

Área: FIS

Development of biodegradable films for swine semen packaging

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Highlights

PLA/starch blends processed by melting and hot pressing. Addition of glycerol as plasticizer and Pluronic F127 as compatibilizer. Physicochemical and mechanical properties evaluated.

Resumo/Abstract

The Brazilian swine industry heavily relies on artificial insemination, which generates large amounts of polyethylene waste from semen storage packages. These plastics are non-recyclable due to biological contamination and pose environmental and reproductive risks. This study aimed to develop biodegradable films to replace conventional blister packaging while maintaining adequate physicochemical and mechanical properties. Blends of polylactic acid (PLA) and starch were prepared using melt processing and hot-pressing, with glycerol as plasticizer and Pluronic F127 as compatibilizer. The glycerol ratio was calculated based on 30% of the starch mass, and 8% Pluronic was added relative to total polymer mass. Blends containing starch/PLA ratios of 50:50, 25:75 and 0:100 with Pluronic addition were named S50-8, S25-8, and S0-8 respectively, and those without Pluronic as S50-0, S25-0, and S0-0. A commercial polyethylene blister (C-0) was used as a comparative. Samples were characterized by thickness, swelling, mass loss, contact angle, tensile strength, and FTIR spectroscopy. Incorporating starch into PLA-based films resulted in a progressive increase in thickness, which was particularly evident at 50% starch. This led to bulkier structures, possibly due to loosely packing. Water stability was preserved up to formulation S25-8. However, films with a higher starch content became unstable in aqueous environment, making it difficult to obtain reliable swelling measurements, for films without starch or containing 25% the swelling ratio remained below 7%. The addition of starch also increased mass loss and surface hydrophobicity, with the contact angle rising from 66° to 77°, for 0 and 50% starch, respectively. Conversely, the addition of Pluronic decreased the contact angle making the surface of the films more hydrophilic, nevertheless, it was essential to promoted phase compatibility between starch and PLA. Despite its role in enhancing blend homogeneity, Pluronic also reduced tensile strength, making the film more fragile. Among the tested formulations, the one with properties most comparable to the polyethylene control (C-0) was the S0-0 film. Overall, although the blends exhibited lower strength compared to pure polymers, their results indicate promising application potential, especially when aiming for a balance between strength, flexibility, and processability. Thus, the apparent reduction in strength should not be seen as a limitation, but rather as an indication that adjustments in composition and processing conditions can lead to materials with mechanical and functional properties tailored to sustainable market demands.

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