



Brief Report

Basic studies on cyanobacteria and Micro algae: A Review

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Abstract

Cyanobacterial lipids and profiling have become a tremendous demand due to its applicability for production of biofuels. They also act as maker for identification of isolates. Cyanobacteria possess different photosynthetic pigments like chl-a, phycobili proteins and carotenoids which have substantial commercial applications. Phycobili proteins are the major photosynthetic adjunct pigments of cyanobacteria.

Keywords: Phycobilli, Cyanobacteria, Algae.

INTRODUCTION

Chlorophyll-a is a pigment commonly found in cyanobacteria that participates directly in the light requiring reactions of photosynthesis. Chlorophyll-a has one of the functional groups bonded to the porphyrin (CH₃ group). Chlorophyll a is a large molecule that has a “head” called a porphyrin ring with a magnesium atom at its center. Chl-a is generally used as an index of phytoplankton biomass (Falkowski et al., 1998). The phycobiliproteins have been classified into several groups viz. phycoerythrin, phycocyanin and allophycocyanin. Phycocyanin and allophycocyanin are universally present in cyanobacteria, while allophycocyanin B apparently occurs in most cyanobacteria (Glazer & Bryant, 1975; Swings & De Ley J, 1977). Many reports are available on the importance of carotenoids related to prevention of health disorders (Moeller et al., 2000). They are also being used as a natural colorant and for cosmetic properties (Cohen et al., 1988). Its Collection, Isolation and Identification of Cyanobacteria has been well explained in a paper (Singh et al., 2022). Simple plants which lack root, stems and leaves; mainly aquatic thallophytes having Chl-a as primary photosynthetic pigment is considered as algae, commonly called blue-green algae. It has been evolved about 3.5 billion years ago.

It Has Chl-a, (some also have b or d), phycobili proteins, glycogen as storage products. Its Cell wall containing amino sugars and amino acids which involves in Oxygen evolving photosynthesis.

The identification of the taxa was done by observing the morphological features and comparing these features with the literature. Desikachary, 1959; Komarek and Anagnostidis, 2005 (**Figure 1**).

Features of Cyanobacteria: The Important features include filaments shape; cell dimensions; presence/absence of sheath, thickness; shape, size and position of akinetes/heterocyst, if present etc. were observed under the microscope.

Importance and Industrial Value of Cyanobacteria

Agriculture: Biocontrol agents, Novel gene pool for crop improvement, Development of sustainable agriculture and ecosystem, Biofertilizer, Plant growth promoter (**Figure 2**).

Food: *Spirulina* has been eaten for centuries by Kanembu people, who live along the shores of Lake Chad in northcentral Africa. It has the highest protein of any natural food (65%). It is of current world algal production, 30% is sold for animal feed applications and over 50% of *Spirulina* is used as feed supplement (**Figure 3**).

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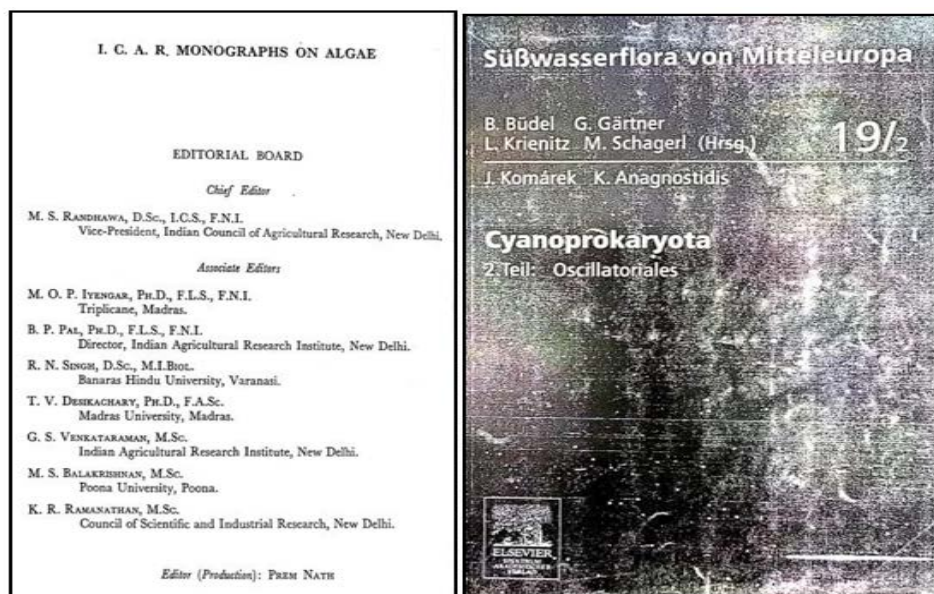


Figure 1. Showing identification of the taxa literature.

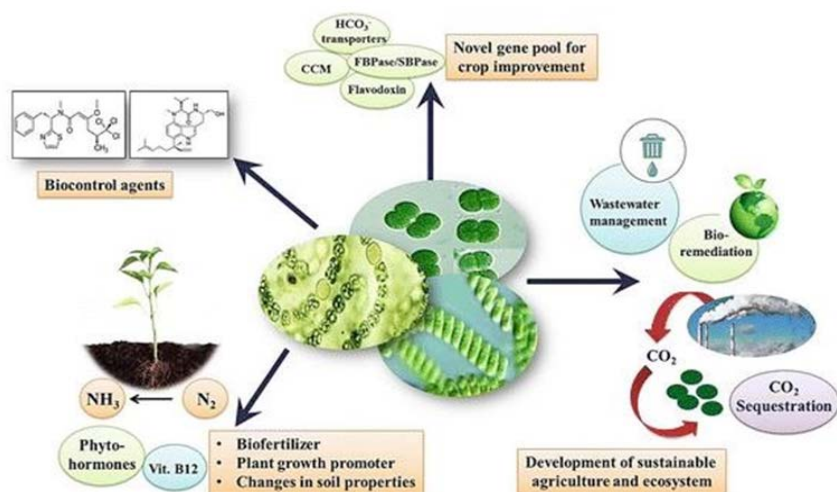


Figure 2. Agricultural importance of cyanobacteria.



Figure 3. Cyanobacteria used as food.

Spirulina is used as feed in the diet of sheep, horses, Canary, finch, parrot, love bird. It is used by ostrich and turkey breeders to increase fertility.

Species of *Nostoc*, *Anabaena* and *Calothrix* increase body weight of *Telapia* hybrid fish with excellent food conversion ratio.

Pigments and Natural Colours: Apart from chlorophyll, cyanobacteria produce two major groups of pigments (phycobiliproteins and carotenoids). From them; Phycocyanin and Phycoerythrin are commercially valuable.

Phycocyanin has been extracted and purified from *Spirulina* sp., *Synechococcus* sp., *Oscillatoria quadripunctulata*, *Aphanizomenon flos-aquae*, *Anabaena* sp. Dainippon Ink & Chemicals (Sakura, Japan) has developed a product called “Lina blue” (PC extract from *Spirulina platensis*), which is used in chewing gum, candies, soft drinks, dairy products (Figure 4).

Medicinal Properties: Phycocyanin has also been reported to reduce the levels of tumor necrosis factor (TNF- α) in blood serum of mice treated with endotoxin. Phycocyanin from *Aphanizomenon flos-aquae* is reported as a strong antioxidant. Carotenoids present in CB protect cells from damage by reactive oxygen molecules, hence, act as antioxidants. *Spirulina*, a rich source of β -carotene, has been used in aquaculture and poultry to improve colour of fishes and egg yolks respectively. Chlorophyll-a extracts from *Spirulina* having iron oxide and higher alcohols (cetyl and stearyl) is patented as strong deodorant (Figure 5).

Cosmetics: A protein-rich extract from *Spirulina platensis* repairs signs of early skin aging, exerts a tightening effect and prevents stretch mark formation (Protulines, Exsymol S.A.M., Monaco). *Spirulina* Firming Algae Mask by ODA (Optimum Derma Aciditate) improves moisture balance of skin.

Spirulina Whitening Facial Mask by Ferences cosmetics contains proteins from *Spirulina* and herbal extracts, which improve skin complexion, and reduce wrinkles without any allergic effect. Cosmetics contain quality ingredients from

Spirulina and other herbs that remove dead skin cells and act as a cleanser to energize the face (Figure 6).

Antibiotics & Drugs: BGA like *Anabaena*, *Nostoc* and *Oscillatoria* produce a great variety of secondary metabolites. *Nostoc* species were used to treat gout, fistula and several forms of cancer. Noscomin, a diterpenoid from *N. commune*, showed antibacterial activity against *Bacillus cereus*, *Staphylococcus epidermidis*, and *Escherichia coli*. Natural products of *Nostoc* sp. are effective against *Cryptococcus* sp. as a causal agent of secondary fungal infections in patients with AIDS. Fibre extracted from *N. commune*, possesses hypocholesterolemic effect in rats. *Lyngbya majuscula*, a marine CB, and produces a wide variety of polyketides, lipopeptides, cyclic peptides and many others (Figure 7).

Fischerella ambigua and *Haplosiphon hybernicus* produce Ambiguines, which show anti-fungal activity on *Aspergillus oryzae* and *Candida albicans*. An anti-cancer factor has been identified in *Scytonema* sp., *Phormidium tenue* and *Anabaena variabilis*.

Enzymes: *Microcystis aeruginosa* possesses a large capacity to mineralize organic per unit of biomass due to alkaline phosphatase activity. A number of studies report detection of enzymes (phosphatase, arylsulfatase, chitinase, L-asparaginase, L-glutaminase, amylase, protease, lipase, cellulase, urease and lactamase) produced by CB. An anti-fertility enzyme, elastase, has been purified from *Oscillatoria* sp.

Biofuels Some unicellular non-diazotrophic CB *Gloeocapsa alpicola* (shows increased H_2 production under sulphur starvation), *Spirulina platensis* (can produce 1 mmole H_2 /12 h/mg cell dry wt in complete anaerobic and dark condition), diazotrophic CB *Anabaena variabilis* etc. are reported for H_2 production.

Bioremediation: *Phormidium ambiguum* and *Chroococcus minutus* have the efficiency to remove lignin from the waste waters of the paper mills (Bharati et al., 1992). *Phormidium valderianum* BDU 30501 is able to remove and degrade phenol (Shashirekha et al., 1997). Fifteen strains



Figure 4. Use of Phycobilins in cosmetics (lipstick, eyeliners etc.) is also gaining momentum.



Figure 5. Phycocyanin is able to scavenge alkoxy, hydroxyl and peroxy radicals in vitro.



Figure 6. Spirulina Facial Scrub by Ferenes.



Figure 7. Antibiotics product.

of cyanobacteria including *Anabaena* sp. PCC7120, *Nostoc ellipsosporum* are known to degrade lindane (Kuritz 1999). Coir waste containing cellulose and lignin content can be degraded by three marine cyanobacterial strains namely *Phormidium* sp., *Oscillatoria* sp. and *Anabaena azollae* sp. having different rate of degradation (Anbuselvi & Rebecca 2009).

Negative Value: The contaminate water supplies by producing colour, odour and giving a fishy taste to the

drinking water. Growth can be checked by addition of very small quantities of copper sulphate and dichlorophen to the water, Chacko (1970) reported that thick blooms caused by *Microcystis*, *Nostoc*, *Anabaena*, *Oscillatoria* and some other BGA bring about depletion of oxygen resulting in large scale death of fish and other aquatic animals (Figure 8).

Preparation Methods: There are many methods of molecular extraction for cultured algae and they include,



Figure 8. Negative effects on aquatic animals.

DNA extraction, purification and gel loading Cells are usually cultured in liquid medium and then collected by centrifugation. This process is called as Lyophilization. After this purification of amplified products takes place and we get Cyanobacteria, Eukaryotic algae with their base pair.

Further sequence the product accordingly to set reaction for PCR amplified product for forward and reverse primer. Thereafter isolate intact total RNA with minimal contamination from DNA, proteins and lipids (ultimate goal to study the level of gene expression) which also involves RNA gel electrophoresis.

CONCLUSION

There are many standardization techniques for Eco friendly cultivation at low cost cultivation, processing of pharmacologically active traditional and aromatic plants which we will be discussing in our next paper.

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