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Characterization of Trilayer Antimicrobial Diffusion Films (ADFs) Based on Methylcellulose–Polycaprolactone Composites

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ABSTRACT: Novel trilayer antimicrobial diffusion films (ADFs) were developed for food applications. ADFs were composed of two external layers of polycaprolactone and one internal layer of nanocrystalline cellulose (NCC)-reinforced methylcellulose (MC) matrix. Two antimicrobial mixtures (formulations A and B) were incorporated in the MC layer and compared via the evaluation of film properties. Resulting ADFs were inserted as diffusion devices into vegetable packages, and samples were stored at 4 °C for 14 days. Microbiological diffusion assays in the presence of ADFs were performed on pathogenic bacteria. From this, the study focused on characterizing the structural, physicochemical properties and total phenols (TP) release from ADFs. This TP release was determined by Folin–Ciocalteu's method and by FTIR analysis. Results indicated a controlled release of antimicrobials into the headspace (16.5% for formulation A and 13.4% for formulation B). Good correlations (≥90%) between both methods allowed validating an innovative, accurate, rapid FTIR procedure to quantify the diffusion of TP. SEM micrographs showed fibrillar structure due to NCC and a more compact network due to antimicrobials. Encapsulated antimicrobial formulations induced color changes without affecting visual attributes of films. ADFs containing formulation B exhibited the highest tensile strength (17.3 MPa) over storage.

KEYWORDS: *antimicrobial film, diffusion, methylcellulose, polycaprolactone, nanocrystalline cellulose, composite*