

## **Abstract**

The present study was conducted with the aim of fabricating smart bilayer polymers based on carboxymethyl cellulose-cellulose nanocrystals film and poly(lactic acid)-*Viola odorata* extract nanofibers (CMC-CNC and PLA-VOE) for freshness monitoring of Pacific white shrimps, minced lamb meat, chicken fillets, and rainbow trout fillets, during refrigerated storage conditions. The fabricated indicators based on CMC-PLA-VOE 5%, CMC-CNC 1%-PLA-VOE 5%, and CMC-CNC 3%-PLA-VOE 5% presented remarkable color changes in pH 1-12 buffer solutions, including red at pH 1-6, violet at pH 7-8, green at pH 9-10, and brown at pH 11-12. Significantly lower water vapor permeability and oxygen transmission rate of prepared polymers were found in comparison with the control groups ( $P < 0.05$ ). Regarding the monitoring of food samples in real-time, the samples spoiled after 3 days, evidenced by total viable count, psychrotrophic bacterial count, total volatile basic nitrogen, and pH values of 7.17-7.54 log CFU/g, 5.68-6.23 log CFU/g, 25.14-28.12 mg N/100 g, and 7.10-7.66, respectively. Meanwhile, the noticeable color change of prepared indicators from white to violet (day 3) and finally dark violet (day 7) was observed, indicating a potential application in intelligent packaging for real-time control of the freshness of perishable food samples.

**Keywords:** Smart packaging; Electrospinning; Colorimetric nanofiber mats.