ABSTRACT

Low fertilization efficiency due to limited nutrient uptake by plants has encouraged the development of slow-release fertilizers (SRFs), which are capable of controlling nutrient release in a gradual manner. This study aimed to synthesize tripolyphosphate (TPP)-crosslinked chitosan membranes modified with polyacrylamide (PAM) and coated with calcium chloride ($CaCl_2$) as SRF membranes, to analyze the effect of PAM concentration on the physicochemical characteristics of the membranes, and to determine their ability to release phosphate and potassium. The membranes were synthesized using the blending method with PAM concentrations of 0.1%, 0.5%, and 1.0%. NPK fertilizer was incorporated into the membranes using a sandwich technique, followed by $CaCl_2$ coating as the outer membrane layer. Membrane characterization included functional group analysis using Fourier Transform Infrared Spectroscopy (FTIR), morphological observation using optical microscopy and Scanning Electron Microscopy (SEM), and evaluation of weight, thickness, swelling degree, water uptake, porosity, hydrophilicity, density, and biodegradability. The performance of the membranes as SRFs was evaluated in an aqueous medium. The results showed that chitosan–TPP and chitosan–TPP/PAM membranes were successfully synthesized, as indicated by shifts in the characteristic absorption bands of chitosan in the FTIR spectra. Variations in PAM concentration affected membrane morphology and physicochemical properties, with 0.1% PAM producing a more open internal structure, whereas 1.0% PAM resulted in a denser structure. PAM modification increased the swelling degree, water uptake, hydrophilicity, density, and biodegradability of the membranes. All membranes exhibited slow-release fertilizer characteristics by gradually releasing 20.70–41.40% phosphate and 5.97–11.00% potassium over a period of 31 days, indicating their potential application as slow-release fertilizer membranes.

Keywords: slow-release fertilizer, chitosan, tripolyphosphate, polyacrylamide, membrane.