Optimization of Production Conditions for Efficient Utilization of Indigenous Microalgal Flora

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ABSTRACT

Introduction: The continuous usage and the progressive exhaustion of fossil fuel sources have exacerbated global climate change, rising crude oil costs, and environmental degradation. Continued use of fossil fuels is irresponsible owing to the increasing growth in air pollution, accumulation of greenhouse gases (GHG), the and the development of acidified rain. Renewable energy has the potential to replace fossil fuels and meet future energy needs, hence reducing global warming and its accompanying severe socioeconomic and environmental consequences Biofuels are liquid and gaseous fuels generated from renewable sources. To maximize environmental and economic efficiency, however, fuel processing should ensure that the fuels utilized are not only environmentally beneficial, but also that can sequester CO2.The three generation phases to the production of biomass energy sources are food crops including sugar cans, maize and wheat are extracted from the biofuel feedstock first generation. The second-generation biofuel feedstocks are made of non-food raw material, rice straw and grass(Lakatos *et al.*, 2019). Algae are the third generation of biofuel (especially microalgae). As microalgae are not compatible with human and animally produced foods, microalgae can therefore provide fast-growing, greenhouse-gas-fixing capability and high lipid production capabilities as an alternative feedstock. The eyes of the world have recently centered on the production of biofuel from microalgae. Study on the production of biofuel with microalgae has started to implement worldwide(Rodionova *et al.*, 2017). Thus, scientists started to focus more on cultivating microalgae for more sustainable extraction of energy. Microalgae are less complex, have a speedy rate of growth and are distinguished by a high oil content. As the cultivation of algae requires less land or can also be grown directly at sea, it can aid to conserve arable soil for food production. Algae can rapidly replicate easily, take CO2, and require less waters than other plants to photosynthesize. Biofuel produced from algae is biodegradable, does not contain Sulphur and it is not poisonous(Obama, 2017).

Objectives:

a. To select polysaccharide rich microalgae from indigenous resources and
b. To investigate chemical and biological method for algal degradation.

Methodology: The study was performed in the laboratory of Microbiology, Department of Microbiology, Hazara University Mansehra. A total 4 samples of fresh water (n=4) were collected from indigenous sources of Mansehra, Pakistan (Siran River, Khakhi, Shinkiari and dadar). Bold Basal Media (BBM) were utilized for the, growth and maintenance of microalgae. All the algal sample abbreviated as (A1, A2, A3 and A4) was identified upon microscopic examination. Characters of algal cell including color, basal body, arrangement, shape and pattern of cells were observed and recorded. Microscopic images were captured using camera. Bold basal medium (BBM) was used for the growth and support of algae. Carbohydrate, decreasing sugar, and glucose tests were performed on all samples. For bioethanol synthesis, the sample with the highest concentration of carbs, glucose, and reducing sugar was chosen. Experiments were conducted to investigate the influence of various circumstances on algae growth rate. Light, temperature, pH, inoculum size, media, agitation and time of the culture were the factors that were regulated for algal development in this experiment. Later, the flasks were placed in a room with fluorescent lighting and at room temperature. After 10 days, the optical density of each treatment was measured using a spectrophotometer at 688nm. The results were documented and examined. The polysaccharide content of microalgae was converted into sugars which can be finally fermented into bioethanol. Two methods (biological and chemical) were used for this conversion and one was selected with higher sugar production. For biologiocal conversion, amylolytic enzymes from microbial sources were used to hydrolyze microalgae and produce large quantities of sugars. The chemical conversion was performed by treating algal biomass with nitric acid.

Results: In this investigation, out of four algal samples collected one algal specie was identified based on highest concentration of polysaccharides, glucose, and reducing sugar and selected for further study of bioethanol production. The effect of several parameters on algal development was studied to identify the best conditions. A series of tests was conducted in this study to determine the effect of modifying the growth media, temperature, pH level, light intensity, time, inoculum size, and aeration on algae development. The initial pH ranged from 5 to 9.5, the temperature, light, time, medium selection, inoculum size, and agitation were all varied. The optical density of each treatment was determined using a spectrophotometer. The findings have been documented and analyzed. The results showed that the selected algal strain grew better in BBM (Bold Basal Medium). The optimum temperature was 28°C. Neither very low nor very high pH is favorable for algal growth. Compared to sunshine or algae placed near windows and exposed to indirect sunlight, artificial fluorescent light boosted algae development. Algae were able to grow to their optimum potential when 15ml of inoculum was used. A comparison investigation was carried out using algal biomass that had been treated chemically (with acid) or biologically.

Conclusion: Due to the shortage of fossil fuel supply and the negative environmental impacts of fossil fuels, algal biofuel production is expected to play a major role in the near future. Enzymatic methods used to extract oil from microalgae is projected to play a larger part in renewable energy utilization, and this new source of renewable energy will play an increasingly important role in the near future.

Keywords: Amylolytic Enzymes, Biofuel, Microalgae, Optical Density, Renewable Energy.

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