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Bioethanol production from marine green algae *Ulva lactuca* and *Sargassum swartzii*: Saccharification and process optimization

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Bioethanol is a sustainable biofuel which can be used alternative to fossil fuels. Today, Third Generation (3G) biofuel is gaining more attention than first- and second-generation biofuel. The more lignin content in the lingo cellulosic biomass is the major drawback of second-generation biofuels. Algae are the renewable feedstock used in the third-generation biofuel production. Algae contain large quantity of carbohydrate; therefore, it can be used for the fermentation by hydrolysis process. There are two groups of algae such as micro and macro algae. In the present investigation macroalgae is chosen as raw material for the production of bioethanol. Two marine algae viz. *Ulva lactuca* and *Sargassum swartzii* were used for the experimental studies. The algal biomass was characterized using various analytical techniques like CHNS Analysis, SEM Analysis and FTIR to understand the physio-chemical characteristics. Batch experiment was done to study the hydrolysis and operation parameters such pH, agitation, fermentation time, inoculum size. The saccharification was done with acid and alkali treatment. The experimental results showed that NaOH treatment shown to enhance the bioethanol. From the hydrolysis study it was found that 0.5 M alkali treatment would serve as optimum concentration for the saccharification of polysaccharide sugar to monomeric sugar. The maximum yield of bioethanol was attained at a fermentation time of 9 days. The inoculum volume of 1 ml was found to be lowest for the ethanol fermentation. Agitation is also important factor which affects the fermentation process. The agitation studies show that the fermentation was higher during the process. The percentage yield of bioethanol was found to be 22.752% and 14.23%. The CHNS analysis showed that S. swartzii contains higher carbon source. It is reported that brown algae contain the most abundant sugars in brown algae are alginate, mannitol and laminarin. Mannitol and glucose from laminarin (a form of glucan in brown algae) are normal sugars that are efficiently used for bioethanol fermentation. However, results confirmed hydrolysis was not completed to recover the sugar from biomass. The specific gravity of ethanol was found to 0.8047 and 0.808 for *Ulva lactuca* and *Sargassum swartzii*, respectively. The purity of bioethanol also studied and found to be 92.55%. Therefore, marine algae can be used as a most promising renewable feedstock for the production of bioethanol.

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