ABSTRACT

The massive use of petrochemical-based plastics poses serious environmental problems due to their resistance to natural degradation. Cassava peel waste (*Manihot esculenta*), abundant and readily available, offers a promising starch source for bioplastic production. However, starch-based bioplastics suffer from high hydrophilicity, low mechanical strength, and poor moisture stability. The membranes were synthesized using the solution casting method, a film-forming technique in which all polymer components are dissolved in a solvent to form a homogeneous solution, which is then poured and dried to produce a solid membrane layer. The resulting membranes were then characterized using FTIR, tensile strength testing, swelling, water absorption, porosity, WVTR, hydrophilicity, water content, biodegradability, and antibacterial activity against *S.aureus* and *E.coli*, as well as morphology via microscopy, and were applied as protective packaging for tomatoes. The addition of chitosan, glycerol, and CMC improved membrane homogeneity through hydrogen bonding and electrostatic interactions. Double cross-linking synergistically produced a denser polymer network citric acid formed covalent ester bonds with hydroxyl groups of starch-chitosan, while Ca^{2+} ions established ionic bridges between polymer chains, confirmed by the emergence of an ester carbonyl absorption band at 1734–1738 cm^{-1} in FTIR analysis. Glycerol concentration significantly influenced network equilibrium; excess concentration introduced free hydroxyl groups beyond the cross-linking capacity, reducing tensile strength and increasing water uptake. The Cs/S/Cross-Gly 1 formulation proved optimal, achieving the highest tensile strength (7.21 N/mm^2), lowest water uptake and porosity, most homogeneous surface morphology, and best performance in extending tomato shelf life as a biodegradable active packaging material.

Keywords: bioplastic, cassava peel starch, chitosan, cross-linking, citric acid, $CaCl_2$, *solution casting*