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Conspectus on Algology

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Abstract

The term Algae contains both unicellular and multicellular organisms. It also includes organisms size ranging from micro- to macro-level. According to Botanical survey of India, 7411 species of algae were present in India, which includes both fresh water and marine algae. Iyengar referred as the father of India Algology. Nitrogen-fixing cyanobacteria (*e.g.*, Anabaena, Nostoc) are used as natural fertilizers in India and other parts of Asia, where they reduce the need for expensive synthetic fertilizers in rice farming. Microalgae contain up to 50-70% protein, 30% lipids, over 40% glycerol, upto 8-14% carotene and a high concentration of vitamins B_1, B_2, B_3, B_6, B_{12}, E, K, D, *etc.*, compared to terrestrial plants and animals.

Introduction

Phycology is another name for algology. The study of algae is known as phycology. Algae, on the other hand, are difficult to classify since they belong to a variety of taxonomic groupings and comprise both prokaryotic and eukaryotic organisms. Algae are all plants and plant-like chlorophyll a-containing creatures that can utilise light energy to fix carbon from atmospheric carbon dioxide (CO_2) and produce oxygen, but are not specialised land plants such as mosses, ferns, coniferous trees, or flowering plants. Mandayam Osuri Parthasarathy Iyengar (15 December, 1886 - 10 December, 1963) was an Indian botanist and phycologist who studied algal structure, cytology, reproduction, and classification. He is referred to as the "Father of Indian Phycology" or "Father of Indian Algology". Algae are eukaryotic and prokaryotic organisms that range in size from tiny unicells with a diameter of less than 1 mm to 60 m long kelps. They are the principal photo-synthesis organisms and may be found in practically all watery or moist habitats in both marine and fresh water settings. Biotechnology now provides a variety of methods for extracting goods from algae, and this number will undoubtedly grow in the future. Global climate change has also sparked interest in algae as sunlight collectors and sustainable energy converters. Algae's diverse biological diversity may be used to generate a variety of useful bio-products, either naturally or by genetic modification. Microalgae also have a number of inherent benefits, including cheap production costs, the elimination of a need for arable land, and the ability to grow quickly in both large-scale outdoor systems and scalable, completely enclosed photobioreactors.

Boon and Curse

Algae are not only important as primary producers in nature, providing oxygen and food for other organisms, but also several species are of economic

importance. Some kinds are consumed as food by humans. These include the red alga Porphyra (also known as nori or laver) an important ingredient of Japanese foods such as sushi. Other algae commonly eaten in the Orient are the brown algae Laminaria (wakame) and Undaria (kombu) and the green algae Caulerpa and Monostroma (ananori). Brown algae or kelps such as Macrocystis, Laminaria, Durvillea and Sargassum are sources of alginates, which can serve as thickening agents and colloidal stabilisers in the food, cosmetic, textile, pharmaceutical and paper industries. The total world production of alginates is about 21,500 tonnes, equivalent to an algal harvest of about 5,75,000 tonnes fresh weight. The principal genera harvested are Macrocystis and Nereocystis (Pacific coast of North America), Laminaria and Ascophyllum (Europe), Durvillea (Australasia) and Laminaria and Undaria (China). Nitrogen-fixing cyanobacteria (*e.g.*, Anabaena, Nostoc) are used as natural fertilizers in India and other parts of Asia, where they reduce the need for expensive synthetic fertilizers in rice farming. Some algae are also proving to be potential sources of new pharmaceutical products, including antibiotics and agents to combat cancer and viral diseases. A number of algal compounds are currently under development by drug companies.

Although most algae are beneficial, some produce powerful toxins, and when they form 'blooms' they can cause major environmental problems by sickening or killing fish, birds, cattle and other animals drinking the water. Moreover, when the cells die and decay they may use up so much of the oxygen in the water that they cause more deaths of aquatic life. The formation of such blooms in lakes and rivers is promoted by nutrient pollution, and increased human pollution of water bodies means that they are becoming more common throughout the world. In freshwaters, the culprit is usually a cyanobacterium, *Microcystis* sp., whereas in the sea the main bloom-forming toxic algae are certain diatoms and dinoflagellates, which cause the so called 'redtides'. Brevitoxin, produced by marine dinoflagellates such as Karenia brevis, is one of the most toxic and complicated organic compounds produced by any organism. When such algae are consumed by shellfish, these animals can in turn become poisonous.

Terrestrial Plant vs. Microalgae

Most algae are eukaryotes. The nuclei of eukaryotic microalgae are similar to those of higher plants, with intracellular organelles including chloroplasts for photosynthesis, endoplasmic reticulum (ER), Golgi apparatus, mitochondria and vacuoles. Microalgae have several advantages over terrestrial plants, for their ability to grow on non-agricultural land and as a source of a wide range of products, ranging from fine chemicals and pharmaceuticals, biofuel to foods and feeds. Microalgae are not a food competitor with crops as they can be produced concomitantly with other harvest value co-products. Microalgae can also be used in the diet of animals and humans. Microalgae are promising sources for novel products and applications (Mohamad *et al*., 2020).

Microalgal research and development are inherently faster than terrestrial species. Related to their high cell division rate, research is often simpler and can be performed several orders of magnitude faster with microalgae than with terrestrial crop species. Furthermore, there is substantial evidence that results of small-scale, cost-effective, experiments can be effectively translated to the very large scale that would be required for carbon dioxide capture and biofuel production. Microalgae contain up to 50-70% protein, 30% lipids, over 40% glycerol, upto 8-14% carotene and a high concentration of vitamins B_1, B_2, B_3, B_6, B_{12}, E, K, D, *etc*., compared to terrestrial plants and animals.

Biological fixation of carbon dioxide is an attractive option because plants naturally capture and use carbon dioxide as a part of the photosynthetic process. Terrestrial plants sequester vast amounts of carbon dioxide from the atmosphere. However, because of the relatively small percentage of carbon dioxide in the atmosphere (approximately 0.036%), the use of terrestrial plants is not an economically feasible option. On the other hand, discharge gases from heavy industries commonly contain carbon dioxide levels significantly higher than that found in the atmosphere (10-20%). Therefore, it would be wise to develop strategies to limit this value.

Importance of Microalgae

The main components of algal cells are proteins, carbohydrates and lipids. Microalgae can be manipulated to induce the production of vitamin A, minerals, pigments and other bio-compounds and their biomass can be used as a dietary supplement for humans and animals, including for aquaculture. Among many attempts to reduce the quantity of CO_2 in the atmosphere, biotechnology of using microalgae in a photo bioreactor has extensively been studied since the beginning of the 1990's. Microalgae contribute to the planet's sustainability. With the biological approach, CO_2 is converted into algal biomass and then into value-added products such as proteins, vitamins, food, feeds, cosmetics, nutraceuticals, pharmaceuticals, bio-fertilizers, bioactive substances (Fernández *et al*., 2021; Mohamad *et al*., 2020). The exciting composition in terms of antioxidants, proteins, vitamins, and lipids makes microalgae a promising source of metabolites or bio-energy. Microalgae use sunlight and carbon dioxide to form bio fuel, food, feed and several high-value bioactive compounds. The microalgae are also known to have bioremediation potentials and also known to fix atmospheric nitrogen symbiotically (Chisti, 2007).

Microalgae contribute to these fields because they possess a high nutritional value, containing high protein concentrations

with all the essential amino acids, lipids with a precious profile and rich in polyunsaturated fatty acids, bioactive carbohydrates such as polysaccharides. Microalgae are especially valuable for their high content of omega-3 fatty acids, such as eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids, which are essential for human health and antioxidants, including pigments such as carotenes, chlorophylls and phycobiliproteins. Microalgae have been primarily used in health foods such as nutraceuticals, which are marketed in powder, tablet and capsule form (Fernández *et al*., 2021). Microalgae cells typically contain 30-80% lipids. Some algal strains tend to produce health-related fatty acids like omega-3, omega-6 and docosahexaenoic acid (DHA) as major algal-based and they are non-toxic, more stable as compared to fish DHA. Microalgae mainly include functional lipids, Polyunsaturated Fatty Acids (PUFA's), proteins, phycoerythrin, phycocyanin, important minerals, vitamins, polysaccharides and enzymes.

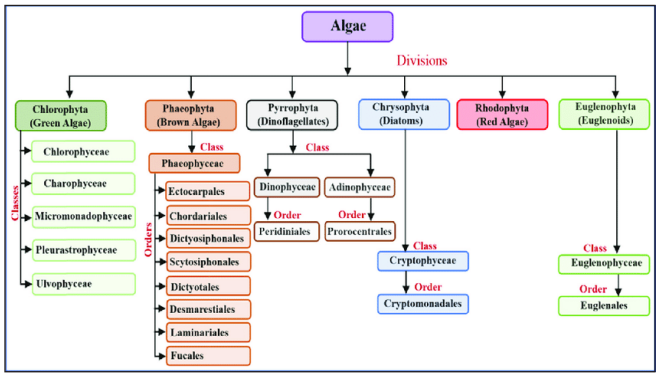

Figure 1: Classification of Algae

Conclusion

The advantages of algae masked the problems created by some noxious algae. In an overall look, the algae are the precious one in terms of having medicinal and pharmaceutical usages. They account for 40-50% of Carbon fixation globally. But awareness among people on algal culture and consumption is still at a negative condition. Little bid the production level of algae increases year by year. But the consumption by People is to be fuelled.

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