

Nutritive value of spirulina – A Review

Ms. Aishwarya kamble , Prasanna Mendgule*, Varad Mathapati, Kuldip Patil,
Nikhil Mabrukar ,Nikita kadam,

Department of Microbiology, Lokmangal college of pharmacy, Wadala, Solapur-413004

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ABSTRACT:

Spirulina, a photosynthetic cyanobacterium, has garnered global interest for its exceptional nutritional content potential health benefits. This review article offers a comprehensive exploration of spirulina, encompassing its nutritional richness. This review serves as valuable resource for understanding the multifaceted nature of spirulina and its contribution to nutrition, health, and industry

I. INTRODUCTION:

Spirulina microscopic blue-green algae belonging to the genus arthrosporic, has emerged as a remarkable candidate in the realms of nutrition, biotechnology and environmental sustainability. This enigmatic organism, with the history of consumption dating back centuries among indigenous communities has gained prominence in recent decades due to its exceptional nutritional profile and versatile applications rich in proteins, essential vitamins, minerals and bioactive compounds, spirulina has captured the attention researches and food industry. the surge in spirulina popularity can be attributed to its potential and address pressing global challenges.

Beyond its nutritional prowess, spirulina exhibits various biochemical activities, such as antioxidant and immunomodulatory effects, which have speaker interest in its potential therapeutic applications.

By shedding light on these aspects, we aim to provide a comprehensive understanding or spirulina's potential contribution to addressing global challenges in nutrition, health and sustainability. As spirulina continues to captivate both scientific curiosity and industrial interest, these article serves as foundation for appreciating its role in shaping a more nourished and sustainable future.

1.NUTRITIVE VALUE OF SPIRULINA

Spirulina, a cyanobacterium belonging to the Arthrosporic genus, is renowned for its exceptional nutritive value. This microscopic organism thrives in various aquatic environments and has become a prominent dietary supplement and food source due to its rich composition of essential nutrients. This section elucidates the remarkable nutritive content of spirulina, emphasizing its vital role in human nutrition and health.

1.1. PORTEIN CONTENT

The protein content of spirulina can vary depending on factors such as its cultivation conditions, processing methods, and the specific species of spirulina being used. However, spirulina is well-known for its high protein content compared to many other food sources. • On average, dried spirulina typically contains around 60-70% protein by weight. This makes it an excellent source of protein, especially for vegetarians and vegans. It is also rich in essential amino acids, which makes it a complete protein source.

• **Essential Amino Acids:** Spirulina is a source of complete protein, which means it contains all nine essential amino acids that the human body needs. These essential amino acids which are included in various compounds such as leucine, valine, lysine, methionine, phenylalanine, tryptophan, and histidine. Having access to these amino acids is crucial for building and repairing tissues in the body.

• **Quality of Protein:** Spirulina protein is considered high-quality because it has a balanced profile of essential amino acids and is easily digestible. This results to make it a valuable source of protein.

• **Bioavailability:** The protein in spirulina is highly bioavailable, meaning that the body can efficiently absorb and utilize it. This makes it a suitable option for people looking to increase their protein intake.

• **Nutritional Profile:** In addition to protein, spirulina is rich in various other nutrients,

including vitamins (e.g., B vitamins, vitamin K), minerals (e.g., iron, calcium, magnesium), antioxidants (e.g., beta carotene, phycoerythrin), and essential fatty acids (e.g., gamma-linolenic acid). These additional nutrients contribute to its overall nutritional value.

- **Recommended Daily Intake:** The recommended daily intake of spirulina can vary depending on individual dietary needs and goals. Some people take spirulina supplements, while others incorporate it into their diet as a whole food or as an ingredient in smoothies, salads, or other dishes.

- **Research and Health Benefits:** Spirulina has been studied for its potential health benefits, which may include immune system support, antioxidant properties, anti-inflammatory effects, and potential benefits for conditions like allergies and high cholesterol. However, it's essential to note that while spirulina offers numerous nutritional advantages, its effects may vary from person to person, and further research is ongoing.

1.2. VITAMINS

Vitamin B1 (Thiamine): Spirulina contains significant amounts of vitamin B1, which plays a crucial role in energy metabolism and the functioning of nerve cells

- **Vitamin B2 (Riboflavin):** Spirulina is a good source of vitamin B2, important for energy production, growth, and overall health.

- **Vitamin B3 (Niacin):** Niacin is essential for various metabolic processes in the body, and spirulina provides a significant amount of this vitamin

- **Vitamin B6 (Pyridoxine):** Vitamin B6 is involved in numerous enzymatic reactions in the body, including amino acid metabolism, and spirulina contains notable amounts of it.

- **Vitamin B9 (Folate or Folic Acid):** Folate is crucial for DNA synthesis and cell growth, and spirulina is a source of this important vitamin.

- **Vitamin B12 (Cobalamin):** Spirulina is often touted as a source of vitamin B12, but it's important to note that the form of B12 in spirulina is not the same as the one found in animal products and may not be readily absorbed by the human body. It is not considered a reliable source of active vitamin B12 for vegans and vegetarians.

- **Vitamin K:** Spirulina contains vitamin K, which is essential for blood clotting and bone health.

- **Vitamin A (Beta-Carotene):** Spirulina is rich in beta-carotene, which is a precursor to vitamin A. Vitamin A is very important for maintaining eye vision, skin, as well as the immune system.

- **Vitamin E (Tocopherol):** Spirulina contains vitamin E, which is a fat-soluble antioxidant that helps protect cells from oxidative damage.

- **Vitamin C (Ascorbic Acid):** While spirulina is not particularly high in vitamin C compared to fruits like oranges, it does contain small amounts of this water-soluble vitamin, which is important for immune function and skin health.

- **Vitamin D:** Spirulina is not a significant source of vitamin D, which is primarily obtained through exposure to sunlight or from fortified foods and supplements.

- **Vitamin P (Bioflavonoids):** Spirulina contains various bioflavonoids, which are compounds that work synergistically with vitamin C and have antioxidant properties.

1.3. MINERALS

Spirulina is a microalga that is rich in various essential minerals and trace elements, making it a valuable source of nutrition. The mineral content of spirulina can vary depending on factors such as growing conditions and processing methods.

- **Iron:** Spirulina is known for its high iron content, making it an excellent source of this essential mineral. Iron is crucial for the formation of red blood cells and oxygen transport in the body.

- **Calcium:** Spirulina contains a significant amount of calcium, which is essential for maintaining healthy bones and teeth, as well as for muscle and nerve function.

- **Magnesium:** Magnesium is vital for muscle and nerve function, energy metabolism, and bone health. Spirulina contains a notable amount of magnesium.

- **Potassium:** Potassium plays a crucial role in maintaining proper fluid balance, nerve function, and muscle contractions. Spirulina contains potassium in moderate amounts.

- **Phosphorus:** Spirulina is a source of phosphorus, which is essential for bone and teeth health, as well as for energy metabolism.

- **Sodium:** While spirulina does contain some sodium, it is generally low in comparison to many processed foods. A low-sodium diet is often recommended for various health reasons.

- **Zinc:** Spirulina provides zinc, an essential trace element that is involved in various enzymatic processes, immune function, and wound healing.

- **Selenium:** Selenium is an essential trace element with antioxidant properties. Spirulina contains selenium, though the amount may vary.

- **Copper:** Copper is involved in several enzymatic reactions in the body, and spirulina contains trace amounts of this mineral.
- **Manganese:** Manganese is essential for bone health and various metabolic processes. Spirulina contains small amounts of manganese.
- **Chromium:** Spirulina contains trace amounts of chromium, which may play a role in insulin sensitivity and glucose metabolism
- **Iodine:** Iodine is crucial for thyroid function and the production of thyroid hormones. The iodine content in spirulina can vary.
- **Sulphur:** Sulphur is a component of certain amino acids and vitamins and is essential for overall health. Spirulina contains sulphur in the form of amino acids like cysteine and methionine.
- **Boron:** Spirulina may contain small amounts of boron, a trace element that is believed to play a role in bone health.
- **Vanadium:** Trace amounts of vanadium can be found in spirulina. Vanadium may have potential roles in glucose metabolism.

1.4. ANTIOXIDANTS

Spirulina is known for its antioxidant properties, which are attributed to various compounds found within this blue-green microalgae. Antioxidants help protect the body's cells from damage caused by free radicals and oxidative stress. Here are some of the antioxidants found in spirulina:

- **Phycocyanin:** Phycocyanin is a blue pigment unique to spirulina. It is a powerful antioxidant and has been studied for its potential anti-inflammatory and neuroprotective effects. Phycocyanin is believed to play a significant role in spirulina's antioxidant capacity.
- **Beta-Carotene:** Spirulina is rich in beta-carotene, a precursor to vitamin A. Beta-carotene is a potent antioxidant known for its role in protecting cells from oxidative damage and supporting eye health.
- **Chlorophyll:** Spirulina contains chlorophyll, the green pigment responsible for photosynthesis in plants. Chlorophyll has antioxidant properties and may help detoxify the body and support overall health.
- **Superoxide Dismutase (SOD):** Spirulina contains superoxide dismutase, an enzyme that plays a crucial role in neutralizing harmful superoxide radicals in the body. SOD is a powerful antioxidant that helps protect cells from oxidative stress.
- **Glutathione:** Glutathione is a tripeptide (composed of three amino acids) and is one of the body's most important antioxidants. Spirulina contains compounds that can support the

production and recycling of glutathione in the body.

- **Tocopherols (Vitamin E):** Spirulina contains tocopherols, which are forms of vitamin E with antioxidant properties. Vitamin E is known for its ability to protect cell membranes from oxidative damage.
- **Selenium:** Selenium is an essential trace element that functions as an antioxidant in the body. Spirulina contains trace amounts of selenium, which can contribute to its antioxidant properties.
- **Phenolic Compounds:** Spirulina also contains phenolic compounds, which have antioxidant properties and may help combat oxidative stress and inflammation.
- **C-phycocyanin:** This is another type of phycocyanin found in spirulina. It has been studied for its antioxidant and anti-inflammatory properties.
- **Carotenoids:** In addition to beta-carotene, spirulina contains other carotenoids such as zeaxanthin and lutein, which have antioxidant properties and are beneficial for eye health. The combination of these antioxidants in spirulina contributes to its overall antioxidant capacity. Antioxidants help protect cells and tissues from oxidative damage, which is associated with various health conditions, including aging, inflammation, and certain chronic diseases.

1.5. ESSENTIAL FATTY ACIDS:

Spirulina is a blue-green microalgae that contains a variety of essential fatty acids, including both omega-3 and omega-6 fatty acids. These essential fatty acids play crucial roles in maintaining overall health and are considered "essential" because the human body cannot synthesize them and must obtain them from dietary sources. Here are the essential fatty acids found in spirulina:

- **Gamma-Linolenic Acid (GLA):** Gamma-linolenic acid is an omega-6 fatty acid that is present in spirulina. GLA is known for its anti-inflammatory properties and has been studied for its potential benefits in managing conditions such as inflammation, skin disorders, and hormonal imbalances.
- **Alpha-Linolenic Acid (ALA):** Alpha-linolenic acid is an omega-3 fatty acid found in spirulina. ALA is a precursor to other long-chain omega-3 fatty acids, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These long-chain omega-3s are important for heart health, brain function, and reducing inflammation.

• **Linoleic Acid (LA):** Linoleic acid is another omega-6 fatty acid found in spirulina. It is essential for maintaining healthy skin, hair, and overall cell function. The body can convert linoleic acid into other important compounds, such as arachidonic acid, which is involved in various physiological processes.

• **Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA):** While spirulina contains ALA (an omega-3 precursor), it does not contain significant amounts of EPA and DHA, the long-chain omega-3 fatty acids found in fatty fish like salmon and mackerel. These long-chain omega-3s have well-established health benefits, including cardiovascular support and brain health. If you are looking to increase your intake of EPA and DHA, you may need to consider other dietary sources or supplements, as spirulina is not a primary source of these fatty acids.

1.6. BIO ACTIVE COMPOUNDS:

• **Phycocyanin:** Phycocyanin is a unique blue pigment found in spirulina. It is a potent antioxidant and has been studied for its potential anti-inflammatory and neuroprotective effects. Phycocyanin also gives spirulina its distinctive blue-green colour.

• **Chlorophyll:** Spirulina contains chlorophyll, a green pigment that is crucial for photosynthesis in plants. Chlorophyll has antioxidant properties and may help detoxify the body by binding to toxins and promoting their elimination.

• **Carotenoids:** Spirulina is rich in carotenoids, including beta-carotene, zeaxanthin, and lutein. These compounds have antioxidant properties and play a role in maintaining healthy vision and protecting cells from oxidative damage.

• **Gamma-Linolenic Acid (GLA):** GLA is an omega-6 fatty acid found in spirulina. It has anti-inflammatory properties and may support skin health and hormonal balance.

• **Phenolic Compounds:** Phenolic compounds are antioxidants found in spirulina. They help combat oxidative stress and inflammation in the body.

• **Sulphated Polysaccharides:** Spirulina contains sulphated polysaccharides, which have been studied for their potential antiviral and immune-modulating effects.

• **Vitamins:** Spirulina is rich in various vitamins, including vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B6 (pyridoxine), vitamin B9 (folate), vitamin B12 (in some cases), vitamin K, vitamin A (in the form of beta-carotene), vitamin E, and vitamin C. These

vitamins contribute to various bodily functions, such as energy metabolism, immune support, and antioxidant protection.

• **Minerals:** Spirulina contains essential minerals like iron, calcium, magnesium, potassium, phosphorus, zinc, selenium, and trace elements like copper and chromium. These minerals play vital roles in various physiological processes.

• **Essential Amino Acids:** Spirulina provides all essential amino acids, making it a complete protein source. These amino acids are essential for protein synthesis and overall health.

• **Polysaccharides:** Spirulina contains various polysaccharides, including glycogen and other complex carbohydrates. These compounds may have potential immune-modulating effects.

• **Nucleic Acids:** Spirulina contains nucleic acids like DNA and RNA, which are involved in cellular processes and can support cellular repair and regeneration.

• **Lipopolysaccharides (LPS):** Spirulina contains lipopolysaccharides that may have immune-stimulating properties, helping to activate the immune system.

• **Phycobillin's:** These are pigments related to phycocyanin and are responsible for the various colours of different spirulina species. They also have antioxidant properties.

• **Fatty Acids:** Besides GLA, spirulina contains other essential and non-essential fatty acids that contribute to its nutritional profile.

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