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Research paper

Characterization, pretreatment and saccharification of spent seaweed biomass for bioethanol production using baker's yeast

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ABSTRACT

Seaweeds are marine macroalgae found abundantly and viewed as potential source of phycocolloids to produce biofuel. In this study, seaweed spent biomass obtained from alginate production industry and biomass obtained after pigment extraction were found to contain a considerable amount of phycocolloids. These two spent biomasses were investigated for the production of ethanol. In this study, the red seaweed spent biomass of *Gracilaria corticata* var *corticata* showed higher content of polysaccharide (190.71 ± 30.67 mg g^{-1} dry weight) than brown seaweed spent biomass (industrial) (136.28 ± 30.09 mg g^{-1} dry weight). Hydrolysis of spent biomasses with different concentrations of sulfuric acid (0.1%, 0.5% and 1%) was also investigated. Brown seaweed spent biomass and red seaweed spent biomass exhibited high amount of sugar in 0.5% and 1% sulfuric acid treatment, respectively. Proximate and ultimate composition of seaweed spent biomasses were analysed for energy value. The FT-Raman spectra exhibited similar stretches for both acid hydrolysed spent biomasses with their respective standards. Ethanol produced through a fermentation process using spent hydrolysates with baker's yeast at pH 5.3 was found to be significant. The ethanol yield from brown seaweed spent biomass and red seaweed spent biomass was observed to be 0.011 g g^{-1} and 0.02 ± 0.003 g g^{-1} respectively, when compared with YPD (0.42 ± 0.03 g g^{-1}) and D-galactose (0.37 ± 0.04 g g^{-1}) as standard on day 4. The present study revealed the possibility of effective utilization of spent biomass from seaweed industry for ethanol production.

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1. Introduction

Fossil fuels accounted for about 88% of the global primary energy consumption [1]. The depletion of fossil fuels, increased cost of fuels, concern about global climatic changes and increased CO_2 emission have led to the discovery of bio-fuels [2]. Biofuels are liquid or gaseous fuels produced from plants, including microalgae, and seaweeds [3], municipal wastes [4] and agricultural or forest by-products [5,6]. Among biofuels, bioethanol, a renewable source of energy, has been accepted more widely as an alternative to fossil fuels.

Seaweeds are macroalgae found abundantly on east and west coast of India and broadly classified into red, brown and green forms based on colour and biochemical composition [7]. Seaweeds have many bioactive compounds like pigments, sulfated polysaccharides such as agar, carrageenan and alginates, that are used for various industrial applications [8,9]. *Gracilaria* sp., *Kappaphycus* sp. and *Sargassum* sp., are well known for agar, carrageenan and alginates production at an industrial scale level, respectively.

Nearly 7.5–8 million tonnes of wet seaweeds are harvested worldwide per year [10]. The production of macroalgae is 15.5 million tonne fresh weight per annum and contributes 93% commercial value of seaweeds in 2008 worldwide [11–14]. *Saccharina latissima* (previously known as *Laminaria saccharina*) is the fastest-growing seaweed called gigantic kelp species. This seaweed is similar to*Saccharina japonica* of which 4 million tonnes fresh weight is harvested annually in Northern China, and almost 0.3 million tonne fresh weight of *S. japonica* was also harvested in Korea whereas from Japan reported for about 50,000 tonnes [9,15–17]. Commercially important seaweeds such as *Gracilaria* sp.,

Abbreviations: BS, brown seaweed spent; RS, red seaweed spent; DW, dry weight.

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