SPIRULINA: "SUPER FOOD, A MIRACLE FROM THE SEA"

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Abstract:

Spirulina or Arthrospira is a blue-green alga also known as Cyanobacteria. It is a native of Asia, Africa and Central America and has been studied for its medicinal qualities since the 1600's and it became famous after it was successfully used by NASA as a dietary supplement for astronauts on space missions. It has the ability to modulate immune functions and exhibits anti-inflammatory properties by inhibiting the release of histamine by mast cells. Multiple studies suggest that this alga may improve several symptoms and may even have anticancer, antiviral and anti-allergic effects. Because of its richness in plant pigments as well as its ability of photosynthesis, *spirulina* was once classified as a plant. With newer innovations in research, genetics and physiology, scientists to moved to the bacteria kingdom, in the genus *Arthrospira* at first, and later into the genus *Spirulina*. There are three common species — *Spirulina platensis*, *Spirulina maxima* and *Spirulina fusiformis* which are studied extensively because of their high nutritional as well as potential therapeutic values.

Introduction:

Spirulina got its name from the spiral or helical nature of its filaments. It is a microscopic and filamentous cyanobacterium that has a long history of use as food and it has been reported that it has been used during the Aztec civilization. Spirulina refers to the dried biomass of Arthrospira platensis, an oxygenic photosynthetic bacterium found worldwide in fresh and marine waters. This alga represents an important staple diet in humans and has been used as a source of protein and vitamin supplement in human without any significant side-effects. Apart from the high (up to 70%) content of protein, it also contains vitamins, especially B_{12}, provitamin A (β-carotenes) and minerals, especially iron. It is also rich in phenolic acids, tocopherols and γ-linolenic acid. Spirulina lacks cellulose cell walls and therefore it can be easily digested.[1]

Spirulina is easy to cultivate but grows well only in alkaline lakes with an extremely high pH and in large outdoor ponds under controlled conditions. There

are only a few areas worldwide that have the ideal sunny climate for production of this alga, including India, Greece, Japan, United States and Spain. Currently, Spirulina can be found in health food stores and is sold mainly as a dietary supplement in the form of health drinks or tablets. Microalgae have been used for more than 10 years as dietary supplements without significant side-effects.[3]

Taxonomy of Spirulina:

Spirulina is a cyanobactery, Gram +ve, like the other blue algae, spirulina is able to photosynthesis and so to produce its own organic matter.

There are more than 39 species according to its composition stability and balance of nutrients. There are several species among which three such as *Spirulina platensis* , *Spirulina maxima* and *Spirulina fusiformis* are studied extensively because of their high nutritional as well as potential therapeutic values.

Spirulina platensis is the species most used in developing countries cultures.

Domain	Bacteria
Kingdom	Archaeplastida
Division	Cyanobacteria
Class	Cyanophyceae
Order	Oscillatoriales
Family	Pseudena baenaceae
Genus	Spirulina

Sources

'Spirulina' is a colloquial term used to refer to a blend of two bacteria, Arthospira Platensis and Arthospira Maxima. The common name 'Spirulina' is derived from 'Spiral', which is in reference to its classical morphology being spiral shaped (although linear shaped Arthospira has been noted). Spirulina is also commonly called a 'blue-green' alga due to its color and its sources.[4]

Nutritionally, Spirulina is technically a vegan source of complete protein that can be up to 70% protein by weight, although some interventions use Spirulina with 55% protein content. The amino acid composition of Spirulina is 'complete' (giving adequate amounts of all essential amino acids) but is relatively lower in cysteine, methionine and lysine when compared to animal products.[5, 6,7,8]

Composition

Spirulina contains:

- Protein, which tends to fluctuate around 65-70% dry weight (at highest estimates), of these proteins, the Phycobiliproteins named allophyco cyanin , C - phycocyanin and phycoerythrin with phycocyanin comprising about half of Phyco biliprotein weight and Phycocyanin comprising up to 20% of Spirulina dry weight.[10,11,12,13 ,14]

- Phycocyaninbilin which may comprise between 0.6 - 1% of Spirulina by total weight.[15]
- Braun lipoproteins, lipoproteins found in bacterial cell walls confer immunological benefits.[16]
- Fatty acids such as γ-Linolenic acid (GLA) at up to 20.8mg/g Stearic Acid, Alpha Linoleic Acid, Palmitic Acid, and Linoleic Acid; exact composition varies depending on production. Total fatty acids tend to fluctuate around 6% by dry weight.[7,10, 18, 19, 20, 22]
- Carbohydrate, of which, some immune system activating polysacchardes (Immulina) at 0.5-2% total dry weight (7-14% total carbohydrate) and Sodium Spirulin.[24,25]
- Trace minerals including Iron (50-150mg), Calcium (600–1,200mg / 100 g) , Magnesium (200 - 600mg/100g), and Selenium (50-100 m c g / 100 g) vitamin C (2 - 4mg/100g).[21,26]

Nutrients	Content of Spirulina (per 10g)
Protein	6 g and 7 g
Iron	5.8 - 18 µg
Vitamin A	1560-3780 µg
Vitamin B1	0.35-0.5 µg
Vitamin B2	0.3-0.5 µg
Vitamin B3	13 µg
Phosphorus	67-90 µg
Magnesium	20-30 µg
Brass	0.08-0.1 µg
Calcium	13-140 µg

Nutritional Facts & Health Benefits

1. Spirulina in malnutrition

Spirulina is mostly used as a great source of protein and vitamin B12. It contains 55-70% of proteins, but studies suggest that it is a subpar source of B12 as the vitamin is not absorbed well after ingestion. Spirulina can improve lipid and glucose metabolism, while also reducing liver fat and protecting the heart.

Even if spirulina does not fill some deficiencies (iodine), spirulina brings all vitamin A, vitamin B, and iron needs and a significant quantity of other essential minerals such as brass, magnesium and calcium. With a recommendation of 10g per day, protein contributes 60% to 70% to meet the major part of protein needs of a child (50%). In this condition, the algae can be considered as a real ingredient.

2. Allergy, Rhinitis and Immunomo dulation

The release of histamines from the mast cells helps Spirulina to exhibit anti-inflammatory properties. Spirulina enhances hematopoiesis to produce more erythrocytes and lymphocytes.[27,28]

It shows direct effect on innate immunity by activating macrophages and activates the T-helper cells and T-cytotoxic cells. Spirulina may modulate the immune system by its role in covering nutritional deficiencies.

In a recent randomized, double-blind placebo-controlled trial, individuals with allergic rhinitis were fed daily, either with placebo or Spirulina for 12 weeks. Peripheral blood mononuclear cells were isolated before and after the Spirulina feeding and levels of cytokines (interleukin-4 (IL-4), interferon-γ (IFN-γ) and interleukin-2), which are important in regulating immunoglobulin (Ig) E-mediated allergy, were measured. The study showed that high dose of Spirulina significantly reduced IL-4 levels by 32%, demonstrating the protective effects of this microalgae toward allergic rhinitis.[29]

Ishii et al. studied the influence of Spirulina on IgA levels in human saliva and demonstrated that it enhances IgA production, suggesting a pivotal role of microalgae in mucosal immunity.[30]

3. Antiviral applications

The active component of the water extract of S. platensis is a sulfated polysaccharide, calcium spirulan (Ca-Sp). According to Hayashi et al. Ca-Sp inhibits the invitro replication of several enveloped viruses including Herpes simplex type I, human cytomegalovirus, measles and mumps virus, influenza A virus and human immunodeficiency virus-1 (HIV-1).[32]

The important component of Spirulina, sulfated polysaccharide, calcium spirulan (Ca-Sp), consists of rhamnose, ribose, mannose, fructose, galactose, xylose, glucose, sulphate and calcium. Ca-Sp inhibits the replication of various enveloped viruses by selectively inhibiting the penetration of viruses into the host cells. The effects of phycocyanin (a biliprotein of Spirulina) is seen to enhance the biological defense activity by reducing allergic inflammation by the suppression of antigen specific IgE antibody and through maintaining the mucosal immune system function against infectious diseases.

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The advantage of using herbs and algal products with proven antiviral properties in fighting certain viruses is that they can be used through immunomo-dulation even when the infection is established.[3]

4.Anticancer effects

Spirulina is a potent cancer fighting phytonutrient. As b-kerotene and phycocyanine, both exhibiting anti-cancer are the natural sources found in abundance in Spirulina, it becomes more natural anti-cancerous substance. It has been argued that the combined antioxidant and immune modulation characteristics of Spirulina may have a possible mechanism of tumor destruction, hence play a role in cancer

prevention. The hematopoietic function of Spirulina is very important to its anti-cancer effects, which increases the production of immune cells and thereby immune-boost natural resistance against cancer and other diseases.

5. Antioxident effects

During oxidative stress, changes occur in NADPH activity, resulting in differences in the conformation of enzymes involved in the mitochondrial respiratory chain, nitric oxide synthase, and xanthine dehydrogenase, thereby generating high levels of superoxide. This leads to apoptosis, cardiac remodeling due to chronic pressure overload and atrial fibrillation etc.

The effect of bilirubin and biliverdin on NADPH oxidase activity is mimicked by a phytochemical phycocy-anobilin which is a homolog of bileverdin. Spirulina reduces the severity and recovery of strokes. It also reverses age-related declines in memory and learning

6. Cholesterol-lowering effects & effects on diabetes

Cardiovascular disease remains the number one cause of death in developed countries, despite increased awareness. High cholesterol is one of the most important risk factors in atherosclerosis.

Spirulina helps to reduce cholesterol in our body. Studies show that it helps to improve cardiovascular health by reducing the concentration of bad cholesterol (LDL) and increasing the level of good cholesterol (HDL). By reducing low-density cholesterol, it lowers the blood pressure and improves the condition of the heart and arteries. Different studies have established that spirulina health benefits include improved cardiovascular function and lowering of the “bad cholesterol” level.

Ramamoorthy and Premakumari administered Spirulina supplements in ischemic heart disease patients and found a significant reduction in blood cholesterol, triglycerides and LDL cholesterol and an increase in HDL cholesterol. More research is needed before Spirulina can be recommended to lower cholesterol levels but its role as a natural food supplement in combating hyperlipidaemia, in combination with other therapeutic options, should not be overlooked.[34]

Diabetes mellitus (DM) is one of the most prevalent diseases and is of great concern globally owing to its health and socioeconomic repercussions. Diet plays a central key role in maintaining the blood glucose levels in diabetic patients to prevent Complications arising. As Spirulina has been associated with cholesterol regulatory, antioxidant and immune

modulatory properties, it seems to be helpful to diabetic patients as a functional food. Spirulina helps in maintaining the nutritional balance in such chronic conditions.

Considering the critical lipid profile in DM patients, Spirulina has been reported to have blood lipid lowering effects which have a positive impact on both healthy subjects as well as heart patients. Since dyslipidemia, oxidative and inflammatory stress are considered to be the contributing factors for diabetes, Spirulina has great promise as a functional food for management of type 2 diabetes.

Finally, Mani et al. in a clinical study, found a significant reduction in LDL:HDL ratio in 15 diabetic patients who were given Spirulina. However, this study was small and better studies are needed before Spirulina can be recommended in diabetes.[35]

Conclusion:

For centuries, coastal populations have taken advantage of the availability of algae to supplement their food supply, also using it as fertilizer and as animal feed. Microalgae have gained particular popularity as a dietary supplement, among which, Spirulina is the genus that has gained the most interest as a food supplement. It possesses a complete range of micronutrients and contains an extraordinarily high level of protein (50 % to 70 %). Additionally, it contains all the important vitamins (with the exception of vitamin C) and has high levels of essential micronutrients. Many people promote Spirulina as a treatment for a range of metabolism and heart health issues, including weight loss, diabetes and high cholesterol, according to the National Institutes of Health (NIH). People may also recommend Spirulina as an aid for various mental and emotional disorders, including anxiety, stress, depression and attention deficit-hyperactivity disorder (ADHD).Spirulina is said to help a range of eclectic health problems, including premenstrual symptoms and amyotrophic lateral sclerosis.

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RAMA COLLEGE OF NURSING
WORLD BREAST FEEDING WEEK -2015 REPORT

Rama College of Nursing, Kanpur, celebrated "World Breast Feeding Week- 2015 from 1 st to 7 th August, with various activities related to the theme, "Breast Feeding at Work Place, Lets Made It Work". The formal inauguration was done on 1st August in the college where significance of the breast feeding week was explained by the Principal Rama College of Nursing. The faculty members and students participated in the programme. Exhibition on breast feeding and infant feeding was displayed at Bhitoor PHC on 5th of August, which was inaugurated by Medical officer, Bhitoor PHC, Kanpur. Around fourty mothers who attended immunization clinic visited the exhibition area. Students of 2 nd B.Sc (N) of RCN explained the exhibits in local language and cleared the doubts of the mothers related to continuation of the breast feeding. It was appreciated by the community.

On 6th August the exhibition was also displayed in the OPD of Rama Medical College Hospital and Research Center, Kanpur. Around fifty mothers, medical and paramedical students, visited exhibition area and all appreciated the hard work of the students to prepare and display the exhibits which are of importance for the breast feeding and child health. All have given their positive feedback and stated that exhibition was attractive and knowledgeable.