Investigating Alternative Fermentation and Pretreatment of Residual Rice Hulls to Optimize Ethanol Yield

Wright-Freeman, Kayla

Yi, Rachel

Millions of pounds of residual rice hulls are produced annually, but this agricultural waste is typically burned, releasing greenhouse gasses into the atmosphere. Previous studies have successfully produced ethanol using rice hulls, so this study aims to compare various ethanol production methods. The pretreatment process is time consuming, so this project aims to compare the ethanol yield of pretreated and non-pretreated rice hulls. Pretreatment consisted of mixing the rice hulls in NaOH solution and autoclaving for 30 minutes, physically rupturing the lignin in the rice hulls and releasing the trapped cellulose for digestion. Next, brewer's yeast (S. cerevisiae) entrapped in calcium-alginate beads, which allow easy removal of the yeast after fermentation, were compared with free yeast. The rice hulls were dried and milled, then separate mixtures were made for each trial using the resulting powder and distilled water. Cellulase was then added to each mixture and incubated for 48 hours to digest the cellulose into glucose for fermentation. The solution was centrifuged and the resulting supernatant was fermented for 48 hours with beaded or free yeast. The ethanol percentage was quantified using an ethanol probe. Final results show no statistically significant difference between the ethanol yields using the various methods of production. Rice hulls also produced more ethanol than did the positive control, which used 1M glucose. Therefore, rice hulls may be used as a supplement to corn when producing bioethanol, the tedious and costly step of pretreatment is unnecessary, and entrapped yeast instead of free yeast may be used for fermentation to aid removal of yeast. Future work may investigate other waste, such as switchgrass or waste from restaurants.

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