

**Title:** Carboxymethyl Cellulose/Citric Acid/Peppermint Essential Oil Biodegradable Film and Evaluation of Bread Preservation Efficiency

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## ABSTRACT

This research, preparation of biodegradable films of carboxymethyl cellulose (CMC) crosslinked with citric acid (CA) were studied. Peppermint essential oil (PEO) was added to enhance antimicrobial properties. The influences of CA content (1-5% w/w CMC) and PEO content (0.5-2.0% v/v) to films properties were examined; chemical structure (Fourier-transform infrared spectroscopy, FTIR), thermal properties (thermogravimetric analysis, TGA), mechanical properties (tensile property), water vapor permeability test (WVPT), moisture content, biodegradability, and bread preservation efficiency. The results revealed that CMC films crosslinked with 2% CA exhibited the highest tensile strength and elastic modulus equal to 16.37 MPa and 310.64 MPa, respectively. The incorporation of 1% PEO was found to be the optimal concentration for film formation and packaging applications. Moreover, the CMC films were biodegraded within 3–4 days and exhibited promising potential in extending the shelf life of bread.

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