Investigating the Efficiency of Carpobrotus edulis, Kelp, and Walnut Shell Bioethanol in Comparison to Corn Ethanol Using Percent Yield and Mass Fractionation

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Cellulosic biofuels are a potential solution to the renewable energy crisis but are currently too expensive to be actualized. Economic, eco-friendly, and efficient cellulosic biofuels from iceplant, kelp, and walnut shells were produced. Chosen precursors avoided cost of land crop maintenance and biodiversity loss. Precursors were pretreated with dilute acid to break apart lignocellulosic fibers based on ideal combined severity factor and degree of polymerization. S. cerevisiae was selected to both break down cellulose and hemicellulose and ferment formed monomers into ethanol--reducing cost. After multiple failed ethanol yield tests, a spectrophotometric MTT chromogen assay modified for home environment was used to determine ethanol yield. Rigorous Phase 2 testing showed that iceplant produced mean 6.4% ethanol ±1.4% (SD) among trials (4.4kg iceplant/gal ethanol compared to national average of 11.8kg corn/gal ethanol). ANOVA data analysis indicated significant difference between iceplant and other bioethanols including controls (+/-) plus homemade corn ethanol--33 fermentation trials and 99 assay trials. Mass fractionation of lignocellulosic fibers showed iceplant and walnut had the greatest glucan-lignin content. Iceplant's success is likely due to high volume concentration and potential yeast favorable nutrients, factors which will be investigated in the future. Iceplant, kelp, and walnut shell precursors with S. cerevisiae in a consolidated bioprocessing methodology are a feasible option for economic, eco-friendly, and efficient cellulosic biofuels. Based on reviewed literature, this is the first usage of iceplant as a biofuel precursor.

Awards Won:

American Chemical Society: Second Award of $3,000