

Article

Influence of Ulluco Starch Concentration on the Physicochemical Properties of Starch–Chitosan Biocomposite Films

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Abstract: This work aimed to prepare ulluco starch (US)/chitosan (Ch) edible films and evaluate the effect of the concentration of US on their physicochemical properties. The use of edible films is a means of adding value to the ulluco crop and evaluating the viability of using new sources to produce packaging materials. Different samples were prepared at different US concentrations (2%, 3%, 4%, and 5% *w/v*) and a fixed chitosan concentration (1.5% *w/v*); then, samples were analyzed, considering their physical, mechanical, and thermal properties. The US/Ch edible films showed an increase in solubility from 17.5% to 21.7%, swelling power (SP) from 38.9% to 267%, tensile strength (TS) from 3.69 MPa to 10.7 MPa, Young modulus (YM) from 18.0 Pa to 652 Pa, and thermal stability as the US concentration increased. However, samples with low US concentrations showed higher elongation at break (EB) (36.6%) and better barrier properties (WVP) (5.61×10^{-11} g/m s Pa). The films evaluated in this work presented good physical, mechanical, and barrier properties, revealing their potential as packaging material ensuring food security, and demonstrating the technological potential of US.

Keywords: packaging; chitosan; biopolymer; films; *Ullucus tuberosus* Caldas



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1. Introduction

One of the main strategies of the food industry for product preservation, conservation, storage, and transportation is the use of packaging. Over the last 50 years, conventional synthetic or petroleum-based plastic packaging such as polypropylene (PP), polystyrene (PS), and polyethylene terephthalate (PET) has adequately accomplished this task [1,2]. However, there are now new concerns regarding the use of these types of plastic, such as the fact that they are single-use, which, added to their low biodegradability, can generate pollution [3]. Their impact on the environment has been such that different policies have been implemented worldwide to reduce the use of single-use plastics [4]. These policies create significant challenges for the industry, and the development and design of eco-friendly packaging is one of the alternatives most explored by researchers [5]. Different investigations have been conducted to evaluate film-forming materials and to study the effect on the physicochemical properties of these films, in order to obtain materials that have similar characteristics to the existing petroleum-based plastics and also provide additional benefits such as antimicrobial and antioxidant properties [6]. However, the huge demand for packaging for the industry requires the search for new sources of materials for the development of this biodegradable packaging; sources which must have certain characteristics such as biodegradability, non-toxicity, biocompatibility, film forming properties, and low cost. Starch is the main carbohydrate reserve in plants and consists of amylose composed of α -(1,4)-D-glucopyranose subunits and amylopectin composed