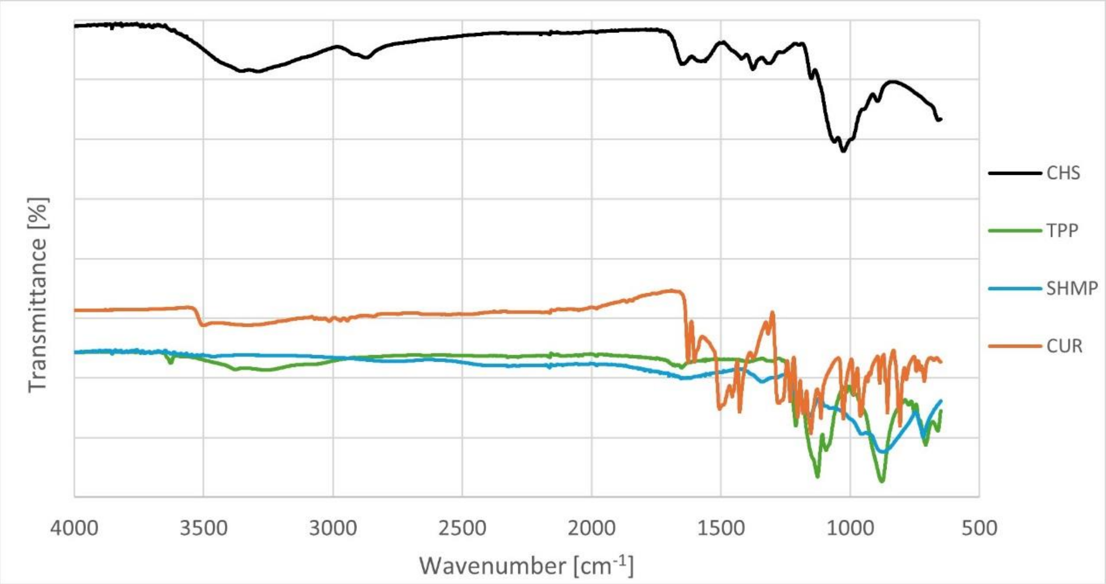

Figure S1. IR spectra of the raw materials—Chitosan (CHS), curcumin (CUR), sodium hexametaphosphate (SHMP) and sodium tripolyphosphate (TPP). IR analysis of the raw materials confirmed their characteristic functional groups. Chitosan exhibited a broad band at ~3400–3200 cm^{-1} corresponding to overlapping O–H and N–H stretching vibrations, along with bands at ~1650 cm^{-1} and ~1580 cm^{-1} assigned to amide I (C = O stretching of residual acetyl groups) and NH_2 bending (amide II), respectively. Strong absorptions in the polysaccharide fingerprint region were observed at ~1150 cm^{-1} and ~1050 cm^{-1}, attributed to asymmetric C–O–C and C–O stretching vibrations. Sodium tripolyphosphate and sodium hexametaphosphate showed no absorption in the high-wavenumber region and were dominated by phosphate vibrations between ~1250 and 900 cm^{-1}, including bands at ~1100 cm^{-1} (PO_2^- asymmetric stretching) and ~1000–950 cm^{-1} (P–O–P stretching), with SHMP displaying broader features than TPP. Curcumin displayed characteristic aromatic and conjugated vibrations at ~1600 and ~1500 cm^{-1}, together with a band at ~1275 cm^{-1} corresponding to enolic C–O stretching, confirming its molecular structure.