

Algae applications and properties



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Algae is considered as photosynthetic and oxygenic organism of the kingdom "Protista"; although it lacks necessary complex factors (roots, leaves), algae undergo one of the most important and well-known biochemical reaction "photosynthesis", where it convert inorganic molecules to organic molecules that is used to feed other organisms as animals by the use of sunlight (light energy).

Algae is a micro-organism, that can produce its own food through the process of photosynthesis. This makes them organism consisting of high levels of chlorophyll. As eukaryotes (an organism whose cells contain complex structures inside the membranes). they undergo photosynthesis through its chloroplasts. As part of the algae, Cyanobacteria have similar feature to the algae except that they have a prokaryotic cell (are a group of organisms that lack a cell nucleus , or any other membrane-bound organelles)structure (Oilgae. com, 2010, p. 1).

Algae are available around the world with a presence in the sea, in freshwater and in wastewater. Algae is considered by some biologists to be a plant like organisms which are photosynthetic (Plants and alga that use ' photons' from the Sun and chlorophyl (the green stuff in plants) to ' synthesize' or to make their food, (sugars))and aquatic that don't have true roots, stems, leaves, vascular tissue and have simple reproductive structures. Majority of the Algae are microscopic which could exist in large sizes. Algae exist in two different forms, the unicellular in the figure of microalgae and the multicellular in the form of macroalgae (Oilgae. com, 2010, p. 1).

Microalgae are small microscopic aquatic photosynthetic plants that require the aid of a microscope to be seen (Hauter 2010, p. 1). The Microalgae figure of algae constitutes of a varied group of photosynthetic and heterotrophic (An organism that cannot synthesize its own food and is dependent on complex organic substances for nutrition) organisms that have the potential to act as a cultivate energy crop. This means that such kind of algae could be refined in complex agro-climatic conditions which enable it to generate byproducts as result such as fats, oils, sugars and functional bioactive compounds (Oilgae. com 2010, p. 1).

On the other hand, the macroalgae are considered to be large aquatic photosynthetic plants that can be seen without the aid of a microscope (Hauter 2010, p. 2). They exist in many different forms and colors. They either grow tall or in mat form. They come in green, red, brown and blue. Examples of some macroalgae include Green (Chlorophyta), Red (Rhodophyta), and Brown-Kelps (Phaeophyta) (Hauter 2010, p. 3).

Scientists classified organisms to be named under algae based on their ability to undergo photosynthesis regardless the shape, mobility, size, cell type and the presence of defined-nucleus. As well as based on the present of primary characteristic “ pigmentation”, type of storage products and the nature of the cell covering. This allowed scientists from years to change the classification of blue-green microorganism from bacteria to algae.

In the 1830s, algae were classified into major groups based on color (e. g., red, brown, and green). The colors are a reflection of different chloroplast pigments, such as chlorophylls, carotenoids, and phycobiliproteins. Each

class of algae shares a common set of pigment types distinct from those of all other groups.

Algae's common anatomy, physiology and environment:

Various cell type, shape, and size

Type: unicellular, multi-cellular

Shape: spherical, rod-shaped, club-shaped, or spindle-shaped.

microscopic -up to 120 metres]

Function: carry out photosynthesis

Common environment : moist soil and aquatic environments

Properties of Algae: Size, Structure, Temperature, Light & Mixing

During the refining process of Algae several elements should be taken into consideration because different algae have different needs. Elements that may differently impact different algae include water, carbon dioxide, minerals and light. Algae are influenced by such factors due to the nature of their lives in the sea, moist terrestrial habitats.

Size & Structure

The structure of the algae exists as a singled celled or multi celled organism. In the singled celled it's found in the form of Thallus (a body of vegetative form of algae) while in the multi-celled form it exists as a complete Thallus organism (Oilgae. com 2010, p. 2).

Algae's aquatic habitat is fairly comfortable and stable. Due to the fact that water as a substance highly supports the structure of the algae most of algae are moist and this factor allows them to smoothly move along water waves and curves. Algae as a water specie absorbs minerals and moist from the surrounding water environment. This contributes to the shape of the algae by increasing its surface area which enhances its absorption.

Temperature

it is crucial that the temperature of the water falls under a particular range in order to support the growth of the algae species. The most favorable temperature would fall between 20 and 30° C (Oilgae. com 2010, p. 2).

Light & Mixing

Medium light is required for algae. Strong or weak light could destroy the algae environment. The algae specie nature is to grow through founding multiples of its self. They activity provides them with the feature of density which tends to block light from reaching deeper into the pond or tank they are placed in. Algae could be supplied by light through natural exposure to sunlight, introduction of compressed air into the bottom of the tank or pond algae placed in, paddling wheels to circulate water movement in the tank or pond or through placing direct light with the right concentration into the algae tank (Oilgae. com 2010, p. 2).

Algae Growth Cycle

Algae consist of numerous life cycle patterns. Yet, algae don't have a predetermined fluctuation of generations as present in higher plants. Blue green algae and particular chlorophyceae have the ability to reproduce asexually is considered to be able to form a fixed set of generations. Algae

go through two major phases, the sporophyte (produces spores (hence the name), by meiosis. These meiospores develop into a gametophyte. Both the spores and the resulting gametophyte are haploid) and the gametophyte (is the multicellular structure, or phase, that is haploid, containing a single set of chromosomes). The major algae cycles are demonstrated through green algae because they are unicellular and simple.

Uses of Algae

Uses of Algae as Energy source, Fertilizer, Food and Pollution control

Algae are consumed as a source of food to humans. It is also utilized as a resource for the production of useful compounds and pollutants from water wastes. Besides that it is used as an indicator to assess the quality of water and changes in water habitat. Commercially, it is consumed for Pharmaceuticals, Nutraceuticals, Cosmetics and Aquaculture purpose.

As a source of fuel algae is used to produce Biodiesel, Bioethanol and biobutanol. As well, it could be used to produce vegetable oil for consumption. It a specie that can be grown to produce hydrogen, oxygen and biomass which is burnt to create heat and electricity (Oilgae . com 2010, p. 4).

As a source of food, algae act as supplements. It is an inclusive protein with essential amino acids that are involved in major metabolic processes such as energy and enzyme production. Algae contain high levels of complex carbohydrate that are necessary source of energy to the human body and enhance its immune system. In addition to that algae constitutes of a broad wide profile of fatty acids including Omega 3 and Omega 6 that play a crucial

role in the production of energy for body consumption. Besides that it combines a collection of vitamins, minerals and trace elements (Oilgae. com, 2010, p. 4). .

As a stabilizing agent, algae are also utilized as “ carrageen”. Carrageen is an outstanding stabilizer in milk products, petfoods, toothpaste, ice-creams and lotions etc. As a fertilizer, algae are used in soil conditioners and act as a source of livestock feed. Last but not least, algae play a significant role as a pollution control agent. It is used in Wastewater Treatment facilities to reduce the need for greater amounts of toxic chemicals. Also, it is used to capture fertilizers in runoff from farms. When subsequently harvested, the enriched algae itself can be used as fertilizer. As well, algae are used by bioreactors are used by some power plants to reduce CO2 emissions in to the atmosphere and by that protect the atmospheric environment from getting polluted(Oilgae. com 2010, p. 4).

Algae provide much of the Earth’s oxygen, they are the food base for almost all aquatic life, a source of crude oil, and they provide food and pharmaceutical and industrial products for humans (Oilgae. com. 2010, p. 4).

Algae Classification

- Cyanobacteria (blue-green Algae)
- Euglenioids
- Cryptomonads
- Haptophytes
- Dinoflagellates
- Ochrophytes

- Red Algae
- Green Algae

Green Algae

A green algal cell:-

Can be motile or non-motile.

Has a central vacuole, usually used for storage

Pigments contained in plastids

A two-layered cellulose and pectin cell wall.

Food is stored as starch in pyrenoids (proteinaceous cores within the plastids).

Range of morphological diversity in Green Algae

Unicells and colonies

single-celled (Chlamydomonas, Chlorella, Euglena, Phacus)

colonial (Hydrodictyon, Volvox)

Filaments

(Spirogyra, Cladophora),

Tubular

(Actebularia, Caulerpa)

Division

General information

Classes

Prasinophyceans(Micromonadephyceae)

Micromonas

Ulvophyceans

The largest green algae(macroscopic)

Occupy marine water

Ulva

Cladophora

Halimedia

Caulpera

Trebouxiophyceans

They are freshwater and global algae

Chlorella

Chlorophyceans

The largest grouped of green algae

Grow as individuals cells, motile or non-motile, and as filaments

Chlamydomonas

Volvox

Charophyceans

It characterized by multilayered structure

Spirogyra

There 3 common micro-Green Algae that can be grown under UAE weather circumstances

Tetraselmis Spp.

Chlorella Spp.

Nannochloropsis.

Algae type

(sea Algae)

Division

Physical Characteristics

Growth temperature

Size

Tetraselmi

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Green Algae

unicellular, motile

15-33 °C

cell size of $12\frac{1}{4}\mu\text{m}$

Nannochloropsis

Green Algae

Unicellular, non-motile

22-24°C

cell size of $3\frac{1}{4}\mu\text{m}$

Chlorella Spp

Green Algae

Unicellular, non-motile

25-29°C

cell size of $10\frac{1}{4}\mu\text{m}$

Why Chlorella Spp?

- Widely studied
- It has been greatly used in photosynthetic studies,
- It has been studied as a potential food product for humans; because it multiplies rapidly and rich in proteins and in B-complex vitamins.

- Chlorella found either single or clustered in fresh or salt water and in soil. (Arab Gulf).
- Small, spherical, non-motile cells, (5-10 micrometer diameter).
- Can resist high temperature environment.
- The easiest to grow in mass culture.
- Chlorella's reproduction is asexual.

The Algae physiology

Metabolism and Growth

The primary reactions in algae are Photosynthesis and Cell Respiration

All photosynthetic organisms should contain one or more pigments that enable it to convert light energy (that was captured by the water molecules) into chemical energy by the use of CO₂, and nutrients to produce new mass cells and O₂.

The photosynthesis reaction in Chlorella Spp Algae - nutrients is ammonia (NH₃)- :



The organic fraction of Chlorella is C₆H₁₁O₃N

Important notes:

- Algae should be in or near aquatic environment because water captures light energy

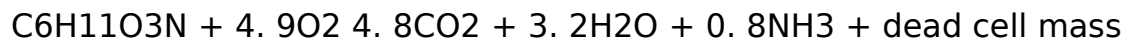
- Algae have the ability to adapt in varies light intensity environments; motile algae can move forward or backward from the light source and non-motile use its internal gas for movements.

The rate of energy production is a function of the surface Area of the pigment in the algae and the light intensity:

$$DE/dt = f(A_s, I)$$

A_s = surface area , I = light intensity , dE/dt = rate of energy

The cellular Respiration reaction in Chlorella Spp Algae



[14] Oilgae. (2010). Retrieved 22 April, 2010, from <http://www.oilgae.com/algae/algae.html>

[15] Hauter , S, & D. (2010). Defining Micro and Macro Algae. Retrieved 22 April, 2010, from <http://saltaquarium.about.com/od/algaemarineplantcare/a/macromicroalgae.htm>