UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF RICE STRAW HEMICELLULOSE BASED BIOCOMPOSITE FILMS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my research.

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ABSTRACT

Biocomposites film has gained significant attention due to their potential applications in various fields of materials science. In recent years, biocomposite films have been seen as viable alternatives for existing petroleum-based plastic for food packaging. Hemicellulose based film has received recognition in food packaging applications due to their excellent film-forming capabilities and biodegradability. However, unmodified hemicellulose films are brittle, hydrophilic, sensitive towards water, and often show poor mechanical properties such as tensile strength which limit their applications. To overcome this issue, citric acid (CA) and Montmorillonite (MMT) were incorporated into hemicellulose films. The aim of this study was to develop hemicellulose, CA, and MMT biocomposite films from rice straw. Then the development of hemicellulose films was used for cherry tomatoes packaging application study. Hemicellulose was extracted from rice straw using alkaline extraction. The effects of different temperature (45°, 55°C, 65°C), NaOH concentrations (0.25M, 0.5M, 1M), and pH (4.5, 5.5, 6.5) on the hemicellulose yield was studied. The obtained hemicellulose was then used to develop hemicellulose film using casting method. CA was incorporated into hemicellulose film and designated as hemicellulose, citric acid (HCA) biocomposite film. Then MMT was incorporated into HCA biocomposite film and designated as HMMT. The appropriate composition of the films was prepared by varying the amounts of hemicellulose, CA, and MMT. The biocomposite film was characterized based on their water vapour permeability (WVP), water vapour transfer rate (WVTR), moisture content, solubility, thermal stability and tensile strength. Furthermore, the inhibitory effect and changes in physical properties (hardness, firmness, colour changes and weight changes) of cherry tomatoes packaged with HMMT biocompiste films were examined. The result showed that the highest yield of hemicellulose was 19.88% at 55°C, 5.5 pH and 1M NaOH. The addition of CA into the hemicellulose film revealed that the film was more stable, less brittle and also enhance the water barrier properties. The addition of 10% CA resulted in the highest values of WVP (10.15 x 10^{-5} g m^{-1} Pa^{-1} s^{-1}) and WVTR (26.25 g m^{-2} s^{-1}) as well as improved the thermal stability and tensile strength of the films. This indicated that HCA10 was found to be suitable for food packaging application. Increasing MMT ratio in hemicellulose biocomposite films has lowered the WVP and WVTR values, moisture content and solubility, however the thermal stability and tensile strength of the films were improved. The addition of MMT also imparted on the inhibitory effects towards *E.coli* growth. HMMT0.5, HMMT1 and HMMT2 films showed higher values of hardness, firmness and lower weight loss compared to unpackaged cherry tomatoes. HMMT1 packaging films with high WVP (5.6 x10^{-6} g m^{-1} Pa^{-1} s^{-1}) and high WVTR (1.75 g m^{-2} s^{-1}) values had the highest value of hardness (386N), firmness (3278N) and lowest weight loss of cherry tomatoes (7.07%) after 10 days of storage at room temperature (25°C). Therefore, it can be concluded that rice straw hemicellulose biocomposite film was successfully developed and HMMT1 biocomposite film shows promising suitability to preserve and extend the shelf life of cherry tomatoes.

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