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Characterization of chitosan edible films obtained with various polymer concentrations and drying temperatures

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ABSTRACT

Chitosan is a promising material that could be used for the development of edible coatings and films on an industrial level because of its film-forming, biodegradable, non-toxic, and antimicrobial characteristics. The aim of this work was to evaluate the effect of the polymer concentration (0.5%, 1.0%, and 1.5%) and drying temperature (2 °C, 25 °C, and 40 °C) on the physicochemical, mechanical, and thermal properties of chitosan edible films. Chitosan edible films were successfully produced using various processing conditions. The use of lower drying temperatures had a positive effect on certain properties of the films, such as the moisture content (*MC*), solubility (*S*), water vapor permeability (*WVP*), and optical properties. However, the use of greater drying temperatures (40 °C), combined with a higher chitosan concentration, enhanced certain properties of the films, such as the tensile strength (*TS*), swelling power (*SP*), and greenness value, while diminishing their luminosity. The chitosan films developed in this study showed many desirable characteristics, which may enable their future use as packaging for food products.

1. Introduction

Currently, the majority of packaging materials used in the food industry are produced from petrochemical polymers. However, this material is practically non-biodegradable, which causes a negative effect on the environment. In addition, compounds, such as bisphenol A (BPA), are often present within their structures. These compounds can migrate to food. This is concerning because there is evidence to indicate that chronic exposure to such compounds is associated with genotoxic activity and epigenetic modifications [1]. Consequently, there is increased focus on the development of alternative packaging products based on polymers, co-products, and agricultural residues [2]. Edible films can be used as substitutes for the synthetic polymers that are currently used in a wide range of products. Such edible films are non-toxic, improve food safety, and extend shelf-life. They are also considered an eco-friendly material because of their short degradation period [3]. Moreover, edible films can act as a protective barrier against external factors, such as microorganisms, physical damage, moisture, oil, and vapor [4,5].

The manufacture of edible films involves several factors, which influence the structure and properties of the film, such as the polymer source, polymer chemical structure, type of plasticizer, component concentrations, and drying temperature. The drying temperature and film-forming material are the most challenging parameters to control during the production of edible films. The drying temperature determines the degree of reorganization or crystallinity of the film, which can induce changes in the optical, mechanical, and barrier properties of the film [6]. Like the drying temperature, the film-forming material influences the mechanical and barrier properties of the edible film, as well as its adsorption and surface properties [7]; however, the degree of this influence depends on the nature, source, structure, and concentration of the material used.

Various materials have been used to produce edible films, including gelatin, starch, gums, pectin, and chitosan [8]. Chitosan is a linear polysaccharide consisting of (1,4)-linked-2-amino-deoxy-β-d-glucan; it is obtained through the deacetylation of chitin, which, after cellulose, is the second most abundant polysaccharide in nature [9]. This compound could be used for the development of edible coatings and films on an industrial level because of its biodegradable, biofunctional, biocompatible, non-toxic, film-forming, and antimicrobial characteristics [10]. Chitosan edible films have been successfully used as packaging materials to

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