Use of co-products of beer industry as reinforce material on the mechanical properties of starch based bioplastic

F. S. Barbosa[(1)], F.M. Fakhouri[(2)], C. W. P. Carvalho[(2)*], J. L. R. Ascheri[(2)], D. P. R. Ascheri[(3)] and C. Y. Takeiti[(2)]

(1) Departamento de Química Industrial/ Universidade Federal Rural do Rio de Janeiro, RJ.
(2) Embrapa Agroindústria de Alimentos, Av. das Américas, 29501, Guaratiba, CEP 23020-470, Rio de Janeiro - RJ, Brazil. E-mail: cwpiler@ctaa.embrapa.br
(3) Universidade Estadual de Goiás, GO, Brazil

Abstract: Starch based biodegradable films present low tensile strength. In general, there are considerable amount of co-products from the agroindustry which could be successfully used to produce other products of economical relevance and most of the time this material are not properly utilized. The objective of this work was to use co-product from beer industry as a reinforce material in starch based extruded bioplastic. Up to 20% barley incorporation in the starch matrix an increase of tensile strength (TS) improving the mechanical property of the cassava starch films.

This work describes the mechanical properties of cassava starch added of varied content of micronized barley powder (0, 10, 20 and 30%) and glycerol by extrusion. Barley co-product from beer industry with ~90% water content were dried and the dried material was finely ground in a planetary ball mill Fritsch (Idar-Oberstein, Germany) for 60 min in order to produce a micronized powder of average particle size of 20 µm. Strip shape extrudate was obtained on a twin-screw extruder Clextral Evolun 25 (Firminy, France) with 10 heating zones with the following conditions: 2 kg/h of solid flow rate, screw speed of 220 rpm, and liquid flow rate of 1 L/h of plasticizer (water plus glycerol). The strips were stored at freeze condition for 24 h and 3 g were taken in a press (5 ton load) for 1 min at 90°C to obtain a flexible film. The mechanical properties of the equilibrated films were investigated using a texture analyser TA-XT Plus (Stable Microsystem, Sussex, England) through tension strength (TS) and elongation at break (EL). The thickness of the films was measured using a digital micrometer IP54 (Fowler, USA).

In general, the addition of barley increased the tensile strength (Figure 1) and reduces the deformation of starch based bioplastics. Considering the addition of barley, intermediate level of barley (20%) almost doubled TS value whereas the highest barley content (30%) did not, however deformation was greatly reduced in at least three fold. It is suggested that a limit of barley use in the compression mold and extruded cassava starch would be around 20%, since 30% barley addition caused a considerable loss in mechanical properties. An increase of mechanical properties of biopolymer sheets reinforced with cellulose was also observed by Nakagaito [1].

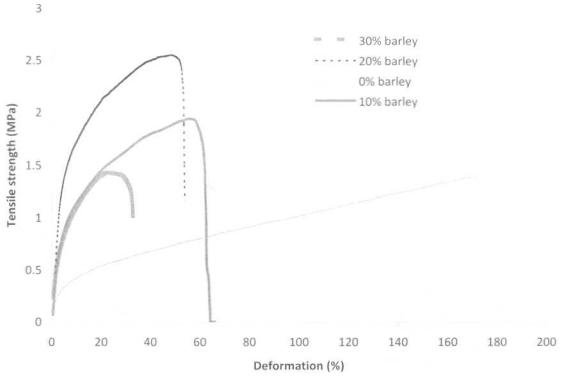

Figure 1: Tensile strength versus deformation of biodegradable extruded cassava starch added of micronized barley from beer

[1] Nakagaito, A. N., Fujimura, A.; Sakai. T.; Hama, Y. and Yano H. Composites Science Technology, 69, 1293-1297, 2009