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| Thesis Title | Development of Nanocomposite Coating Film with Gas and Water Vapor Barrier Properties for Bagasse Molded Pulp Packaging |
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ABSTRACT

Nowadays, the interest and awareness towards utilizing sustainable and biodegradable materials for packaging have been more realized, particularly in single use and food packaging. Molded pulp packaging from wood source and agricultural waste (e.g., sugarcane bagasse and bamboo) has gained more attention and chosen in replacement of petrochemical-based packaging. However, some insufficient performances of molded pulp packaging such as gas and water vapor barrier properties have limited its uses are limited. Nanocellulose is a promising, highly sustainable biomaterial with exceptional physicochemical properties and now drawing increasing interest for more comprehensive applications. It has unique properties, including high crystallinity, high strength, non-toxic, and outstanding gas barrier property. Thus, it has excellent potential to improve molded pulp packaging for new uses (e.g. dried food and instant food). This research aims to develop the prototype of nanocellulose integrated molded pulp packaging with enhanced gas and water vapor barrier properties sufficient to preserve dried food. In the first part, nanofibrillated cellulose (NFC) was modified by esterification reaction, which led to modified NFC (mNFC) with different degrees

of substitution (DS), between 0.21 and 0.55, as confirmed by titration, FTIR, and ^{13}C NMR. A partial fragmentation and decrease in crystallinity of mNFC were revealed by TEM and XRD. To form molded pulp sheets, 5 wt% mNFC was added into a bagasse (BG) pulp slurry, then partially dewatered before hot-pressed. mNFC worked effectively as self-retention aid, partly solving the issue of drainage during sheet forming as commonly observed from unmodified NFC. The BG/mNFC (DS 0.55) sheet exhibited an enhancement in tensile properties. Water resistance and barrier performance of the current sheets were also evidently increased. The results suggested that the higher DS on mNFC can improve water resistance and mechanical properties, simultaneously overcoming drainage challenges in processing of molded pulp products. In the second part, the molded pulp samples were surface-coated with the nanocomposite films based on modified nanocellulose (1-5% loading contents) and shellac biopolymers. An exceptional improvement in oxygen transmission rate (OTR) was obtained in a condition of BG/S-mNFC2.5; 61 cc/m²-day, while BG/S-mNFC5 showed the lowest water vapor transmission rate (WVTR) of 8.64 g/m²-day and water contact angle (WCA) of 87.6°. Oil resistance and mechanical properties were also positively affected by shellac coating. On the other hand, shellac gave side effects on thermal stability. The newly developed molded pulp packaging in this project were comparable to various commercial packaging materials for dried and instant food. The results indicated the high possibility in using this current pulp based integrated with nanocellulose for instant food packaging application.

Keywords: Molded Pulp, Nanofibrillated Cellulose, Shellac, Chemical Modification, Nanocomposite Coating, Water Vapor Transmission Rate, Oxygen Transmission Rate