Wonder Gift of Nature: Spirulina

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Humans have to keep themselves healthy and fit to have a progressive life. A nation with healthy people moves ahead. In this context, it will be apt to be aware of the fact that nature has given India a very precious gift in the form of Spirulina, a blue green alga. Spirulina is very rich in protein content. Its utility as a dietary supplement and a therapeutic substance, not only for animals but also for human beings, is well recognised.

Life Cycle & Ecology

Spirulina is a blue-green alga. It belongs to the class Cyanophyceae, order Nostocales and family Oscillatoriaceae. Its multiplication generally occurs by fragmentation. It can be produced in uncontaminated water, fresh or brackish, and also in sewage - fed systems. The conditions needed for culturing Spirulina are distinct from other algal forms. These include high alkalinity as well as nutrient content. It grows as multicellular filaments that are helically coiled, hence its name. The filaments, which are called trichomes, have necridia along the length of the filaments. The necridia lyse and the trichome is broken into short segments of 2 to 4 cells called the hormogonia. The hormogonia grow and develop into the coiled trichomes. Being a tropical organism, Spirulina is thermophilic; the optimum temperature and pH for most strains are 36±2°C, 9-10 respectively. Spirulina is now being produced in many parts of the world, the major producer being the Sosa Texaco in Mexico. The research work in India with regard to the utilisation of this blue – green alga has largely been focussed on two species viz. *Spirulina platensis* and *S. fusiformis*.

Nutritive Role of Spirulina

In 1947, UN declared Spirulina as "the best food for tomorrow". World Health Organisation (WHO) and also scientists from all over the world have confirmed that it has a blend of nutrients that no single plant source can provide.Its uniquely outstanding features are:

- Every kilogram of Spirulina on dry weight basis is equivalent to 1,000 kg. of assorted vegetables in terms of nutrition.
- Spirulina is nature's richest source of protein. Spirulina has more protein, six times more than eggs, and 20 times more than milk. It stands out among the algal forms as one with protein content of 60 – 72% on dry weight basis.
- Spirulina provides all essential and non-essential amino acids. It is also the richest source of vit. B_{12}. In addition, it contains an excellent blend of Vitamin A, B_1, B_2, B_6, C,D,E,F and H along with an array of trace elements.
- Spirulina is a good source of beta-carotene (1.70mg/kg) that enhances and protects eyesight and Gamma-Linolenic acid of Spirulina reduces bad cholesterol in blood, It also reduces obesity, alcoholism, and mental disorders.
- Antioxidants in Spirulina are the most powerful scavengers of free radicals in the body. Thus, Spirulina can prevent diabetes, cancer, emotional fatigue and stress.
- High content of potassium present in Spirulina corrects hypertension and helps in proper functioning of heart muscles and nerves.
- Spirulina is virtually fat free. So much so, it helps in uniform weight reduction with no side effects.
- The greatest promise of this alga, particularly in India, lies in its potential as poultry feed. It can become a rich source of Vit. A in chicken eggs.

Role of Spirulina in Aquaculture

The application of this alga in aquaculture offers a very promising avenue for its use in fresh and processed form. Based on FCR and body weight gains, this algal diet was found to be superior to ground nut oil cake (GNOC) and even more superior to natural foods; b). It has substantial levels of PUFA, (Polyunsaturated fatty acid) including γ-linolenic acid, which is used in the synthesis of prostaglandins in fishes; c). It plays a role in augmenting pigmentation of ornamental fishes and prawns; d). The blue pigment, phycocyanin, makes upto 20% of the dry weight of Spirulina. It enhances disease resistance and improves organoleptic qualities of the fishes and e). It has also been found recently to have application in the preparation of biofertiliser, cattle feed, fuel and in the making of cosmetics.

The commercially available tablets of Spirulina are Spiruwin, Nuclina, Vitexid, Zyrullima etc.

Cultivation

Maintenance of Stock Culture: Pure Spirulina culture can be maintained on algal slant (2% agar + medium), exposed to normal light. The culture medium is prepared by mixing chemicals (g/lit) like Sodium bicarbonate 18.00, Di-potassium hydrogen phosphate 0.50, Sodium carbonate 4.00, Sodium nitrate 2.50, Sodium chloride 1.00, Magnesium sulphate 0.20, Ferrous sulphate 0.01, Potassium sulphate 1.00, Calcium chloride 0.04, and EDTA 0.08. Trace quantities of

Manganese chloride, Sodium molybdate, Zinc sulphate, Sodium tungstate, Titanium sulphate and Cobalt nitrate are also used. The aforesaid comparison is known as Zarrouks medium for indoor culture of Spirulina. The slants are to be sub - cultured at 30 days of intervals.It is also possible to maintain stock culture in liquid form in conical flask or glass carboys with the medium. The carboys alog are exposed to light and the contents need to be changed at intervals of 30 days. It is desirable to keep the starter inoculum in shade than directly exposing it to sunlight so as to avoid bleaching of the cells. After a few days, when the Spirulina starts growing as evidenced by thickening of the culture marked by the development of an intense blue green colour, it can be the diluted in glass carboys. Glass carboys are kept under shade (8-10 Klux lights) and they are shaken a few times every day, for fragmentation which is very important. After 8-10 days, inoculum is ready for outdoor cultivation.

Outdoor Cultivation: Mass cultivation of Spirulina in outdoors is possible under optimal conditions of light, pH, agitation, nutrients, initial inoculum concentration and control of contamination. The production unit has to be located in areas with suitable climatic conditions and places where all culture conditions are optimum. The technological factors involved in the mass cultivation of Spirulina are presented in Table 1.

Culture Basins: These basins are one of the important requisites for Spirulina cultivation, for making the process economical, easy to operate and durable. The shape and size are not very critical. The shape of basins and material used to construct the same may vary depending on the available materials and cost considerations. Tanks made of PVC, or pits earthen pots, lined with polyethylene sheets or brick cement mortar constructed tanks, can be used. The cement raceways or vats with length-breadth ratio of 1.5:1 with mid-rib for water circulation are preferred. Paddle wheel agitators are used to prevent algal accumulation at the surface and to ensure uniform distribution of nutrients.

Culture media: For mass culture of Spirulina, a simplified culture medium is recommended. This can be developed by adding chemicals (g/lit) like Sodium carbonate 4.00,Magnesium sulphate 0.20, N: P: K fertiliser (15:15:15) 1.00, Zinc sulphate 0.01,EDTA 0.08.

Harvesting: There are several available methods to concentrate Spirulina cells from the dilute medium in which they are suspended. The methods are: 1). By gravity filter; 2). Plate and frame filter press; and 3). Self opening bowl centrifuge.

Drying or processing is one of the most important steps in Spirulina production. This has quality enhancement effect on the product. The various methods that are available for drying the concentrated Spirulina slurry are shown in Table 2.

The role of Spirulina is manifold. It can generate new hope for farmers and industrial people once it is utilised for mass cultivation. Mass cultivation of Spirulina will generate good employment opportunities both in rural and urban sectors. Women of rural areas can take up Spirulina culture as a cottage industry. Several low-cost inputs like biogas slurry may be used. Individuals can maintain about 100 sq. mt of area in the form of cement vats/cistern (3x2x0.5 m; 15-20 nos.) to whom the central unit in the village/place could supply nutrient inputs on regular basis and in turn collect Spirulina powder produced. From the central/ main unit, Spirulina can be sold to either domestic consumer or exported overseas directly. However, for that a network has to be developed between the farmers and input suppliers with buy-back facilities. *(contd... on page 29)*

Table 1:Technological Factors Involved in the Mass Cultivation of Spirulina:

Parameters		***Requirements***
Cultivation systems	-	Cement tanks
Nutrients	-	Commercial fertilisers, crude salts, simple nutrient composition of medium/Zarroucks media etc.
Light	-	Sunlight and shading needed in intense lights 35-45 Klux.
Agitation	-	Manual stirring by glass rod (30 min/day)
pH	-	8-10, self adjusted by bicarbonate addition
Temperature	-	25-30°C
Culture depth	-	20 cm.
Flow rate of Medium	-	20 cm/sec.
Initial concentration	-	150 mg. Dry Biomass/L
Final concentration	-	600 mg. Dry Biomass/L
Culture period	-	15 days
Harvesting	-	Filtration through bolting silk cloth
Drying	-	Sun drying on plastic sheets

Table 2: Methods for drying the Spirulina slurry

Sl. No	Drying techniques	Drying (Surface Temp).(°C)	Drying time	Quality
1	Sun Drying	33-35 °C	14 hrs	Fair (for feed)
2	Steam heated drum drying	120-128 °C	16 sec	Very good (for feed)
3	Vacuum shelf drying	50-65 °C	5 hrs	Very good but hygroscopic
4	Cross flow air drying	60 °C	20 hrs	Good (for feed)

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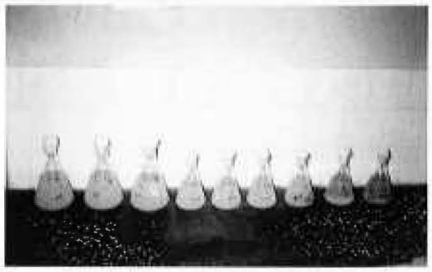
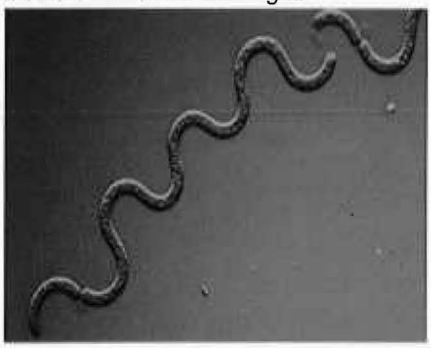


Inoculums in Conical flask

15- days old of Spirulina culture

Mass culture of Spirulina in cemented tanks with tube light.

Spirulina culture in plastic buckets.



Spirulina fusiformis is a filamentous blue green alga having length of 400-600 μ with a width of 13 μ.

Spirulina platensis is a filamentous blue green alga having length of 330-500 μ with a width of 8μ.

Book review

Bibliography of Tunas

ISSN: 0972-2351 **Authors:** N G K Pillai and Jyothi V Mallia
Publishers: Central Marine Fisheries Research Institute, P B No 1603, Kochi - 682 018, Kerala

Abiding interest on tuna as a precious capture fishery and farming resource is on the upswing among all categories of maritime nations, be they developed, developing or under-developed. There has been the generation of an enormous extent of literature on Tunas, that treasures valuable developments related to their stocks and their exploitation, besides sustainability aspects. Those engaged in studies on tuna and in their exploitation face problems in accessing as they need such of the publications that contain the needed information. This book, under review eminently minimises these problems.

The authors have provided a bibliography that virtually lists all published literature on tuna. For having accomplished this difficult task, they deserve to be appreciated with gratitude by all concerned, particularly the research scholars and professionals in the field. They will be immensely benefitted by this listing. The bibliography covers the biology and fisheries of tuna, tuna stock assessment, harvesting and post harvesting aspects of the fish, and the contributions in respect of tuna tagging, and bait fishes of tuna. It also covers physiology, genetics and breeding work done on tuna.

Cage farming of tuna is an up and coming activity. The authors have done a thoughtful job in covering this aspect too in this book.

The uninitiated as well as those familiar with tuna often face problems in the identification of at least some of the tunas. Apparently taking this aspect into account, the authors have thoughtfully included in the book the field identification features of all important tunas.

Although the main focus of the authors is to present to the readers the bibliography of tunas, they have done much more this. They have rendered an immense service of a lasting nature by including in the book an account on the trends in world tuna fishery, while also detailing the status of tuna fishery in India.

Because of the focal interest on tuna, world wide, there can be the danger of their overexploitation, which is stated to be already in evidence. Conscious of this aspect, the authors have rightly dealt with the requirements of conservation and management of tuna stocks.

There are several websites on tuna. The authors have given the particulars of these websites for the benefit of the readership. A subject index and an author index also have been included in the book for the facility of the readership.

N G K Pillai and Jyothi V. Mallia have rendered a lasting service to the global tuna sector by authoring this book. More valuable than this is the contribution of the Director of the Central Marine Fisheries Research Institute, Prof.(Dr.) Mohan Joseph Modayil, by way of publishing this book of enormous importance. He has added a telling preface too.

The bibliography is an output of the Ministry of Earth Sciences, New Delhi funded project on Tuna resources of Indian EEZ - An assessment of growth and migratory pattern.