Sustainable fabrication of hydrophobic composite films inspired by plant cuticles

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Abstract

Plant cuticles are the outermost membranes that cover and protect the aerial organs of plants [1]. Cuticles are mainly composed by polysaccharides, cutin, and waxes. Cutin is the main component of plant cuticles, being the polymer matrix that supports the rest of the cuticle components [2]. Cutin of tomato fruits is mainly composed by hydroxylated fatty acids. In this work, tomato cutin monomers (C) were dissolved in ethanol through a sonication process and blended with an aqueous solution of sodium alginate (A). Different alginate/cutin weight ratios (100/0, 75/25 and 50/50) were prepared. Free-standing films were obtained and characterized to study morphological, mechanical, thermal, hydrodynamic and barrier properties. In addition, to induce the esterification of cutin monomers, all the materials were heated in oven at 150°C for 8 hours. A/C 50/50 sample resulted the best composite material with an interesting morphology and hydrophobic behaviour. Nevertheless, to enhance its mechanical and barrier properties, three different percentages (5, 15, 30 wt.%) of beeswax (BW) were added. The addition of beeswax led to a significative increase of both mechanical and water barrier properties. These green alginate-cutin-beeswax composite materials could be potentially used in food packaging.

References

[1] Dominguez et al., New Phytologist, 189 (2011) 938-949

[2] Heredia-Guerrero et al., Journal of Experimental Botany, 19 (2017) 5401-5410

Figures

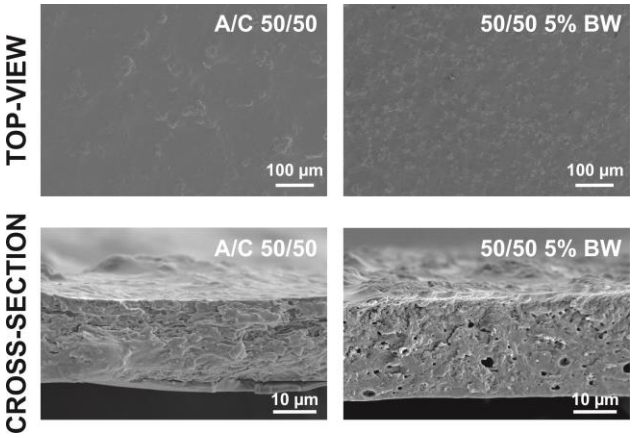

Figure 1: SEM top-view and cross-section images of A/C 50/50 sample after heating treatment and after addition of 5 wt.% beeswax (A/C 50/50 5% BW).

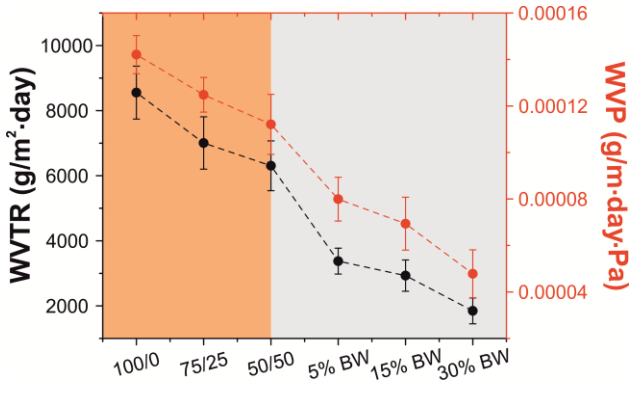

Figure 2: Water vapor transmission rate (WTR, black) and water vapor permeability (WVP, red) of alginate/cutin polyester after heating treatment (100/0, 75/25, 50/50) and after addition of beeswax (5% BW, 15% BW, 30% BW).