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Developing thermoplastic films from wheat flours with different proportions of finely grinded bran

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The use of wheat flour to obtain bioplastics has been proposed about one decade ago. Recent works from our group demonstrated that tensile properties of thermoplastic films depend on wheat grain hardness and baking properties of refined flours, expressed as Chopin's alveograph parameters (P, L, P/L, W). Moreover, we used wholegrain flours for producing bulk samples and found that the bran worked as a reinforcement, affecting tensile properties in function of the bran grinding level. This is of relevance being the bran a mill by-product to dispose of. This study was aimed at developing thermoplastic films from flours with different bran proportions. One refined wheat flour blend (F0, having P=64, L=99, P/L=0.65, W=182) from an industrial mill was mixed with three increasing proportions of finely grinded bran (treatments F1, F2 and F3, respectively). Roughly, F1 represented a wholegrain flour, F3 a grinding tail and F2 a mix 1:1 wt of F1 and F3. We tested several recipes and procedures, with progressive adjustments from that reported in Puglia et al, and measured film tensile properties (strength, σ ; elongation at break, ε (2) (Figure 1). By extruding the selected recipe (well defined proportions of wheat flour, glycerol, sorbitol, magnesium stearate, PVA/water solution) with a specific temperature profile (130-135-140°C), all flours gave films with $\sigma > 2.0$ MPa, while only F1 gave an acceptable ε value. To further modulate ε of films from F1, we investigated the blending with low melting biopolymers (PCL, PBAT) and plasticizer agents (citric acid). Results indicate that a 20-30% of PCL, plus citric acid, may give, even in presence of bran, a suitable deformation for crop mulching applications. All films were compostable and non-phytotoxic. Results open perspectives for using wholegrain flours to obtain rigid and semi-rigid films, or deformable films suitable for mulching.

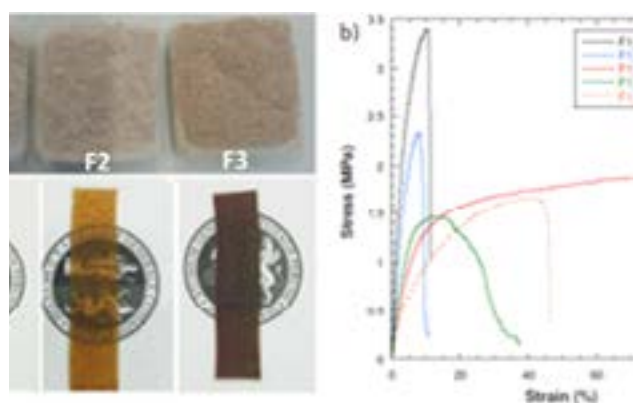


Figure 1: Wheat flours with different proportions of finely grinded bran and related thermoplastic extruded films (a) – tensile stress-strain curves for film containing low melting biopolymers (PCL, PBAT) and citric acid as plasticizer agent (b)

Biography

Paolo Benincasa is Associate Professor at the Dept. of Agricultural, Food and Environmental Sciences of the University of Perugia, Italy. He has 25-year expertise in Crop Science and Technology. His research activity focused on the evaluation of agronomic aspects affecting crop yield and quality and on the management of crop residues and soil fertility in conventional and organic farming systems. Recent research developed together with his colleagues of the Materials Engineering group focused on biobased materials, looking at the factors (cultivar, environment, cultivation practices, post-harvest manipulation) that may affect the mechanical properties of derived manufactures. Novel findings are reported in articles published in high ranked journals.

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