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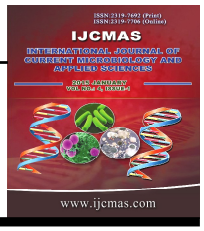

Original Research Article

Mineral profile of edible algae *Spirulina platensis*

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Keywords

Spirulina platensis, Mineral profile, Dietary supplement

A B S T R A C T

Spirulina platensis, is a photosynthetic, filamentous, spiral-shaped, multicellular and blue- green micro alga. As it contains chlorophyll *a*, like higher plants, botanists classify it as a micro alga belonging to *Cyanophyceae* class; but according to bacteriologists it is a bacterium due to its prokaryotic structure. Mexicans (Aztecs) started using this microorganism as human food. Its chemical composition includes proteins (55%-70%), carbohydrates (15%-25%), essential fatty acids (18%), vitamins, minerals and pigments like carotenes, chlorophyll *a* and phycocyanin. Pigments are used in food and cosmetic industries. The extracts of *Spirulina* could prevent or inhibit cancer in humans and animals and has immuno-promoting effects. It is the most important commercial micro alga for the production of biomass as health, food and animal. In the present study, the mineral profile of *Spirulina platensis* was analysed. The results conclude that among minerals, potassium has the maximum composition followed by phosphorous, calcium, magnesium, iron and sodium. Based on the results, *Spirulina* supplementations proved with a larger evidence and based on scientific validation studies has been accepted by global accreditation as a safe nutritional and dietary supplement.

Introduction

Systemic classification
Phylum:Cyanobacteria
Class: Cyanophyceae
Order: Oscillatoriales
Genus: Spirulina
Species: platensis

The name *Spirulina* comes from a Latin word meaning tiny spiral. It is microscopic, spiral-shaped, belong to the phylum Cyanobacteria. Even though it is single-celled attaining sizes of 0.5 millimeters in length, which makes some individual cells visible to the naked eye. There are several species of *Spirulina.*

The most commonly used nutritional supplements are *Spirulina platensis* and *Spirulina maxima*. Although *Spirulina* in fact is a bacteria it is commonly referred to as a type of algae. It is estimated to have been around for 3.5 billion years, making it one of the older photosynthetic life forms.

Spirulina platensis (Fig.1) was found in abundance at the lake by French researchers, trait within the 1960s, it is used as a daily food source after the 16th century. The first large-scale production plant was established in the early 1970s and drew attention worldwide. Today it is consumed by millions of people all over the world and they are discovering lots of health benefits apart from its nutritive value.

Habitat

Spirulina is found in tropical and subtropical regions in warm bodies of water with high carbonate/bicarbonate content, elevated pH and salinity. Their large, gas-vacuolate filaments (3 to 12μm in diameter) are easily collected by filtration and other physical means of separation. *Spirulina* was isolated from fresh water sample in 1827 by Turpin. It has been on the planet over 3 billion years. It still grows wild and abundantly around the world in very alkaline, mineral-rich, largely pollution-free, soda lakes. However, the fresh-water ponds and lakes favors are notably more alkaline, in the range of 8 to 11 pH, than ordinary lakes and cannot sustain any other forms of microorganisms. This water is too salty (up to pH 11) to support fish to use for growing terrestrial crops or for drinking. But it is perfect for growing *Spirulina.* It thrives in very warm waters of 32 to 45˚C (approximately 85 to 112˚F) and has even survived in temperatures of 60 ˚C (140˚F). In fact, the hotter it gets and the more the mineral salts concentrate as water evaporates faster and more prolifically *Spirulina* grows.

Morphology

Spirulina belongs to the oxygenic photosynthetic bacteria that cover the groups Cyanobacteria They are filamentous and non-heterocystous. They are prokaryotic, has pluri-stratified cell wall, photosynthetic or thylakoid lamella system, ribosomes and fibrils of DNA region and numerous inclusions are present. The capsule has fibrillar structure and covers each filament protecting it. The irregular presence of capsule around the filaments in *S.platensis* is a differentiating morphological characteristic to compare with *S.maxima*. Trichome width varies from 6 to 12 μm, and is composed of cylindrical cells. The helix diameter varies from 30 to 70 μm; the trichome length is about 500 μm. It is very important to explain that the helical shape of *Spirulina* in liquid culture is changed to spiral shape in solid media. These changes are due to hydratation or dehydratation of oligopeptides in the peptidoglycan layer. Cell division occurs by binary fission.

Materials and Methods

Collection of sample

Spirulina platensis was manufactured and purchased from Genius nature herbs Pvt. Ltd., Coimbatore.

Mineral Analysis

The mineral analysis was found out by using Atomic Absorption Spectrophotometer (AAS) by (AOAC, 1995); (Gupta, 1999).

Results and Discussion

The sample *Spirulina* was analsyed to find out the mineral profile and was represented (table and chart). In the present study based on mineral composition potassium (930.0mg) and calcium (876.0mg) was showed the maximum content, followed by phosphorous (230mg) and magnesium (205.0mg), iron (29.0mg) and sodium (32.0mg) was found to be very low. Iron in

some nutritional complements is not appropriately absorbed. Thus *Spirulina* is considered as an excellent food, lacking toxicity and have anticancer, antiviral, immunological properties and it also acts as a potent antioxidant. The vitamin and mineral contents of edible seaweeds make them nutritionally valuable.

Manivannan et al (2009) reported the mineral composition of different groups of seaweeds such as Chlorophyceae (*Ulva lactuca, Enteromorpha intestinalis) Phaeophyceae (Turbinaria ornata, Padina gymnospora*) and Rhodophyceae (*Hypnae valentiae, Gracilaria folifer*a) from Mandapam coastal regions and found that *P.gymnospora* was showed the maximum content of mineral composition such as copper, chromium, iron, lead, sulphur and calcium content and potassium than other seaweeds. Seaweeds are known as an excellent source of vitamins and minerals, especially sodium and iodine, due to their high polysaccharide content which could be the dietary fiber. Muthuraman and Ranganathan (2004) selected six species of marine macro algae viz., *Caulerpa scalpelliformis, Cladophora vagabunda, Enteromorpha compressa, Halimeda macroloba, Ulva fasciata and Chaetomorpha antennina* to investigate protein, amino acids, total sugars and lipid contents. Mineral content are shown to vary according to species, wave exposure, seasonal, annual, environmental and physiological factors and the type of processing and method of mineralization (Honya et al.,1993; Fleurence, and Le Coeur, 1993; Mabeau, and Fleurence, 1993; Yamamoto et al.,1979; Yoshie 1994).

Transformed into natural organic forms by *Spirulina*, minerals become chelated with amino acids and are therefore more easily assimilated by the body. Many times people have ingested large amounts of inorganic minerals without benefit to health because the body does not know what to do with these incompatible forms. In fact, evidence is accumulating that the inorganic minerals can block absorption of the organic forms, leading ultimately to mineral deficiency diseases.

Thus *Spirulina* contains essential minerals and trace elements absorbed from its growth medium into chelated, easily absorbed forms:

- POTASSIUM: A crucial mineral that regulates body electrolyte balance. Deficiency can cause heart arrest, hypertension, adrenal exhaustion and muscular collapse.
- CALCIUM: The most abundant mineral in the body, it is especially important to bone and dental health, but is also involved in neural transmissions to the muscles. Spirulina supplies about as much calcium, gram for gram, as milk. .
- MAGNESIUM: Deficiency can lead to spasmodic muscle disorders, including cardiac irregularities. Helps assimilation of vitamin C, vitamin B and protein.
- MANGANESE: Activates enzyme systems along with zinc. Promotes activity of neurotransmitter acetylcholine and helps to stabilize blood sugar.
- IRON : Promotes formation of hemoglobin, the oxygen-carrying blood pigment found in healthy red blood cells. Iron deficiency is most common among women in their reproductive years.
- PHOSPHORUS : The second most abundant mineral in the human body, it is found practically in every cell. Functions with calcium to maintain bone density. Helps to digest carbohydrates and the B vitamins niacin and riboflavin.

Iron in some nutritional complements is not appropriately absorbed. Iron in Spirulina is

60% better absorbed than ferrous sulfate and other complements. Consequently, it could represent an adequate source of iron in anemic pregnant women (Courtesy of Earthrise Farms Spirulina Library Earthrise Company. 424 Payran Street, Petaluma, CA 94952 USA).

Thus the results of the present study proved that *Spirulina platensis* is used as a potential health food in human diet and used in food industry as a source of ingredients especially with high minerals. *S.platensis* are known to contain an excellent source of minerals, especially calcium and potassium. *Spirulina* is claimed as a non-toxic, nutritious food, with some corrective properties against viral attacks and tumoral growth and as a source of the yellow coloration of egg yolk when consumed by hens. By taking *Spirulina*, people are able to maintain consistent energy levels. In addition, because it is so high in minerals, protein and essential fatty acids it is a healthy energy food that is especially useful for people on low-calorie diets. It lowers cholesterol, suppresses fatty accumulation in the liver, prevents tumor formation, enhances the immune system and protects kidneys. Thus in Indian system of medicine, the blue green algae *S.platensis* is considered as an important source of food and as health tonic.

Table.1 Mineral profile of Spirulina platensis

S.No	Parameter	Values
1.	Potassium	930.0 mg
2.	Calcium	876.0 mg
3.	Phosphorous	230.0 mg
4.	Magnesium	205.0 mg
5.	Iron	29.0 mg
6.	Sodium	32.0 mg

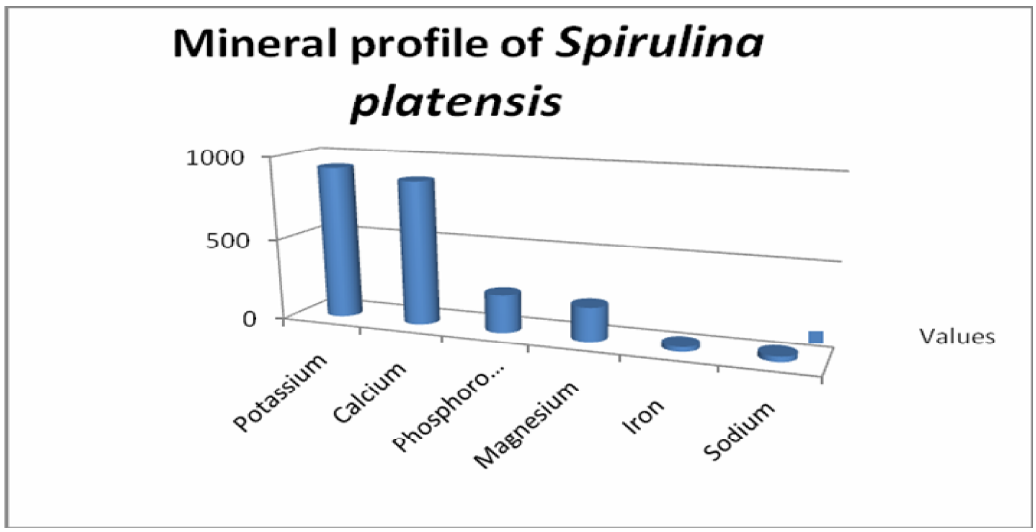

Fig.1 *Spirulina platensis*

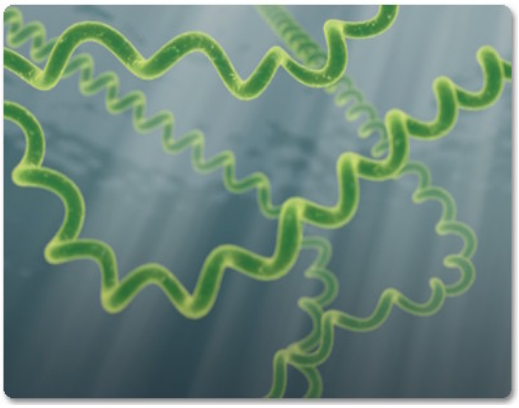

Fig.2 *Spirulina powder*

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