ABSTRACT

The development of a biopolymer-based composite film with antibacterial compounds is one way to address environmental pollution issues caused by conventional plastic packaging. The utilization of carboxymethyl cellulose (CMC) as a biodegradable film-forming material combined with eugenol diallyl phthalate copolymer (PEGDAF) as a natural antibacterial active component through cross-linking and improving film flexibility and zinc oxide (ZnO) as an inorganic filler that strengthens the matrix and provides additional antibacterial activity is expected to produce more functional active packaging materials. This research aims to synthesize a CMC/PEGDAF/ZnO-based composite film and studying the tensile strength, percentage elongation, contact angle, antibacterial activity, and biodegradability properties. The study began with the synthesis of eugenol diallyl phthalate (PEGDAF) copolymer through a cationic addition polymerization reaction. Characterization of the synthesis results included FTIR analysis, molecular weight, melting point, and solubility. The next stage involved the synthesis of a CMC/PEGDAF composite film with varying ZnO concentrations of 1%, 2%, and 3% of the total weight of CMC and PEGDAF. The composite film characterization included FTIR, SEM-EDX mapping, tensile strength (TS), elongation (E%), and contact angle. The final stage was testing the antibacterial activity using the disc diffusion method and biodegradability to obtain the best effectiveness from varying ZnO concentrations in the composite film. The results showed that PEGDAF was successfully synthesized as a reddish-brown solid with a yield of 77.94%, a molecular weight of 13,838 Da, and a melting point of 65–68°C. The synthesis of CMC/PEGDAF composite films with ZnO variations of 1%, 2%, and 3% resulted in thin films with a transparent yellowish to whitish-yellow appearance. SEM mapping-EDX characterization showed that ZnO was dispersed on the surface of the composite film matrix. The highest tensile strength was obtained at 2% ZnO with a value of 11.291 MPa, while the highest elongation at break was observed at 1% ZnO with a value of 61.167%. The highest contact angle was achieved at 3% ZnO with a value of 84.963° (hydrophilic). The best antibacterial activity against S. aureus and E. coli was observed in the composite film with 3% ZnO. The biodegradability test results showed that all films are biodegradable, with a decreasing degradation rate as the ZnO concentration increases.

Key words: *carboxymethyl cellulose, eugenol diallyl phthalate copolymer, zinc oxide, composite film, antibacterial*