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INCORPORATION OF BENTONITE CLAY IN CASSAVA STARCH FILMS FOR THE REDUCTION OF WATER VAPOR PERMEABILITY

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Abstract

Complete factorial planning 2^3 was applied to identify the influence of the cassava starch(A), glycerol(B) and modified clay(C) content on the water vapor permeability(WVP) of the cassava starch films with the addition of bentonite clay as a filler, its surface was modified by ion exchange from cetyltrimethyl ammonium bromide. The films were characterized by X-ray diffraction(XRD), fourier transform by infrared radiation(FTIR), atomic force microscopy(AFM) and scanning electron microscopy(SEM). The factorial analysis suggested a mathematical model thats predicting the optimal condition of the minimization of WVP. The influence of each individual factor and interaction in the WVP was investigated by Pareto graph, response surface and the optimization was established by the desirability function. The sequence of the degree of statistical significance of the investigated effects on the WVP observed in the Pareto graph was C>B>A>BC>AC. Interactions AB, BC and AC showed that the modified clay was the factor of greater significance.

Keywords: Modified Clay; Glycerol; Cassava starch; Biofilm; Water vapor permeability; Factorial planning

1. Introduction

Recent decades have witnessed a growing interest in the development of biopolymeric films designed to reduce environmental pollution caused by non-degradable waste from synthetic polymers, mostly derived from petroleum. To compete with these conventional materials, biopolymers, which are biodegradable materials from renewable sources, can be a healthy alternative to reduce this negative impact on society (Restrepo-Flórez, Bassi, & Thompson, 2014).

Besides the sustainable character, there is also interest in the food industry to use biodegradable films as a coating of fresh fruits and vegetables, due to the intense demand for products in good conditions of consumption. For this, biopolymers must have their physicochemical properties modified, since their hydrophilic nature influences the barrier properties of the coating (Reddy, Vivekanandhan, Misra, Bhatia, & Mohanty, 2013; Rhim, Park, & Hac, 2013). Therefore, the demand for an edible coating that is sustainable and with excellent water vapor barrier, mechanical, optical and thermal properties is a challenge.

In this context, the biodegradable films with excellent barrier properties used for fruit coatings play an important role in the preservation, distribution and commercialization of these films, since it is able to reduce respiration and the production of ethylene by the product, besides carrying chemical additives that help in the maintenance of quality and that reduce the deterioration by microorganisms, actually prolonging shelf life of the fruits, once reduced mainly due to storage in a high humidity environment (Azarakhsha, Osmana, Ghazalia, Tanb, & Mohd Adzahanb, 2014; Cortez-Vega, Pizato, Souza, & Prentice, 2014; Pascal & Lin, 2013; Velickova, Winkelhausen, Kuzmanova, Moldao-Martins, & Alves, 2013).

The main substances used as forming a biopolymeric matrix are proteins, alginates, pectins, starches, cellulose derivatives and other polysaccharides (Wihodo & Moraru, 2013). Cassava starch is a polysaccharide synthesized by plants to be used as an energy reserve and is considered one of the most promising natural biopolymers because of its attractive combination of high availability, biodegradability and relatively low cost (Zhu, 2015). However, cassava starch due to its hydrophilic structure resulting from the presence of amylose and amylopectin in its composition requires that its