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An efficient hybrid feedstock pretreatment technique for the release of fermentable sugar from cassava peels for biofuel production

Gabriel S Aruwajoye and **Evariste B Gueguim Kana**
University of KwaZulu-Natal, South Africa

Statement of the Problem: Agricultural residues present a low cost feedstock for bioenergy production around the world. Cassava peels waste are rich in organic molecules that can be readily converted to value added products such as biomaterials and biofuels. However, due to the presence of high proportion of structural carbohydrates and lignin, the pretreatment of this feedstock is imperative to achieve maximum substrate utilization and energy yield. The purpose of this study is to develop an efficient feedstock pretreatment technique that will ensure maximum release of fermentable sugar from cassava peels waste for biofuel production.

Methodology & Theoretical Orientation: The study models and optimizes the release of Fermentable Sugar (FS) from cassava peels waste using the Response Surface Methodology. The investigated pretreatment input parameters consisted of soaking temperature (^{0}C), soaking time (hours), autoclave duration (minutes), acid concentration (% v/v), substrate solid loading (% w/v) within the range of 30 to 70, 0 to 24, 5 to 20, 0 to 5 and 2 to 10 respectively. The Box Behnken design was used to generate 46 experimental runs which were investigated for FS release. The obtained data were used to fit a quadratic model.

Findings: A coefficient of determination of 0.87 and F value of 8.73 were obtained indicating the good fitness of the model. The predicted optimum pretreatment conditions were 69.62^{0}C soaking temperature, 2.57 hours soaking duration, 5 minutes autoclave duration, 3.68% v/v HCl and 9.65 % w/v solid loading corresponding to FS yield of 91.83 g/l (0.92 g/g cassava peels) thus 58% improvement on the non-optimized pretreatment.

Conclusion & Significance: Our findings demonstrate an efficient pretreatment model for fermentable sugar release from cassava peels waste for various bioprocesses.

216074440@stu.ukzn.ac.za

Influence of ultrasound-assisted extraction on volatiles and residues in wood pyrolysis

Zhenyu Wang, Lijie Qu, Jiali Zhang, Zhengbin He, Songlin Yi and **Jun Mu**
Beijing Forestry University, China

Eucalyptus was used as the raw material for treatment with ultrasound-assisted extraction (UAE) to study the ultrasonic effects on volatiles emitted and residues produced during pyrolysis. A swept ultrasonic cleaner with a frequency of 40 kHz and an intensity of 360 W was applied to samples at 60°C for 30 minutes. The characteristics of the ultrasound-treated samples were then compared with those of Soxhlet-extracted and untreated biomass by TG-FTIR and SEM. The results showed both mechanical and chemical effects of ultrasound played a significant role in efficiently altering biomass characteristics. In thermogravimetric analysis, UAE samples showed the highest maximum mass loss rate (-52.1%/min) with the lowest temperature (378.4°C), while the other two samples presented similar trends to each other with lower maximum mass loss rate. Volatile profiles obtained by TG-FTIR indicated that CO and methanol components were mainly influenced by extraction, while CO_2, CH_4, and formic acid responded more strongly to the effects of ultrasound. After UAE, an increase in CO, CH_4 and decreases in CO_2 and formic acid were produced during pyrolysis. From SEM images, the fracture of pit membranes clearly showed the mechanical effects of ultrasound, which accounted for the significant enhancement of extraction of valuable ingredients.

wangzhenyu1992@126.com