

# 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 (WVP), 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 1–3 days and exhibited promising potential in extending the shelf life of bread.

## INTRODUCTION



## OBJECTIVES

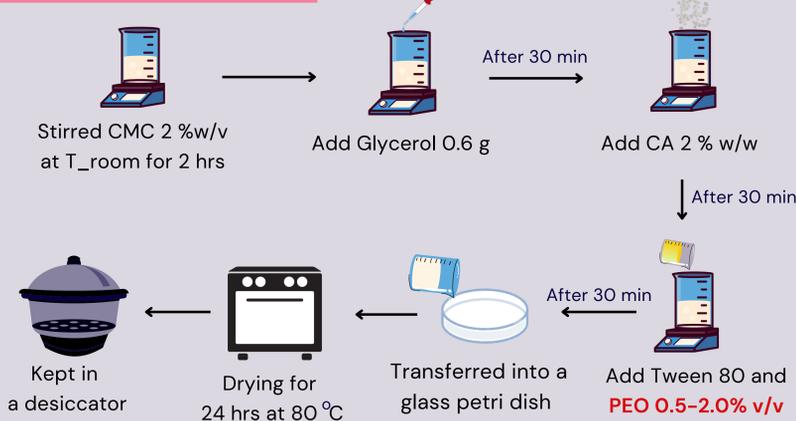
- To prepare CMC biodegradable film with optimal citric acid and peppermint essential oil ratio for packaging applications.
- To evaluate the performance of the biodegradable films to assess their effectiveness in preserving food quality in bread packaging.

## EXPERIMENTAL

### Condition of CA



### Condition of PEO



## RESULTS & DISCUSSION

### Mechanical properties (Tensile)

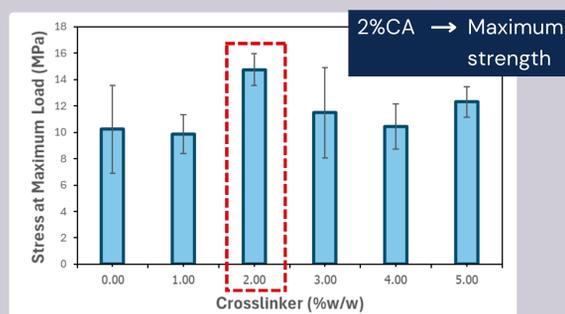


Fig.1 Tensile strength of CMC film with various %CA.

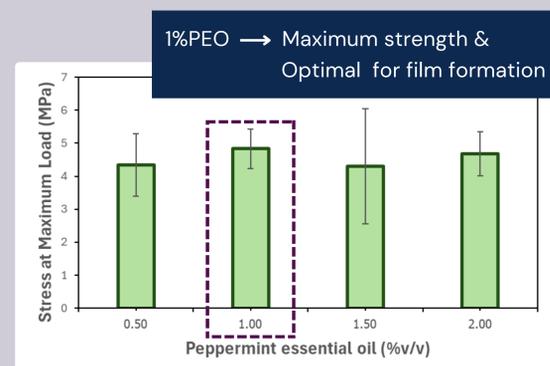


Fig.2 Tensile strength of CMC film with various %PEO.

### Water vapor permeability

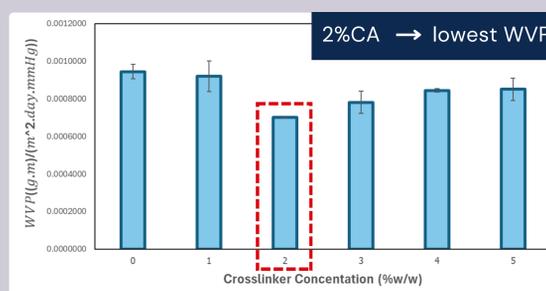


Fig.3 WVP of CMC film with various %CA.

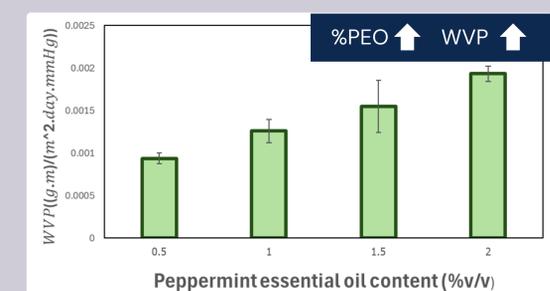


Fig.4 WVP of CMC film with various %PEO.

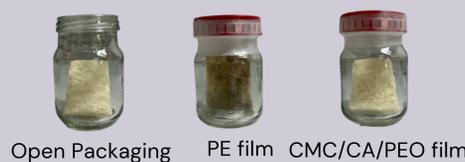
### Biodegradation analysis

Table 1 Biodegradability of CMC film with various %PEO.

FILM TIME	CMC	CMC/PEO_0.5	CMC/PEO_1.0	CMC/PEO_1.5	CMC/PEO_2.0
START					
3 hrs					
6 hrs					
12 hrs					

- CMC/PEO films undergo slightly shape changes and becomes softer at 3 hrs.
- Significant visible degradation of the CMC/PEO films can be observed at 12 hrs.

### Bread preservation efficiency



- Open packaging:** significant shape changes on 1st day became hard and fragile
- PE film:** Visible microbial growth was observed on the 13th day
- CMC/CA/PEO film:** no visible microbial growth

## CONCLUSIONS

- The biodegradable film of CMC/CA2/PEO1 is suitable for packaging applications in which visible microbial growth on bread has not been observed from day 10 to 27.
- The biodegradable film is degradable in soil within 1–3 days.