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Determination of Optimum Iron Requirement for Production of Microalgae Biomass as Biofuel Feedstock

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Microalgae biomass is considered as one of the promising alternative feedstock for biofuel production. The biomass productivity of some of the microalgae can exceed an order of magnitude compared to any other terrestrial plant. Apart from nitrogen and phosphorus, iron is one of the major elements that must be provided to microalgae culture for high density biomass production. The amount of iron that is required per cell or per unit of microalgae biomass will vary among microalgae strains. Depending on the concentration of iron in the cultivation media, the microalgae will accumulate different amount of iron and this process may alter the compositions of other major metabolites. In order to be competitive the cost of microalgae biomass production should be lower and the desired metabolites should be present in higher percentages; therefore, the appropriate concentration of iron should be determined. On the contrary, there are very limited study on the microalgal iron requirement. The first objective of this study is to determine the minimum concentration of iron requirement by some of the locally isolated potential microalgae. The second objective of this study is to characterize the lipid accumulation under different iron concentrations. Gillard f/2 and BG-11 are the two common nutrients composition used to culture marine and freshwater microalgae respectively. In these two nutrients media, the concentrations of iron are 0.65 mg/l and 1.24 mg/l for Guillard F/2 and BG-11 media respectively. Due to some limitations, in most of the cases the concentrations of phototrophic microalgae in large scale biomass production doesn't exceed 0.5 g/L. If these two media are to be used in large scale, iron requirement can be calculated as 1.3 kg (6.3 kg as $FeCl_3.6H_2O$) and 2.4 kg (12 kg as $FeCl_3.6H_2O$) respectively for each ton of biomass production. Therefore, the cost of the iron fertilizer can be significant for low cost feedstock; furthermore, if there is residual iron in the discharge water it will require additional treatment steps. Three local marine microalgae (Nannochloris sp., Tetraselmis sp., Chlorocystis sp.) and three local freshwater microalgae (Scenedesmous sp., Chlorella sp., Neochloris sp.) were selected to study their iron requirement. Apart from iron, all the nutrients were added as per f/2 or BG-11 media concentrations. However, for the marine microalgae, the

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range of iron concentration was 0 to 1 mg/L while for the freshwater microalgae it was 0 to 3 mg/L. All the experiments were conducted in triplicates. 10 ml of culture was inoculated in 90 ml containing any culture media in a 250 ml flask; the flasks were kept in an orbital shaker which was maintained at 120 rpm speed, 25°C, 12 hours photoperiod. The growth period for any strain was kept fixed at 7 days. It was found that marine Naanochloris sp. didn't require the addition of iron; the available iron in the seawater is sufficient to produce 0.5 g/L biomass density. The other two strains had also smaller iron requirement compared to f/2 media. For the three freshwater microalgae, there was also minor requirement for iron (1 mg/L) which was much lesser than iron concentration in BG-11 media. Iron deficiency, during the cultivation process, resulted in bleaching and changes in metabolites (especially in pigments). Nannochloris sp. and Scenedesmous sp. will be later grown in outdoor small raceway tanks (1000 liter) to verify the indoor small scale results.