



Cyanobacteria's beneficial impacts on human wellness

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<p>Research Article Received on May 16, 2023 Revised on June 25, 2023 Accepted on July 13, 2023 Published on October 18, 2023</p> <p>Article Authors Neha Kumari, Neelesh Kumar Maurya</p> <p>Corresponding Author Email neeleshkumar.maurya@gmail.com</p>	<p>Because of their colour, cyanobacteria are also known as blue-green algae (BGA). These are gram-positive prokaryotes. They manufacture their own food by photosynthesis and are rich in colours such as chlorophyll <i>a</i>, carotenoids, and phycobilins. Blue-green algae have been demonstrated to be useful in the treatment of hypertension and may be used as a protein supplement. Moreover, it is used to treat high levels of cholesterol or other fats (lipids) in the blood, diabetes, obesity, and a variety of other diseases. BGA are healthy natural products that are high in essential amino acids, gamma-linolenic acid (GLA), fibre, vitamin B, calcium, phosphorus, and iron. They also contain pigments, including gamma-carotene, xanthophylls, chlorophyll, and other bioactive components. BGAs may be present in a wide range of plant-based diets. Microalgae and cyanobacteria must be cultivated using controlled cultivation methods or collected from their natural habitats before they may be sold as nutritional supplements all over the world. The current review focuses on the nutritional and medicinal advantages of blue-green algae.</p>
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The term "blue-green algae" refers to a kind of microorganisms that produce blue-green colors. They thrive in saline water as well as certain huge freshwater lakes. Blue-green algae have been utilized for food in Mexico and several African cultures for ages. Since the late 1970s, they have been offered as a supplement in the United States (Fais *et al.*, 2022). Blue-green algae products are used to treat a variety of illnesses, but there is little scientific data to evaluate whether or not they are effective for any of them. Blue-green algae are used orally as a source of protein, vitamin B, and iron (Priyanka *et al.*, 2023). They are also given orally to treat anemia, and to prevent unintended weight loss. They are also used to treat ADHD, hay fever,

diabetes, stress, exhaustion, anxiety, depression, weight loss, premenstrual syndrome (PMS) and other women's health concerns including menopause. Some people use blue-green algae to treat precancerous growths inside the mouth, eyelid twitching, immune system booster, memory booster, energy and metabolism booster, exercise performance booster, lowering cholesterol, preventing heart disease, healing wounds, and improving digestion and bowel health. High blood pressure, HIV/AIDS and HIV-related illnesses, cancer, fatty liver disease, hepatitis C and arsenic poisoning are all treated using blue-green algae. Blue-green algae is used to treat gum disease within the mouth (Andrade *et al.*, 2023).

Blue-green algae is also consumed or utilized as a culinary coloring (Echegaray *et al.*, 2023). Blue-green algae are most typically found in salty tropical or subtropical environments, but some forms can even be found in huge freshwater lakes. This algae's natural color can give water bodies a dark-green look. Certain blue-green algal products are cultivated under strict guidelines. Others are cultivated in the wild, where they are more susceptible to contamination by bacteria, liver toxins (microcystins) generated by specific bacteria and heavy metals. Only buy items that have been tested and proven free of these pollutants.

How does it Function?

Blue-green algae have a high protein, iron, and mineral content that are easily absorbed when consumed. The effects of blue-green algae on the immune system, swelling (inflammation) and viral infections are being studied.

Organic Blue-Green Algae Natural Compounds

Blue-green algae have 70% vegetable protein and more beta-carotene than broccoli. Blue-green algae is a one-two punch in that it has a high concentration of nutrients over 65 vitamins, minerals, and enzymes as well as the full spectrum of eight essential amino acids and ten non-essential amino acids, all of which are easily absorbed by the body. In fact, up to 97% of the important vitamins, minerals, and enzymes present in blue-green algae are easily absorbed (other supplements have absorption rates as low as 5-25%). *Aphanizomenon flosaqua* (AFA) also has the highest level of physiologically active chlorophyll of any known diet (Fais *et al.*, 2022).

Antioxidant Capacity of Blue-Green Algae

Aphanizomenon flosaqua is high in antioxidant chemicals. The oxygen radical absorbance capacity (ORAC) of foods and other substances reported to contain antioxidants is determined using a technique known as the oxygen radical absorbance capacity (Benedetti *et al.*, 2010). The ORAC technique was used to edible AFA at Italy's University of Urbino Carlo Bo. The findings favored researchers who advocated for the use of AFA as a dietary antioxidant supplement to alleviate oxidative stress (Abdel-Wahab *et al.*, 2023).

Another research was undertaken by the University of Urbino Carlo B to assess AFA's capacity to protect normal human red blood cells and plasma from oxidative damage. The results indicated that AFA reduced oxidative damage in both. Additionally, AFA slowed the depletion of helpful enzymes in the body. According to a Japanese study, a product containing blue-green algae from Lake Klamath had significant antioxidant activity and was an effective adaptogenic, which is a chemical that helps the body adapt to defend itself against stresses (Sarin and Verma, 2009).

B₁₂ and Blue-Green Algae

There is significant debate about whether AFA is a good source of vitamin B₁₂. Several natural sources of vitamin B₁₂ are insufficient physiologically. Nevertheless, preliminary study undertaken by Italy's Department of Neurorehabilitation at Villa Salus Hospital examined the vitamin B₁₂ levels of 15 vegan participants who supplemented with an algal product from Lake Klamath and discovered that their B₁₂ levels were higher than in a control group. Although first study was inconclusive, experts thought it supported the premise that AFA is a dependable source of vitamin B₁₂ (Baroni *et al.*, 2009).

Stem Cells with Blue-Green Algae

Adult stem cells are responsible for mending damaged cells. However, as we age, our stem cells lose their regenerative function and become more susceptible to oxidative damage. As a result, the body is less able to restore itself. The Department of Neurosurgery at USF explored the effects of AFA on cultured human stem cells based on prior research that revealed blue-green algae might affect immunological function in animals. According to early findings, an ethanol extract of AFA may increase human stem cell growth (Arnold *et al.*, 2023).

Concerns about Blue-Green Algae

Although blue-green algae are widely consumed in the United States, Canada and Europe, there has been some worry regarding the presence of microcystin, a harmful consequence of blue-green algae. As a result, the Oregon Health Division and the Oregon Department of Agriculture have set regulatory restrictions on the amount of microcystin in BGA products (Aparicio-Muriana *et al.*, 2023).

Other study has also found a link between beta-methylamino-L-alanine (BMAA), an amino acid generated by blue-green algae and some neurodegenerative diseases (Arnold *et al.*, 2023). If you are pregnant or breast feeding, as with most goods, ask your healthcare professional before using blue-green algae supplements.

Applications and Effectiveness

There is insufficient evidence to rate the effectiveness of allergies caused by the seasons (hayfever). Early study suggests that consuming 2 gm of blue-green algae per day by mouth for 6 months may alleviate certain allergy symptoms in people.

Insulin Resistance caused by HIV Medication

According to preliminary studies, ingesting 19 gm of blue-green algae by mouth for two months promotes insulin sensitivity in persons who have insulin resistance caused by HIV treatment (Olabi *et al.*, 2023).

Poisoning with Arsenic

Early study indicates that eating 250 mg of blue-green algae and 2 mg of zinc twice by a day for 16 weeks decreases arsenic levels and the effects of arsenic on the skin in persons who live in locations with high arsenic levels in drinking water. Early research indicates that dissolving 3 ml of a product containing blue-green algae, peony, ashwagandha, gotu kola, bacopa and lemon balm (Nurture and Clarity, Tree of Healing-LD, Israel) into 50-60 ml of water and drinking three times daily for four months improves ADHD in children aged 6-12 years who have not taken other treatments for ADHD. Early study indicates that using a specific blue-green algae product (Super Blue-Green Algae, Cell Tech, Klamath Falls, OR) at a dose of 1500 mg daily for 6 months did not diminish eyelid spasms in persons with blepharospasm.

Diabetes

Early research found that persons with type 2 diabetes who consumed 1 gram of a blue-green algae product (Multinal, New Ambadi Estate Pvt. Ltd., Madras, India) twice day for two weeks had decreased blood sugar levels.

Exercise Efficiency

An early study found that when males who jog regularly ingest 2 gram of blue-green algae three times a day for four weeks, they could sprint for longer lengths of time before feeling weary (Arnold *et al.*, 2023).

Hepatitis C

The effects of blue-green algae on persons with chronic hepatitis C have been inconsistently studied. One research found that ingesting 500 mg of *spirulina*, a blue-green algae, three times daily for six months resulted in higher improvements in liver function than milk thistle in persons with hepatitis C who had not yet been treated or who were refractory to prior therapies. Another study, however, found that eating blue-green algae for one month deteriorates liver function in persons with hepatitis C or hepatitis B (Rogan *et al.*, 2023). The effects of blue-green algae on patients with HIV/AIDS have been inconsistently studied. Early study indicates that ingesting 5 gm of blue-green algae by mouth daily for three months lowers infections, stomach and intestinal difficulties, weariness, and respiratory problems in HIV/AIDS patients. Taking blue-green algae, on the other hand, does not appear to increase CD4 cell counts or viral loads in HIV patients.

Elevated Cholesterol Levels

According to preliminary studies, blue-green algae decrease cholesterol in those with normal or slightly higher cholesterol levels. The research findings, however, have been inconsistent. Blue-green algae only reduced low-density lipoprotein (LDL or bad) cholesterol in certain tests. Blue-green alga has been shown in previous trials to reduce total cholesterol and LDL cholesterol while increasing high-density lipoprotein (HDL or good) cholesterol (Abdel-Wahab *et al.*, 2023).

High blood pressure

Early study indicates that consuming 4.5 gram of blue-green algae per day by mouth for 6 weeks decreases blood pressure in certain patients with high blood pressure.

Fatigue over Time

Early study indicates that consuming 1 gram of blue-green algae by mouth three times per day for four

weeks did not relieve fatigue in persons with long-term fatigue complaints (Abdel-Wahab *et al.*, 2023).

Malnutrition

Early study on the use of blue-green algae in combination with other nutritional interventions for baby and child malnutrition yields mixed findings. Weight gain was seen in undernourished youngsters feeding *spirulina*, a blue-green algae, along with millet, soy and peanuts for 8 weeks. In another trial, children as young as three years old who were fed 5 gm of blue-green algae daily for three months gained no more weight than those who received only conventional nutritional therapies (Rogan *et al.*, 2023).

Symptoms of Menopause

An early study found that consuming 1.6 gram of a blue-green algae product by mouth daily for 8 weeks reduces anxiety and sadness in menopausal women. Yet, does not appear to alleviate symptoms like hot flashes.

Obesity

The effects of blue-green algae on overweight or obese adults have been inconsistently studied. According to one preliminary study, ingesting a specific blue-green algae product (Multinal, New Ambadi Estate Pvt. Ltd.) at a dose of 1 gram given two or four times per day by mouth for three months enhances weight reduction in overweight individuals. Yet, another preliminary study finds that consuming 2.8 gram of *spirulina* orally three times per day for four weeks did not aid weight reduction in overweight persons who are already on a low-calorie diet (Rogan *et al.*, 2023).

Mouth Ulcers that are Precancerous (Oral Leukoplakia)

Early study indicates that consuming 1 gram of *spirulina* everyday by mouth for 12 months lowers oral leukoplakia in smokers (Huang *et al.*, 2021).

Periodontal Disease (Periodontitis)

Early study suggests that injecting blue-green algae gel into the gums of persons with gum disease improves gum health. As a good source of protein, B vitamins and iron.

Immune System Booster

Additional research is needed to assess the efficacy of blue-green algae for these applications. Natural Medicines Comprehensive Database assigns a scale of efficacy based on scientific evidence: effective, certainly effective, probably effective, likely ineffective and inadequate evidence to grade (detailed description of each of the ratings) (Huang *et al.*, 2021).

Adverse Reactions

When used in moderation, blue-green algae products devoid of pollutants such as liver-damaging chemicals known as microcystins, poisonous metals and dangerous microorganisms are possibly safe for most individuals. Doses as high as 19 gm per day have been used successfully for up to two months. Smaller daily dosages of 10 gm have been used successfully for up to 6 months. Nausea, vomiting, diarrhea, stomach pain, exhaustion, headache and dizziness are common side effects. Contaminated blue-green algae goods, on the other hand, pose a risk, particularly to youngsters. Children are more susceptible than adults are to polluted blue-green algae products. Blue-green algae contamination can result in liver damage, stomach discomfort, nausea, vomiting, weakness, thirst, fast heartbeat, shock, and death. We should not use blue-green algal products or marine foods without tested for microcystins and other contaminants (Vichi *et al.*, 2012, Maurya, 2022).

Conclusion

Therapies that enhance CVD and NAFLD prevention are in high demand. In cells, animals, and humans; edible BGA has been found to lower inflammation, oxidative stress and blood lipids. BGA contains carotenoids, GLA, PC, fibers and plant sterols that can help lower CVD and NAFLD. BGA lowers total cholesterol, triglycerides, and intestinal cholesterol absorption in the blood. By inhibiting the NF- κ B pathway, BGA decreases proinflammatory mediators. BGA reduces oxidative stress by scavenging free radicals and inhibiting lipid peroxidation. Biomass from cyanobacterial farming may be used to produce bioenergy, food supplements, nutraceuticals, bio-fertilizers, aquaculture feeds and poultry feeds in a sustainable manner.

Cyanobacteria, which contain bioactive compounds with antiviral, antibacterial, antifungal, and anticancer activities, should be studied by food scientists.

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