Economic Importance of Algae |

The following points highlight the economic importance of algae. Algae Constitute the Link of Food Chain

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1. Algae Constitute the Link of Food Chain:

Both fresh and salt waters contain an enormous variety of algae which constitute the fundamental or primary link of many diverse food chains. Algae synthesize organic food stuffs, just as do the plants of the land. As the flesh of the land is dependent upon the activities of the green leaf, so the fish and other aquatic forms of animal life are dependent, directly or indirectly, upon algae, and fish in turn are important item in the daily diet of larger sea animals and man.

A number of aquatic algae form the food of fish either directly or indirectly. Diatoms, filamentous and some planktonic green algae, and a number of blue-green algae are very often found in the guts of various species of fresh and brackish water fish and they appear to be directly utilized as fish food.

The reserve food materials in these algae, e.g., fats and volutin in the diatoms; starch, often accompanied by oil in the green algae; sugars

and glycogen in the blue-green algae; and polysaccharides in Euglena are utilized by fish.

2. Algae is Useful in Fish Culture:
That algae are fruitfully utilized in fish culture can very well be indicated from the successful culture of the Siamese fish, Tilapia mossambica which is voracious feeder of filamentous algae. This particular fish has been successfully introduced in different parts of India. A culture of Scenedesmus is often exclusively used as a daily dose of fish meal for the culture T. mossambica.

3. Algae is Used for Recreational Purposes:
Certain selected algae are grown in recreational areas like—lakes and streams along with fish.

4. Algae is Useful in Sewage Treatment Plants:
Species of Chlamydomonas, Scenedesmus, Chlorella and Euglena are used in sewage treatment plants for providing through photosynthesis the oxygen necessary for rapid decomposition of the sewage by bacteria.

5. Algae and Water Supplies:
In the summer months the phytoplankton in ponds, lakes and reservoirs may become so abundant as to be extremely conspicuous. The water becomes cloudy and may assume a yellowish or greenish tinge. A floating mat of scum may develop.

These manifestations of algal growth are popularly termed 'water bloom'. Such concentrations of algae are extremely objectionable, not only in public water supplies but also in waters used for bathing, fishing and other recreational purposes.

The blue-green algae are most frequently involved in the contamination of water supplies, but the greens, the flagellated golden-brown, and the diatoms are also troublesome at times. Mention may be made of Prymnesium parvum, Gymnodinium veneficum and

Microcystis spp. which cause mortality of fish and domestic animals that drink water infested with these algae.

The living and the dead and decaying algae impart disagreeable oily or fishy odours to the water.

Toxic protein decomposition products may be formed by blue-green algae and these are known to have caused death of cattle, sheep, and other animals which have drunk heavily infested water. In addition to the unsightly appearance and the unpleasant odours and tastes, the presence of algae in reservoirs requires a greater concentration of chlorine for bacterial control and causes difficulties in filtration.

6. Algae as the Origin of Petroleum and Gas:

The origin of oil and gas has been a matter of controversy, but it is now generally believed that, like coal, these fuels owe their energy to photosynthesis in ancient plants. Unlike coal, however, which was laid down in inland swamps, oil and gas were formed from organic matter in marine environments.

The plankton of the seas was probably of the greatest importance as a source of this organic matter. Minute marine algae captured the energy of sunlight, which was in turn transferred to the animals that fed upon them.

Organic compounds derived from the plankton, both plant and animal, accumulated in mud deposits in shallow waters of the ocean floor. In the source, materials were buried by sedimentary action and, in an oxygen-free environment, gradually converted into oil and gas.

Natural gas is largely methane (CH_4), which can be produced by certain kinds of anaerobic bacteria. Gas is generally associated with oil and can result from the action of methane-producing bacteria upon organic compounds.

7. Algae and Limestone Formation:

Many species of algae withdraw calcium from water, both fresh and salt, and deposit it, in the form of calcium carbonate, in their cell walls or gelatinous sheaths. The most significant forms in this category are the blue-greens and reds, but certain green algae and flagellates are also concerned.

The blue-greens are chiefly important in fresh-waters; they are responsible, for example, for the formation of extensive limestone deposits around hot springs and glaciers. The red algae are the most important calcareous algae of the seas; in particular, they play a significant role in the construction of coral reefs and islands.

Although true coral results from the activities of minute sedentary animals, it is recognized that lime-secreting red algae are almost as important in the formation of coral reefs as the coral organisms themselves. The calcareous red algae are best developed in the warmer seas, but certain species also flourish in temperate and polar regions, where they form extensive banks of limestone in coastal areas.

The algae are not only important in the present age in the formation of calcareous deposits, both in the seas and fresh waters, but also they have played a significant part in the production of beds of limestone rocks, which may be 1000 feet thick.

8. Algae is Used in Space Research and Other Fundamental Studies:

In recent years Chlorella is being used in space research. Chlorella has been found very suitable for keeping the air in space vehicles pure on long interplanetary flights. The stale air in which the carbon dioxide has been concentrated is fed into a flood-lit container containing a mixture of water and nutrient chemicals and Chlorella.

The alga restores oxygen into the space vehicle by its photosynthesis. Again species of Chlorella, Chlamydomonas, and Acetabularia are used as tools for solving fundamental biochemical and genetical problems.

9. Algae is Used as Food:

Large number of algae have entered into the diets of human beings from ancient times. The earliest records are those of the Chinese, who mentioned such food plants as Laminaria and Gracilaria in their 'materia medica' several thousand years ago.

The ancient inhabitants of Japan ate Porphyra as a healthful supplement to their rice diet. Its use became widespread, not only in Japan, but in China in course of time. Kombu, a Japanese food is prepared from stipes of species of Laminaria.

The most diversified dietary use of seaweeds was developed by the Polynesians and reached its peak in Hawaii, where during the nineteenth century at least 75 species were separately named and used regularly as food in that island world. The Hawaiians called them 'limu' and considered them a necessary staple of their daily diet.

Perhaps the best known and most widely used food alga in Western Europe in recent centuries was Irish moss, or carragheen (Chondrus chrispus), which was cooked with milk, seasoned with vanilla or fruit, and made into a highly palatable dish known, as blancmanges. The jellying qualities of Irish moss gave the alga an early food use.

Man, thus obtains carbohydrates, vitamins (algae are especially rich in vitamins A and E, and they contain some C and D), and inorganic substances, e.g., iodine (goiter is unknown among the people who eat seaweeds), not to mention the benefits of the mild laxative action of the ingested algae. Witsch (1959) stated that vitamin B value of young cultures of Chlorella equals that of lemon juice.

In Japan, powdered Chlorella ellipsoidea has been used successfully mixing with green tea.

In Germany and in the United States considerable work is being carried out on the suitability of mass cultures of Chlorella as an alternative source of animal feed and of human vegetable food.

10. Algae is Used as Fodder:

The orientals developed wide human uses for marine algae, but Europeans profited by extensive use of these plants for stock feed. In Iceland and Scandinavia, in the British Isles, and along the coast of France, stock has long been driven or allowed to wander to the seashore at low tide to feed on seaweeds.

Some kinds of algae, such as Rhodymenia palmata and Alaria esculenta, are favourable food of goats, cows, and sheep, and in Scotland and Ireland the stock actively hunt the shores at low tide for particular algae, especially the former.

The milk does not have any taste of algae, nor is the meat inferior because of the seaweed diet. Such animals, that have for several generations been nourished on algae, show better ability to digest it than those not so habituated.

The shortage of grain in many parts of Europe during World War I led to considerable experimentation with the use of seaweeds as food for cows and horses. Stock- feed factories were established in France, Norway, Denmark and Germany, and various methods of treating and reducing seaweeds to meal or powder were developed.

The favourable results in animal husbandry in Europe led to the industrial processing of the great Pacific-Coast kelp (Macrocystis) for animal rations. Seaweed-meal factories have been operating in the United States for several decades, providing supplementary feeds for poultry , cattle and hogs.

The high mineral and vitamin G content of kelp meal has made possible its use in various poultry and other animal rations.

11. Algae is Used as Fertilizers:

The value of seaweeds in fertilizing the soil was discovered early in the history of agriculture in coastal Asia, and by the ancient colonizers of the coasts and islands of North-Western Europe. In some areas of Britain, and along the coast of North-West France, the cutting of

rockweeds for manure has been so intensively practiced that it became necessary to regulate it by laws that have now been in effect for nearly 100 years.

In the United States, long before the recognition of their potash content, seaweeds were employed for fertilizers by the thrifty farmers. Not only the chemical fertilization, but also the water-holding capacity of fragments of the algae in the soil proved effective. These provided valuable small reservoirs of water in close contact with the roots of the cultivated plants.

Furthermore, the bulky organic substances decay slowly in the soil and form humus. Again yield of paddy is increased substancially when paddy field is inoculated with nitrogen fixing blue-green algae. Some of them are: Tolypothrix tenius, Aulosira fertilissima, Anabaena oryzae, Anabaenopsis arnoldii, Calothrix confervicola, Nostoc commune, and Cylindrospermum bengalense.

12. Algae is Used as Medicine:

Medicinal applications of plants are almost as old as their food uses. From earliest times the Chinese used Sargassum and various Laminariales for treatment of goiter and other glandular troubles. Gelidium very early became employed for stomach disorders arid for heat-induced illness.

The gentle swelling of dried Laminaria stipes upon exposure to moisture make them surgical tool in the opening of wounds. Similarly, the orientals have employed the same technique in child-birth for expansion of the cervix.

Perhaps the algae used most widely and for the longest time for medicinal purposes and from which agar is extracted are the agarphytes, including Gelidium, Pterocladia, Gracilaria, and Ahnfeltia. The name ‘agar-agar’ is of Malay origin and. means ‘jelly’. This jelly was obtained by boiling up seaweeds and cooling the resulting liquid.

Agar early became useful for stomach disorders and as a laxative, and was once employed as a dietetic. It was originally produced and marketed in China, bat the Japanese took over production in about 1662 and maintained a world monopoly till 1940.

The most significant date in the utilization of agarphytes was 1881, when Robert Koch proved the value of agar in the cultivation of bacteria. Since that time is has become essential to the work of hospitals and medical research laboratories throughout the world. Besides these, Chlorella is used for the preparation of antibiotic Chlorellin.

13. Industrial Utilization of Algae:
The industrial utilization of algae may be outlined in the following manner:

(i) Kelp Industry:
Industrial utilization of seaweeds in Europe had its principal early development in the production of 'kelp', a name that originally referred to the ash, rich in soda and potash, derived from burning marine plants. Kelp production was begun sometimes in the seventeenth century by French peasants and spread to other parts of North-West Europe.

Drift-weeds were first used, but cutting was later resorted to Laminaria and Saccorhiza in North Britain as of major importance.

But Fucus and Ascophyllum were also widely used, and in some areas Himanthalia and Chorda. The kelp ash from these plants was widely bought by early industrialists for use in manufacture of soap, glass and alum. During the eighteenth and early nineteenth centuries the demands became considerable, and enormous quantities of seaweeds were handled in areas of rich algal growth.

Kelp extract contains a number of chemical elements, notably potassium and iodine. About 25 per cent, of the dry weight of kelp is potassium chloride. Many species of kelp are used as food for man,

especially in the Orient. In Northern Europe they also serve as food for domestic animals, such as sheep and cattle.

(ii) Algin Industry:

Algin is the general term designating the hydrophilic, or water-loving derivatives of alginic acid. The most commonly known algin is sodium alginate, but other commercially important compounds are the potassium, ammonium, calcium, and propylene glycol alginates, as well as alginic acid itself.

With the exception of alginic acid and calcium, alginate, the algin products offered commercially arc soluble in water to form vis-Sous solutions.

Algin occurs generally throughout the brown algae (Laminaria, Macrocystis, Sargassum and Fucus) as a cell wall constituent. It has remarkable water-absorbing qualities that make it useful in numerous industries in which a thickening, suspending, stabilizing, emulsifying, gel-forming, or film-forming colloid is required.

Thus, algin provides ice cream with a smooth texture by preventing the formation of ice crystals. In automobile polishes it suspends the abrasive; in paints, the pigments; also in pharmaceuticals, the drugs and antibiotics. As a stabilizing agent it serves in the processing of rubber latex .and in the printing of textiles. As an emulsifier it is widely used in such products as water-based paints, French dressings, and cosmetics.

The algin industry has become so important to such a wide variety of industries that extensive survey of kelp-bed ecology is an effort to guard against loss of this important resource. Harvesting methods are now carefully regulated, and a huge amount of money is being spent on kelp-bed research throughout the world.

Experimental studies are continuing on the relation of pollution to kelp survival and on kelp-bed grazing organisms.

(iii) Agar Industry:

The outstanding use of the red algae, however, is in the production of agar. This is a dried and bleached gelatinous extract obtained from red algae—Gelidium nudifrons, G. pusillum, G. robustum, and Gracilaria verrucosa. Agar is used extensively in medicine, chiefly as laxative, since it is not digested and increases greatly in bulk with the absorption of water.

More important than this medicinal utilization is its use as an essential ingredient in the preparation of medium for the growth of bacteria and fungi. As such it is indispensable in bacteriological laboratories, because no adequate substitute for agar is known.

Since the introduction of agar into bacteriology in 1881, the agarphytes have become increasingly industrialized and the technical uses of agar enormously expanded. Modern industry has developed such a multitude of applications that only a fraction of them can be noted here. Large quantities of agar are used as a food adjunct.

Agar serves widely as a substitute for gelatin, as an anti-drying agent in breads and pastry, in improving the slicing quality of cheese, in the preparation of rapid-setting jellies and desserts, and in the manufacture of frozen dairy products. The use of agar in meat and fish canning has greatly expanded, and hundreds of tons are utilized annually.

Agar has proved effective as a temporary preventive for meat and fish in tropical regions, due to the inability of most purifying bacteria to attack it.

Early industrial uses of agar in the Orient included sizing fabric, water-proofing paper and cloth, and making rice paper more durable. Modern industry has refined and expanded these uses to meet new needs in the manufacturing of such items as photographic film, shoe polish, dental impression molds, shaving soaps, and hand lotions.

In the tanning industry agar imparts a gloss and stiffness to finished leather. In the manufacture of electric lamps, a lubricant of graphite and agar is used in drawing the hot tungsten wire.

The increasing applications have called for wide expansion of the collection of agarphytes, and since Japan supplied most of the world's markets before World War II, when those supplies were cut off, a great amount of hurried research was conducted in an attempt to develop domestic agar supplies not only in the United States, but in South Africa, Australia, New Zealand and Russia.

(iv) Diatomaceous Earth Industry:

The Diatoms are equally important in comparison with other algae that have industrial utilization. Most species of Diatoms are marine, and when these minute plants die, they fall to the sea bottom and, because of their siliceous nature, the cell walls are preserved indefinitely. Great deposits of this material, known as diatomaceous earth, are found in many parts of the world.

The largest beds in the United States, some 1400 feet thick, are in California. The beds are sedimentary deposits originally laid down on the floor of the ocean and later raised above the level of the sea.

Because diatomaceous earth is inert chemically and has unusual physical properties, it has become an important and valuable material in industry. It makes an excellent filtering agent, which is widely used to remove colouring matters from products as diverse as petrol and sugar.

As a poor conductor of heat it is used in soundproofing. It is used in the manufacture of paints and varnishes, of phonograph records, and as a filler for battery boxes. Because of its hardness, it is used as an abrasive in scouring and polishing powders.