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Chitosan films containing deep eutectic solvents as plasticizers: Effects of the chitosan characteristics and DES composition and concentration on film properties

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The use of deep eutectic solvent (DES) as plasticizer to produce chitosan films potentially useful in food packaging and to develop new wound dressing materials is explored in this study. The ultrasound-assisted deacetylation (USAD process[1]) was applied to commercial beta-chitin to result in chitosan U_CH, which exhibited DA = 32 % and M_w = 193 kDa, while a commercial chitosan (C_CH) that was also employed in this study displayed DA = 17 % and M_w = 221 kDa. Different DESs were prepared by mixing and heating at 80 ºC a hydrogen bond acceptor (HBA = choline chloride and betaine) and different hydrogen bond donor (HBDs), namely, glycerol, lactic acid and malonic acid. Typically, chitosan was dissolved in dilute aqueous acetic acid and a given amount (30% or 70% in relation to the chitosan weight) of DES was added, then the resulting solution was transferred to a 90 mm diameter petri dish and dried at 37 ºC for 24 h in a forced-air oven. All chitosan-based films exhibited low transparency (T < 50 %) to ultraviolet (200 nm < λ < 400 nm) and visible light (400 nm < λ < 800 nm), regardless of the DES and its concentration, but films formed from chitosan C_CH displayed a less pronounced UV light blocker effect, indicating a possible role for the interactions involving DES components and the acetamido groups of GlcN units on the chitosan chains. Indeed, ATR-FTIR spectroscopy allowed the structural characterization of chitosan and evidenced specific interactions involving HBA/HBD and the components of a given DES and chitosan functional groups. Preliminary results of tension tests showed that choline chloride/lactic increased the elongation at break while decreased the tensile strength and Young's modulus as compared to chitosan film containing only glycerol. Further mechanical tests as well as thermal and morphological analyses, swelling capacity evaluation and degradation assessment that are under development will be discussed too.

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References
[1] FIAMINGO, A. et al. Extensively deacetylated high molecular weight chitosan from the multistep ultrasound-assisted deacetylation of beta-chitin. Ultrasonics Sonochemistry, v. 32, p. 79–85, set. 2016.