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論　文　内　容　要　旨

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学位論文題目	Agricultural Biomass Waste Conversion into Biofuels and Biomaterial via Steam Explosion Pretreatment (農業バイオマス廃棄物の水蒸気爆発前処理によるバイオ燃料およびバイオマテリアルへの変換)		

内容要旨

One of the effective and environmentally friendly pretreatments for agricultural lignocellulosic biomass waste is steam-explosion pretreatment which only used water during the pretreatment process. This study was tried to map the potential products that could produce several products from one-system process which converted the POLBW into second generation bioethanol. The POMLBW was through the total biorefinery process via steam explosion pretreatment, water extraction and acetone extraction which. All the content from each step was characterized which potentially could be used as a material for several utilization such as water-soluble material from the water extraction could use as antioxidant resource the low-molecular-weight-lignin from acetone soluble material could utilized as antimicrobial agent in various uses, and the cellulose and glucose content that could converted second-generation bioethanol by simultaneous saccharification and fermentation (SSF) for the first chapter and cellulose was utilized it as packaging material with its low molecular weight lignin as antimicrobial agent. This report tried to give an optional biorefinery system that emphasizes the environmentally friendly process of continuous biorefinery using steam explosion pretreatment for palm oil mill lignocellulosic biomass waste (POLBW): empty fruit bunches (EFB), kernel shell (KS), and kernel fibers (KF) to produce antioxidant, low-molecular-weight lignin (LML), and ethanol in one-system. The highest antioxidants were from KS and KF, with total-phenolic-amounts of 117.01 and 106.22 mg/g. The lowest EC50 value of 0.25 g/L from EFB 35/5 (pressure/steaming time) and KS 45/10 which resulted in 92.52 and 92.43% of radical scavenging activity (RSA), respectively. The average of LML was 1589-2951 from steam exploded POMLBW with conditions 20/5 to 45/5 (pressure/steaming time) with good antimicrobial activity. The enzymes saccharification from EFB 35/5 resulted in the highest saccharification of 97.31%, which also produce a high ethanol-conversion via simultaneous saccharification and fermentation (SSF) using *Saccharomyces cerevisiae* BA11 which operated 40° C yielded 95.37% ethanol conversion. This second chapter was to develop active packaging by using cellulose nanofiber (CNF) incorporated with low-molecular-weight lignin (LML) from empty fruit bunches (EFB) of palm oil, which was pre-treated with a steam explosion. The LML was used as an antioxidant and antimicrobial agent which could be released by water contact. The CNF and LML were concentration-dependent toxicity with low cytotoxicity. The concentration of 1% LML generated the best condition for the

mechanical properties and thermal parameters, where it still maintained the sheet transparent with a smooth surface. Their tensile strength significantly strengthened 20% (72 MPa) and 107% (257 GPa) of young' s modulus compared to the only CNF sheet. The thermal properties were increased by 72% of Td5 at 131° C and 8% Ts at 119° C from only CNF. The wettability result of the CNF-LML active packaging was hydrophilic, which could support the LML water-released. The best condition of antioxidant activity and antimicrobial activity was from 10 and 15% LML with 91.9 and 88.7% of radical scavenging activity, respectively, with approximately 8-11 mm of inhibition zone from both concentrations. Where those conditions also increased the glass transition (Tg) by 4% and 5% from only CNF with 63 and 65.1° C, respectively. The active packaging from CNF incorporated with LML was described as satisfactory. The best antioxidant and antimicrobial activity condition were obtained from CNF-LML 100 and 150. However, if the product as active packaging was counted heavily on color aesthetic, the CNF-LML 10 would be the best condition with satisfaction of antimicrobial and antioxidant activity and strengthened its mechanical properties such as maintaining the sheet transparent, having a smooth surface with no micro crack, good wettability, highest tensile strength, and young' s modulus, and highest T_{d5}. Other than that, the CNF and LML had a low cytotoxicity which could be a strong reason for the safety factor for food application or agricultural postharvest products.