

EFFECT OF NITROGEN SOURCE ON THE GROWTH OF FRESHWATER ALGAE

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Abstract

Freshwater green algae (*Scenedesmus bujugatus*) were grown in batch cultures at different nitrogen levels. Freshwater green algae were grown at different nitrogen levels (0.5g/L to 1.0g/L) at 26°C in a sterile condition. Algal samples were collected when it reached its stationary phase and analysed for protein, lipid, and carbohydrate and growth rate. Addition of nitrogen source led to an increase in the biomass (from 1 to 3 g/L), protein content (38 to 46 %), carbohydrate (7 – 18 %) and lipid (20 to 55 %). At low nitrogen levels, the green algae contained a protein (42 %), lipid (55 %) and carbohydrate (11 %). The algae did not show any increase in their biomass, lipid and protein compositions, when the nitrogen concentrations in the nutrient medium was increased above 1.0 gm/L. Thus the green algae can be grown under increasing nitrogen level to yield high biomass, lipid and protein compositions.

Keywords : Freshwater algae, *Scenedesmus bujugatus*, Bold basal medium, biomass, lipid, protein and carbohydrate.

I. INTRODUCTION

A variety of aquatic microalgae, including the green alga *Scenedesmus*, have been studied for their possible efficacy as bioresources for applications as fish feed, human food supplemental human nutrients and pharmaceutical products (Belay et al., 1993) and also for the bioremediation of polluted water (Chong et al., 2000). *Scenedesmus* is a ubiquitous organism and dominant microorganism in fresh water lakes and rivers (Borowitzka and Borowitzka, 1998 and Jorge et al., 2000). Microalgae grown in mass cultures are often considered for conversion to biofuels. This is based upon the fact that various algae (e.g. species of *Chlorella* and *Spirulina*) exhibit high yields of about 10-40 g dry biomass per m² and per day (Kessler, 1980), provided that they are grown in monoculture over a long period. Many advantages are recognized in microalgae cultivation, such as: high protein biomass (above 60 %), absence of parts to be discarded during processing, use of arid or semi-arid areas around the world and growth in saline waters without competing with traditional agriculture.

However, in present day conditions of algal mass culture, there exist several fundamental problems like frequently the algae are grown in open ponds, where the algae can be attacked and destroyed by parasites (Schnepf, 1974). In order to avoid the above problems the algae are grown under axenic conditions in closed tanks. The nutrient media are freed from bacteria either by sterilization or by sterile filtration.

The aim of this study is to enhance the biomass, and lipid compositions in freshwater green algae at different nitrogen concentrations. *Scenedesmus bujugatus* was chosen for the study, because it is presently used algae in

mass cultures. According to the literature mass cultures of *Scenedesmus* species have daily yields of about 12 – 35 g of dry weight per m³.

The fresh water green algae were grown in inorganic nutrient media containing different concentrations of nitrogen (NaNO₃). Nitrogen is known to have a strong influence on the metabolism of lipids and fatty acids in various algae. As described earlier, addition of nitrogen leads to an accumulation of fats in diatoms (Harder, 1942). The composition of these fats has not always been reported. Variations in the nitrogen concentrations of the nutrient media also cause changes in the composition of lipid like substances such as algal carotenoids (Kessler, 1980).

II. MATERIALS AND METHODS

A. Culture conditions

Scenedesmus bujugatus used in this experiment was obtained from centre for Advanced studies in Botany, University of Madras, Chennai, Tamil nadu. The algae were grown in 1 L volumes in 2 L Erlenmeyer flasks. The strains were cultivated at 26°C with a light: dark photoperiod of 12:12h, with a light intensity of 1900 lux and were continuously stirred for aeration.

B. Medium composition

The freshwater green algae were grown in Bold Basal medium containing varying concentrations of Sodium nitrate: 0.5 g/L -1.0g/L. The pH was adjusted to 6.8 with HCl and NaOH prior to autoclaving.

C. Analytical procedures

Samples were taken aseptically each 24 h; growth of algae was measured by reading wet weight, dry weight

and total cell count. Total lipids were determined by Bligh and dyer method. Total protein was determined by Biuret method and total carbohydrate by Dubois method.

III. RESULTS AND DISCUSSION

A. Biomass concentrations of *Scenedesmus*

Biomass concentrations of *Scenedesmus bujugatus* for 552 h was analysed with different nitrogen concentrations. Since nitrogen is an important nutritional source, *Scenedesmus bujugatus* response varied with different nitrogen concentrations. The growth rates of the *Scenedesmus bujugatus* cells for different nitrogen concentrations are shown in Figure 1.

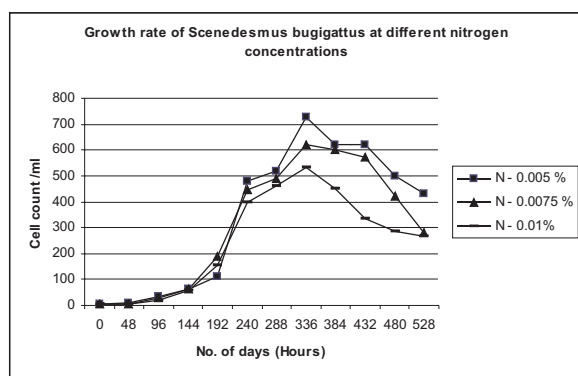


Fig. 1. The growth rate of the *Scenedesmus bujugatus* for different nitrogen concentrations.

In all the cases, an increase in the nitrogen concentrations of the nutrient medium led to decrease in the growth rate. Fourteen days after the start of the culture, growth rates were determined to be the highest for 0.5g/L concentration of nitrogen. The cell count of *Scenedesmus bujugatus* started decreasing, when they were grown with 0.75g/L and 1.0g/L nitrogen concentrations. Growth rate was higher for 0.5g/L nitrogen concentration when compared with 0.75g/L and 1.0g/L nitrogen concentrations. The freshwater green algae, had productivities when grown with different nitrogen concentrations.

In the freshwater green algae, the total protein increased with increasing nitrogen concentrations. The protein content was higher (42 %) in case of 0.5g/L nitrogen concentrations and it decreased with increasing nitrogen concentrations.

At low (0.5g/L) nitrogen concentrations the green algae contained relatively large amounts of total lipids (55%). These amounts decreased with increasing nitrogen concentrations. According to the studies by Piorreck *et al*, *Scenedesmus obliquus* had high lipid

content of (33 – 63 %) with low KNO_3 concentrations (0.0003%).

Total carbohydrate level showed higher value of 18 percentages in case of 0.5g/L nitrogen concentrations and it got reduced with high nitrogen concentrations. Total lipids, protein and carbohydrate concentrations in *Scenedesmus bujugatus* for varying nitrogen concentrations are shown in Figure 2.

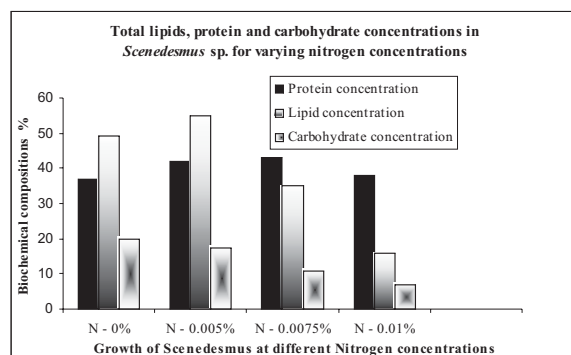


Fig. 2. Total lipids, protein and carbohydrate compositions in *Scenedesmus bujugatus* for varying nitrogen concentrations.

IV. CONCLUSION

The cultivation of the microalgae *Scenedesmus bujugatus* was feasible using nitrogen sources (sodium nitrate). The best results as biomass obtained was about 2.992 g/L in the presence of 0.5g/L concentration of sodium nitrate and the lipid concentration of 550mg/gm of algae. The increasing nitrogen concentrations in the medium can reduce the price of inputs and would be an economic improvement for large scale cultivation. The addition of nitrogen at different concentrations in the medium, serve to accelerate physiological and biochemical activities of the fresh water green algae *Scenedesmus bujugatus*.

V. REFERENCES

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