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Development of flexible bioplastic from cassava starch and glycerol using thermoplastic extrusion

Farayde M. Fakhouri[1], Carlos W. P. Carvalho[3], Cristina Y. Takeiti[3], José L. R. Ascheri[3], Ana Paula Bilck[2], Fábio Yamashita[2], Lúcia H. Innocentini-Mei[1]

[1]UNICAMP State University of Campinas, Campinas, São Paulo, Brazil, [2]UEL State University of Londrina, Londrina, Paraná, Brazil, [3]EMBRAPA Food Technology, Rio de Janeiro, Brazil

The need for high quality food along with concerns about the disposal of long-term food packaging in landfills, lead the search for substitute materials for such packaging as, for example, biodegradable plastics.

Starch is a polysaccharide which has thermoplastic properties and is widely produced in the domestic market, whereas glycerol is a residue that can come from oil or biodiesel industry. In this work, we developed flexible composite films based on cassava starch, plasticized with glycerol and produced by thermoplastic extrusion process followed by blow.

Bioplastics blown were characterized by mechanical properties (tensile strength and elongation), physical (thickness), morphological (SEM) and X-ray diffraction.

To obtain the pellets, it was used a twin-screw extruder brand Clextral with 10 heating zones. The conditions to process the pellets made from cassava starch and glycerol were 6kg / h flow rate, screw speed of 150 rpm, screw speed of 19.6 rpm and a flow rate of 1.5 kh plasticizer.

The plasticization of the system was done using 70% crude glycerol and 30% water. The processing temperature was in the range of 110 - 120 ° C. To obtain a flexible film, the pellets were blown into an extruder brand BGM (model EL-25, Sao Paulo, Brazil) and the resulting films were stored at 25 ° C and 50% RH, before the beginning of their characterization.

Bioplastics blown showed little expansion during the blowing step and were visually homogeneous, whitish and without cracks (Figure 1), with slightly yellow particles that could be seen with the naked eye. The average thickness found was 0.7206 mm in this study.

The values of tensile strength observed for the films of starch and glycerol was 7.645 MPa. The biofilms formed presented a large elongation (27.25%) and water steam permeability of 4.77 gmm/m2dkPa.

The X-ray diffractogram has shown biofilms with an amorphous structure, without crystalline peaks. Despite some roughness on the surface of the biofilms, which could compromise their mechanical properties, the microscopy showed a homogeneous matrix without the presence of remnants of starch granules.

This indicates that the starch granules were completely modified by the action of shear, temperature and plasticizer, giving the impression of a cohesive matrix consisting of an amorphous material. The direction of the biofilm extrusion shearing can be seen in Figure 2.

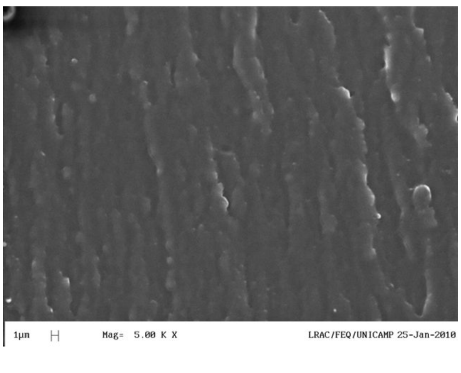

Figure 1. Cassava starch bioplastic being formed by blowing.

Figure 2. Cassava starch bioplastic microscopy surface at 5000x.