Biorefinery of Sugarcane Trash for Biomaterials and Future Renewable Energy

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*Abstract:* Sugarcane trash (ST) is promising biomass in sugar-producing countries including Indonesia and commonly only discharged in plant during harvesting of sugarcane stem. ST relatively contains high holocellulose and moderate lignin content that has potency to convert for valuable biomaterials such as lignin based biosurfactant and future renewable bioenergy such as bioethanol. In order to increase the utilization efficiency, the biorefinery concept of ST was conducted in this study. ST was subjected to treat by microwave assisted maleic acid (MA) pretreatment to dissolve hemicellulose then followed by alkaline pretreatment assisted microwave or also autoclave heating of MA treated ST for dissolving lignin and obtain rich cellulose content in the treated ST. Subsequently, to precipitate lignin, the liquid fraction of microwave (lignin SCT A) and autoclave (Lignin SCT B) pretreatment was isolated by 2% HCL. Besides that, the MA-alkaline microwave pretreatment of ST pulp (SCT A) and MA-alkaline autoclave pretreatment of ST pulp (SCT B) was characterized the physico-chemical properties. While the lignin SCT A and lignin SCT B were also determined the yield, its physico- chemical properties including lignin purity, syringyl (S) to guiacyl (G) ratio, functional groups, and the thermal behavior. The results show that lignin SCT B has higher yield than lignin SCT A, however the purity of lignin SCT B was since versa and all yields are lower than commercial lignin. Compared to commercial lignin, the ash content and moisture content of lignin SCT A and B was higher. Even though, the transition glass (Tg) of lignin SCT A and B was lower than commercial lignin due to lower moisture content, these Tgs are in the range of Tg of lignin that reported in previous studies. From the thermo gravimetry (TGA) analysis, lignin SCT B has less mass loss or has higher residue of non-volatile compound. Compared to commercial lignin, both lignin SCT is more stable. During the pyrolysis, some lignin fraction products were obtained including para coumaryl alcohol (H), S and G ring. Both lignin SCTs have higher S than G as typical of grass lignin with S/G ratio of them is same for them. S/G ratio of lignin SCT is higher compared to

commercial lignin. It means that lignin SCTs are probaly easier to be further processed than that was commercial lignin. This result is confirmed by FTIR spectra that typically present S (1265 cm-1) and G (1210 cm-1) ring and also aromatic ring at wave number 1600 cm-1. Pretreatment combination of ST causes the disruption in the morphological features of pretreated ST with MA-alkaline microwave pretreatment tends to cause more intensive rupture than MA-alkaline autoclave pretreatment. Thus, the degree of crystallinity for each pretreatment is lower than control. FTIR spectra of treated SCT pulps shows some functional groups including OH (free) stretching vibration of hydrogen bonds (3400 cm-1), aromatic skeletal vibration of lignin 1600 cm-1 and S (1265 cm-1) and G (1210 cm-1), C-O-C glycosidic stretching in cellulose (crystalline) and aromatic skeletal and C-O stretch at 1100 cm-1 also C-O-C stretching at β-glycosidic linkages between anhydroglucose units in cellulose. The chemical component of pretreated SCT shows that ethanol-benzene extractives increase while lignin content decreases drastically. HPLC analysis can only detected glucose both in liquid and pulp of pretreated SCT.

*Keywords: biomaterials, cellulose, lignin, physico-chemical properties, pretreatment combination, sugarcane trash.*