 5 grams per day

Child's disease-fighting dose – 10 grams per day

Starting dose for adults – 3 grams

Adult's maintenance dose – 10 grams per day

Adult's disease-fighting dose – 20 grams per day

Athlete's dose – 60 grams per day

In addition to being your powerhouse of essential vitamins and minerals, spirulina is a potent detoxifier, so depending on your toxic burden, you may or may not experience a detox reaction. For that reason, it is best to start with a small dose and work your way up.

For example, if you are an adult who wishes to take the typical maintenance dose of 10 grams per day, start with one-quarter or one-half this dose to start (see general recommendations above). Once you see how your body responds, you can then gradually increase your intake to the full recommended dose.

Potential Side Effects From Spirulina

Spirulina is a safe source of protein, nutrients, vitamins and minerals with a long history of use. Though there are no known side effects associated with spirulina, your body may react to it based on your current state of health. Some of the most prominent reactions you may experience include:

- **Slight fever** – The high protein content in spirulina increases metabolism, which may elevate body temperature
- **Dark green stool** – Spirulina can remove accumulated waste products in your colon, which may cause darker stool. Also, spirulina is high in chlorophyll, which turns your stool green
- **Gas** – Buildup of gas may indicate that your digestive system is not functioning properly
- **Excitability** – Your body is converting protein into heat energy, which may cause temporary feelings of restlessness
- **Breakouts and/or itchy skin** – This is caused by the colon cleansing process and is a temporary reaction
- **Sleepiness** – This is caused by the detoxification process and may indicate [your body is exhausted and needs more rest](#)

Also keep in mind that while spirulina is entirely natural and generally considered a healthy food, there are some important contraindications you need to be aware of. Avoid spirulina if you are:³⁸

- Severely allergic to seafood
- Allergic to iodine
- Pregnant
- Nursing

If you have hyperthyroidism (overactive thyroid), consult your health care provider before taking spirulina. Also avoid taking spirulina if you are currently running a fever, as it

may raise it further.

Conclusion

As you can see, spirulina is a potent superfood with a wide variety of health benefits. Just remember to do your research when it comes to buying a product, and go easy when first starting out, until you know how spirulina affects you. Remember, your body may go through an adjustment period when you first start taking it, and your best bet to minimize your risk of a reaction is to gradually increase your dose.