Review Study on Factors Influencing the Growth of Microalgae and Their Application

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Abstract- **The group of simple, mostly autotrophic algae includes a wide variety of unicellular and multicellular forms. Many of them are photoautotrophs, while others are mixotrophs, getting their energy from both photosynthesis and the assimilation of organic carbon. This review article has described a number of factors, including pH, nutrients, light, predation, and others, that can affect the growth of microalgae. In this review article, a look of the use of microalgae for humans is included along with affecting elements.**

***Keywords*-influencing factors, microalgae and bioenergy.**

INTRODUCTION

The group of simple, mostly autotrophic algae includes a wide variety of unicellular and multicellular forms. Many of them are photoautotrophs, while others are mixotrophs, getting their energy from both photosynthesis and the assimilation of organic carbon. Algae can range in size from tiny, single-celled forms like *chlorella* to intricate, multicellular forms like the enormous kelps. They use a variety of reproductive strategies, including straightforward asexual cell division and intricate sexual reproduction.Based on the size range of an algae, it can be divided into macroalgae and microalgae. Seaweeds, also known as macroalgae, are plants that can reach 60 metres in length and can thrive in both fresh and salt water. Mostly photoautotrophic, macroalgae use their cell membrane to take in nutrients. They are the foundation of the food chain and a crucial source of food and shelter for a wide variety of fish, shellfish, and other invertebrates in the aquatic environment. For example, the macroalga *sargassum* can serve as a nursery for young fish. Microalgae are tiny, photosynthetic organisms that can flourish in freshwaters and oceans. The population of microalgae known as phytoplankton is made up of several microalgae. Worldwide, the phytoplankton is responsible for more than half of all primary production (Guschina and Harwood 2006). They have a comparable photosynthesis process to terrestrial plants. The only plankton capable of converting solar radiation into biological molecules is microalgae (de la Rosa et al. 2001). Microalgae are typically more effective in converting solar energy to biomass due to their basic cellular structure and the fact that they are submerged in an aqueous environment where they have easy access to water, CO2, and other nutrients (Gouveia 2011). A broad surface of exchange with the environment is implied by their high surface-to-volume ratio (Van Harmelen and Oonk 2006). They have a quick reproductive rate and are mostly to blame for the murkiness of aquatic bodies.

Factors Influencing the Growth of Microalgae

Numerous environmental conditions, including light, temperature, pH, inorganic and organic nutrients, and biological interactions including competition and predation, have a significant impact on the growth and variety of microalgae.

Light

Sunlight is the primary factor influencing the growth of microalgae in any aquatic system. Like all plants, algae photosynthesize, using light energy to transform carbon dioxide into organic compounds, particularly sugars. In a natural ecosystem, light penetration is influenced by the incident light's available intensity, which varies depending on the pond's geographic position (Khan and Jhingran 1975). The photosynthesis process, which affects phytoplankton productivity, is also influenced by the vertically propagating light waves in the water body (Cole 1984).

pH

Microalgal growth is affected by variation in pH conditions. Studies reveal that the pH reduction from 6.6 to 5.0 promotes algal abundance (Leavitt, *et al.* 1999). It is expected that algal abundance would decrease by the rise in pH. Reduced growth was observed in a group of pH tolerant algae when the pH exceeded 9.5 (Pedersen 2003). Only carbonate and bicarbonate ions are available to submerged photosynthetic plants in water with high pH (Carr and Whitton 1973).

Temperature

The ideal temperature for growing microalgal cultures is typically between 20 and 24°C, though this might change depending on the culture and culture media. The majority of commercially cultivated microalgae species can withstand temperatures between 16 and 27 °C. Lower than 16°C temperatures will limit growth, while greater than 35°C temperatures can be fatal to some species.

Nutrients

The main nutrients that promote the growth of algae are nitrates and phosphates, which are inorganic compounds made from organic components that have decomposed (Gebremariam 2008). Microalgae will grow more readily in water due to the increased nitrogen level. The type of nitrogen that is readily available affects the productivity and growth of microalgae (Dortch 1990; McCarthy 1982). Another element that restricts the growth of microalgae in culture is phosphate. Phosphorus concentration in the system decreases during plankton multiplication (Moss and Balls 1989). According to Lam and Silvester (1979), blue green algae assimilate phosphate more quickly than green algae and store a significant amount of reserve phosphate for long growth periods at low phosphate concentrations.

Competition and Predation

Nitrates and phosphates, which are inorganic substances created from decomposing organic materials, are the primary nutrients that support the growth of algae (Gebremariam 2008). Because of the higher nitrogen content in the water, microalgae will grow more quickly. Microalgae production and growth are influenced by the kind of nitrogen that is easily available (Dortch 1990; McCarthy 1982). Phosphate is another substance that inhibits the growth of microalgae in culture. During plankton multiplication, the system's content of phosphorus falls (Moss and Balls, 1989). Blue green algae assimilate phosphate more quickly than green algae and store a substantial quantity of reserve phosphate for prolonged growth periods at low phosphate concentrations, according to Lam and Silvester (1979).

Microalgae for Human and Animal Nutrition

Today, microalgae for human nutrition are sold in a variety of forms, including tablets, capsules, liquids, and inclusion in beverages, snacks, pastas, candy bars, gums, and drinks (Liang, et al. 2004).Four strains dominate the commercial applications: Arthrospira, *Chlorella*, *D. Salina*, and *Aphanizomenon* sp. *Chlorella* is marketed as a dietary supplement or as a health food (Borowitzka, 2006). Suggested health advantages include effectiveness against gastric ulcers, wounds, and constipation as well as prevention of atherosclerosis, hypercholesterolemia, and tumour activity. Because of its high protein content and superior nutritious value, *spirulina* is employed in human nutrition (Spolaore, et al. 2006).

Additionally, it is a great source of linolenic acid, an important fatty acid that cannot be produced by the human body (Becker, 1994). *Spirulina*-based nutraceuticals are made by numerous businesses. According to Singh et al. (2005), the dried *spirulina* industry was worth $40 million in the United States in 2005.

Microalgae can be used in the feed for a number of species, including fish (aquaculture), pets, and farm animals, in addition to its application in human nutrition. In fact, over 50% of the world's current Arthrospira output is utilised as a feed supplement (Yamuguchi 1996), while 30% of the world's current algal production is sold for animal feed uses (Becker 2004). By supplying a wide range of natural vitamins, minerals, and vital fatty acids as well as enhancing immunological function and fertility, algae have a good impact on physiology (Certik 1999).

Microalgae for Wastewater Treatment

Microalgae are frequently utilised to efficiently remove nutrients from wastewater. Microalgae are a particularly appealing option for biotreatment because of their ability to transform solar energy into useable biomasses and to include nutrients like nitrogen and phosphorus, which can lead to eutrophication (De la Noue and De Pauw 1988). It can be used to treat human waste as well (Mohamed 1994).

Microalgae for Renewable Energy

Numerous types of sustainable biofuels can be produced from microalgae (Spolaore et al. 2006; Banerji et al. 2002; Gavrilescu and Chisti 2005; Fedorov et al. 2005). According to Deng et al. (2009), some microalgal species, such *Botryococcus braunni*, can have up to 80% of their dry weight in lipids. These microalgal biofuels may be generated with little land, with fewer greenhouse gas emissions, and at a sustainable rate. They have a number of advantages over fossil fuels. Microalgae use photosynthesis to convert sun energy into chemical energy.

Thus, the chemical energy generated by the algae biomass is stored as oils, carbs, and proteins. From the perspective of biodiesel, a species' ability to produce energy is determined by the amount of lipid that results from the conversion of solar energy into chemical energy. Future energy sources that can effectively replace petroleum-based fuels include microalgal biofuels. The isolation of species, the choice of species, culture, harvesting, and oil extraction are crucial elements that determine the biodiesel production process. The oxygen concentration is the largest difference between biofuels and petroleum feedstocks; biofuel has 10-12% more oxygen than petroleum fuel (4%) and is also environmentally friendly and renewable.

Numerous microalgae are also helpful for nitrogen-fixing bio-fertilizers (Vaishampayan, et al. 2001) and bioremediation procedures (Kalin, et al. 2006; Suresh and Ravishankar 2004). Numerous environmental conditions, including light, temperature, pH, inorganic and organic nutrients, and biological interactions including competition and predation, have a significant impact on the growth and variety of microalgae. Although several technologies have been developed for converting microalgal biomass into different value-added products, many of them have not yet been commercialised due to the high cost of producing microalgal biomass. The only way to increase microalgae biomass production is through designed aquaculture techniques, which can eventually result in technology that is commercially feasible. For the creation of effective aquaculture techniques, a deeper comprehension of the microalgal ecosystem and the variables affecting microalgal growth is required.

CONCLUSION

Microalgae are a sustainable source that can meet society's desire for nutrient- dense food by offering a crucial resource. We can infer from this review study that light, nutrients, pH, and other factors affect the growth of microalgae.The growth of microalgae is influenced if the factors that influenced its growth are not correctly provided.However, microalgae are a source of nourishment for both people and animals.

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