

Biomass Production of *Chlorella vulgaris* in Indoor and Outdoor Systems under Different Conditions

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IN THIS study, the results obtained for *Chlorella vulgaris* indicate that Bold's medium was the most favorable for growth and chlorophyll a accumulation under neutral or slightly acidic pH value, being exposed to photoperiod of 14/10 hrs. light/dark for *Chlorella vulgaris*. Optimum light intensity and temperature for maximum growth and chlorophyll a content were 5000 lux and 25°C., respectively. The results in outdoor experiments for biomass production of *C. vulgaris* (carried out using different fertilizers) indicate that the maximum growth expressed as the gain in dry weight at the 6th day of incubation periods obtained in culture of OI medium. The cultures of urea-N had better growth than that of other fertilizers. Urea-N and super phosphate mixture followed urea for dry weight gain. However in cultures supplemented with super phosphate and organic manure, the growth increased slowly. In outdoor system, growth response of *C. vulgaris* was also studied using different nitrogen sources (ammonium sulfate + urea, potassium nitrate, and sodium nitrate). It has been found that the growth was more higher in case of ammonium sulfate + urea at 6th day incubation period. It can be clearly seen that sodium nitrate supplemented to algal cultures induced a significant increase in the growth of *C. vulgaris* a phenomenon that was continued up to the end of incubation periods. Under these conditions maximum yield for *C. vulgaris* is realized. Analysis of yield indicates that *Chlorella* cells contained 45.6% protein, 7.6% fat, nucleic acid 3%, ash 18.87%, crude fiber 8.2%, and total carbohydrate 10.1%.

Microalgal culture techniques were carried out in indoor or outdoor systems. Indoor systems cultivate algae under controlled conditions, however there is some overlaps for example, the early stages of large outdoor unialgal systems start indoor where it is easier to protect them from predators, competitors and diseases, furthermore this allows better adjustment of illumination, temperature, and nutrients within required levels.

Several reviews discussed the biological potentialities of microalgae. Richmond (1990) and Borowitzka (1992). Samonte et al. (1993) reported that the use of living microalgae for feeding shrimp larvae during the early stages of life is essential. Microalgal mass culture technology in open systems have been reviewed by Richmond and Becker (1986), Borowitzka and Borowitzka (1989) and Richmond (1990) they reported that the technical complexity of photoreactors have been considered for long time as the antithesis of open ponds technology.

Chlorella species is one of the most important single cell green algae which has been a subject of many investigations. It is characterized by a high protein content which reaches as high as 50% of its dry weight, unlimited growing season and an excellent yield per acre when compared with higher plants (Ryther 1959).

From the standpoint of commercial production, illumination and temperature should be maintained within certain limits (Camacho et al. 1990). Continuous cultures are only feasible for the production of relatively small amounts of microalgae. Advances were achieved, however by the application of continuous culture techniques for large scale production of microalgae. Indoor microalgal facilities usually use for illumination fluorescent tubes (80 Watts) arranged as to provide maximum