

Spirulina (Arthrospira plantensis) the 'Super food' as a nutritional supplement: A review

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Abstract

Spirulina are multicellular and threadlike blue-green algae. In this review we have studied about the essential nutrient and medicinal properties of spirulina such as antioxidant, antiviral, antifungal, and etc. Spirulina has certain methods of preparation and original morphology under certain conditions. It is used as various disorders. Here we have summarized the available information concerning the human clinical potential and uses of spirulina and also taxonomy. Spirulina are mainly due to chemical composition is consists of protein, amino acids, carbohydrates, fatty acids, vitamins, pigments further studied that cultivation, production another different essential source's. The review provides important information on productivity and also cultivation of spirulina. Cultivation and creative formulation are further necessary to conventional products with based on protein system. This review is an hard work to collect these nutritional and medicinal functions, uses, methods of preparation, Cultivation, morphology of spirulina in an vast information the literature on spirulina.

Keywords: spirulina, antioxidant, antiviral, anticancer, arthrospira plantensis

Introduction

Spirulina (Arthrospira Plantensis) is a 'super food'. It is multicellular, filamentous blue-green algae. It gives main as well as important role in popularity of health food industry and help to increasing proteins, vitamin, and nutrient in aquaculture diet. Spirulina acts as potential therapeutic agents for treatment of oxidative stress included diseases. It is helps to reduce the blood cholesterol gives production against cancers help to enhance the immune system. The production of spirulina is widespread that means all over the world with low cost and high productivity (charpy, langlade and Alliod 2008). *S. plantensis* grows at warm alkaline water which is rich in nitrogen and phosphorus nutrient. It mainly found in lakes of Africa, latin America and South Asia. It is also found in tropical and semitropical areas (castennolz and al 2001). *S. plantensis* is blue-green algae has a spiral cellular structure and has extraordinary capacity to survive under condition these conditions are harsh to survive another algae. *S. plantensis* has different names at different location in world like at North region of cameran called as 'sembe'. In chad called as 'Didhe'. *S. plantensis* contain high amount of protein, minerals, traces elements and many vitamins such as B₁, B₂, B₁₂, and E. The Scientific Name is Spirulina is Arthrospira plantensis.

Spirulina was first discovered by Spanish Scientists "Hernandez Cortez". and "Conquistadors" in 1519. *S. plantensis* is used as supplementary dietary ingredients of feed for aquaculture china is use the *S. plantensis* as a partial substitute of imported forage to promote the growth immunity and viability of shrimp. Spirulina gives different application in agriculture, food, pharmaceuticals, perfume, medicines, and science. It is also used as food supplement and marketed in the form of pills, capsules, powders in form of cakes, biscuits and health drinks etc [1, 2, 3, 5, 6, 7, 8].



Fig 1: Spirulina in Powder and Tablet form

Morphology

Spirulina is a coadjuvant, more than one cell and thread blue-green microalgae with coadjuvant bacteria that proper nitrogen from air. Spirulina can be stick or circle-shaped phycocyanin is the main photosynthetic pigment. This pigment colour is blue. Reproduction of spirulina is a binary fission. The helix shape of the filament (trichomes) this maintain only in a liquid environment or culture medium. The helix shape have length is 50 to 500 μm and width is 3 to 4 μm . Gram-negative bacteria is a similar to the cell wall. The spirulina body surface is a smooth and uncovered and easily digestible [13].

Taxonomy [13]

Table 1

Phylum	cyanobacteria
Class	cyanophyceae
Order	nastoscales
family	oscillatoriaceae
genus	spirulina turpin

Cultivation of spirulina

Natural habit

Spirulina is a algae species found and growing in natural fresh water. Spirulina also found in natural habitats such as soil, marshes and sea water. In the natural habitats growth of spirulina depends upon supply of nutrient when supply of nutrient maximum they form pollution reach the water bodies the algae rapidly developed grow and increase population to the maximum [1, 7, 13].

Commercial Cultivation

Early 1960's japan started large scale cultivation of microalgae of chlorella followed by spirulina in early 1970's. Today's more than 22 countries that cultivate spirulina commercially large scale [9, 13].

Harvesting of spirulina

Harvesting and processing, packing based on following principle stages

Filtering of culture medium

The pond will be ready for harvest after five day. After seeding process is complete. Different method use different farmers to harvesting spirulina. This is because of the availability of materials sources. Filtrations is carried out to harvesting. Spirulina culture is collected in holder and poured onto the cloth. The culture medium flows back into the pond leaving spirulina on cloth excess of culture medium residues that still remains can be drained by squeezing or application of pressure [1, 13].

Cleaning

After the filtering by filter collected spirulina media is washed by distilled water to remove impurities to avoid contamination or culture media impure residue salts. The cleaning is complete after this process water is removed by squeezing or pressing process and make it ready for drying [1, 6, 10].



Fig 2: Cultivation and collection of spirulina

Material

S. plantensis is grows in alkaline warm water and doesn't comes to soil to avoid contamination it requires pools or containers for its best growing.

It is needs sunlight 350 midryinenstein is the most suitable level for spirulina. Container should be made of wool, metal even sacks, filled with sand or soil. Water is most important for growth of spirulina water have alkaline pH (10) [9, 12].

Fertilizers

1. Sodium bicarbonate (NaHCO₃).
2. Potassium nitrate (KNO₃).
3. Sodium Chloride (NaCl).
4. Iron sulphate (FeSO₄).

Litmus paper

For maintaining the pH level of culture at 10-10.5. Filtration cloth- Density of cloth should be 30-40 micron in diameter made of polypropylene nylon or polyesters' for filtering and separating the spirulina from culture medium. Electric dryer and grinding device for dry collected spirulina and grinding to form it in powder form for easy use.

Methods of production of spirulina

S. plantensis is obtained from the form which are situated at Name as (younde Cameroon). It was cultivated inside the basic water tank which has pH 10 add fertilizer for best growing. Every day a third of culture medium was collected on fabric filter which washed by water after remaining spirulina accumulate on very fine mesh filter (30-40) micron. Then it was pressed for 20min to obtain a biomass and then put on the racks in the form of spaghet. After a this process it should be dry by using a electric dryers at temperature 40 degree Celsius. This temperature is important to preserve the vitamin and phytonutrient. Then dried algae was grinded into a fine powder to make different products [2, 3, 7, 13].

Analysis of spirulina by following step.

- Preparation of aqueous extracted.
- 100g of *S. Plantensis* powder with 1000ml water agitate for 24 hour and then filter.

Determination of micronutrients

Protein, carbohydrates, lipids, determinate by using methods (van soers, 1967; AOAC, 1980; AOAC, 1984; Bergeret 1985). Phytochemical screening and phenolic profile of *S. plantensis*. Determination of phenolic content of the extraction. Total antioxidant activity by ferric reducing antioxidant power assay (FRAP). Quantitative of phenolic compound by HPLC. Determination of phycocyanin and carotenoid.

Chemical Composition of spirulina

Spirulina can be used simply as protein supplement, but is also considered to have effect on immunity. Spirulina with its high nutritional value has been consumed as food. Protein spirulina is among the richest source's of protein. It's protein content is about 60%-69%. Spirulina was shown to required fish from sablethal levels of some chemicals equally nutritional supplementation of spirulina has helped in mollifying the incidence of anemia experienced during pregnancy. Spirulina contain eight necessary and eighth non-necessary amino acids that binding protein molecules. Spirulina has absence of cellulose in its cell walls build-up of mucopolysaccharide. Mineral composition of k⁺ and Na⁺ are determine by using flame heating photometer while calcium and magnesium determine by various method of titration that means complexometric titration [2, 3, 9, 13].

Table 2

protein	60%-69%
carbohydrates	16%-20%
lipids	5%-7%
minerals	6%-9%
moisture	2.5%-6.0%ca

Role of spirulina

In Radio-protective. Spirulina has a important role in Radio-protection against the radiation and rays its effects. Anemic condition induced by irradiation that cause due to reduced. Spirulina are the immunity favors and its has most strong antioxidant and anti-inflammatory effect may be due to ability to bended heavy metals and radioisotopes.

Uses [3, 5, 6, 10, 11, 12]

Spirulina and it's use by humans

In clinical trials spirulina can serve as additional cure for many disease. Spirulina capsule have excellently in lowering blood lipid level and after radiotherapy and chemotherapy decreasing white blood corpuscles.

a. Nutritional supplement

Spirulina is high or more quality protein, vitamins, minerals and many biologically active substance. The spirulina cell wall consist of polysaccharide this polysaccharide has a digestibility of 86% and easily absorbed in human body. The *S.plantensis* powder is using in the form of food table. The brands names are Linavina and Pirulamin.

b. Anemia

The Anemia petint 4 g of spirulina each after in 30 days. Then the blood hemoglobin are increase form 10.9 to 13.2. spirulina substantially, reduced the glucose level in the blood in both male and female between 40 to 60 years.

Use as fertilizer

In 1981 the FAO document probability of blue-green algae replacing chemical fertilizers. The blue-green algae grown in shallow earthen ponds in India. When farmer are not use chemical fertilizer algae gave same benefit in India. The use of spirulina are basis on fertilizer is obstruct by inexpensive.

Use as medicines

The studies shown that the spirulina intake within 4 weeks reduce serum. Spirulina make the tumor necrosis factor in macrophages suggesting a possible tumor destruction. Spirulina contain vitamins A. It is a important of prevented eye disease iron. And vitamins B₁₂ it useful in treating hypoferric anemia and pernicious anemia. Spirulina is a animal cell growth stimulant and in the treatment of residual water using.

a. Antioxidant

Spirulina consists of nutrient, vitamins, and other valuable contents. Apart from its important as a food. A cumulative for supplementary nutritional proteins, there are a lot of capacity for medical properties. One of the most important features of spirulina is antioxidant. Antioxidant are the substance which neutralizes the free radicals generated due to oxidative. The chelating (EDTA) properties of spirulina was studied when human neuroblastoma cells *in vitro* were exposed to toxic amount. This property explained by the antioxidant of spirulina.

b. Antifungal

The immunological effect of spirulina plantensis extracted was test in Bulb mice infected with candidiasis. Antifungal activity of cell extract of blue-green algae against the two fungal strains. *Aspergillus Niger*, *Aspergillus flavus* was studied. *S.plantensis* biomass are used to maintain the counts of starter organisms in acidophilus-bifidus-thermophiles milks at satisfactory levels during whole duration of storage. This is a great opportunity for the production of functional dairy products.

c. Antiviral

Nutrient supplement or drug that has accumulated by antiviral activity as an ability to positively effect the immune system would be considerable medicinal interest. An interesting paper (19) related to antiviral property research from japan against on a regular basis of inhibit the replicated each other. Large amount of compound with antimicrobial activities have been isolated from diff organisms and influence for the antiviral activity of spirulina. Antiviral activity has been suggested to be due to the effect that chelation on molecules confirmation. Antitherpetic activities are obtained for crude extract of *S.plantensis*. Pigments retained 50% of enter virus 71 induced apoptosis at con. of 0.056-0.101 μ m

d. Anticancer

Water extracts methods of *S.plantensis* inhibit growth of human cells. In 1987 investigated at the Harvard University at presented spirulina and *Dunaliella* are combine to each other extracted from promote the regress of the tumors in mouths in the rodents. Different types of animal studies have demonstrated the anticancer uses of spirulina. Anticancer effects are more essential significant clinical improvements, burning sensation, blanching and painful observed and safe management of oral submucous fibrolysis. Diabetes mellitus it a one of the different metabolic disorder is becoming a major health problem very large time use of different drugs can lead to different side effect.

Use of Spirulina in Poultry

Spirulina is high quantity natural feed additives that can use to the animal and poultry nutrition. Spirulina containing diets and superior productive and reproductive performance improve and compared to control in the birds. The birds eggs are yolk colour was improving by supplement spirulina to laying hens diets.

Use of Spirulina in Aquaculture

Spirulina is a in expensive feed than other animal origin. Spirulina containing feed was found the reduce in mortality and the cultivation time. In use of feed spirulina the helped to the improve disease resistance of high value resulting fish.

Packaging

Dry spirulina usually sealed in plastic bags due to plastic bags avoid hygroscopic action on dry spirulina. Spirulina also packed in capsules around 60 or 100 capsule are packed in a battle and sold ^[13].

Storage

Spirulina stored in dry fresh hygienic storage room to avoid determination of spirulina pigments.

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Conclusion

Spirulina has developed as the marvel food supplement. Spirulina is highly nutritious and chemical composition of nutrient as compared to different food resources. It shows as cancer prevention and treatment of spirulina. A blue-green algae provides various others nutrient including protein, minerals, vitamins and antioxidant, antiviral. Therefore more should be done in study, culture, cultivation, morphology, production, method of preparation, harvesting, taxonomy and beneficial use of their important inclusion. From this review it may be concluded that Spirulina shows Antiviral, Anticancer, and Antioxidant activity against a variety of harmful viruses. This reviewed encourages further there research and encourages considering day by day supplement with *S.plantensis*.

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