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Evaluation of some Physical and Mechanical Properties of Carboxymethyl cellulose/ Tragacanth Edible Film

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Introduction: An edible film is a thin layer, made of edible materials, which once formed can be placed on, or between food components. Protecting the product from mechanical, physical and chemical damages, as well as microbiological activities, are some of its functions (Falguera et al, 2011). The main materials made of these films are proteins, lipids and polysaccharides which are able to be used as alone or in blending form (Hernandez et al, 2008 ;Gennadios, 2004). Carboxymethylcellulose (CMC), is a linear polysaccharide that its natural and biodegradable features cause to exhibit excellent film-forming properties (De Moura et al, 2011). Films prepared with these polymers, generally have good gas barrier properties and moderate to propriate mechanical features (Gutierrez et al, 2012). Using the edible, biodegradable films, due to the sensibility to moisture and poor mechanical properties particularly in moist status, is almost limited (Wang et al, 2009; Silva et al, 2009). Because of high hydrophilic property, CMC films also have a low resistant rate to water vapor permeability (Mohanty et al, 2000). Gum Tragacanth (*Astragalus* sp.) is another polysaccharide used to produce edible films and coatings. This gum can be widely used as a stabilizer, emulsifier and thickener in food industry, pharmaceutics and cosmetics (Azarikia & Abbasi, 2010). Tragacanth also has a prominent effect on physical and mechanical properties of the potato starch-based edible films (Fazel et al., 2002). It has also a proper blending potential in blending with other hydrocolloids, carbohydrates and most of proteins and lipids (Farahnaki et al., 2009). Yet, not any researches has made about the effect of blending tragacanth gum with other carbohydrate polymers. Blending of polymers can enhance the functional properties of the produced films (Bourtoom, 2008). Hereby, the current study has been done in order to preparate the best edible film with suitable physical, mechanical and biodegradable properties and has tried to introduce an ideal blend film made of different rates of carboxy methyl cellulose and tragacanth.

Material and methods: In this research in order to improve the physico-chemical characteristics of biodegradable edible films, blending two polymers of carboxymethyl cellulose (CMC) and tragacanth (*Astragalus* sp.) was studied. At first, it was tried to making the film. For this purpose in laboratory the solubles of CMC 1% w/w and tragacanth of 0/75% w/w were prepared. In order to dissolute the polymers, both polymers subjected to heat (75 °C) and following the temperature decrease (~ 40 °C), glycerol (20% of the polymer) was added to each one. Therefore, CMC and tragacanth were blended to each other at proportions of 25:75, 50:50, and 75:25 (v/v) and water vapor permeability, solubility, mechanical properties and microstructure were evaluated. Microstructure of the produced films was assigned by an electronic microscope (Philips, made in Netherlands). Thickness of samples was determined by a digital balance (0/0001 mm, Mitutoyo- made in Japan) via measuring in five points of each sample. Water vapor permeability, moisture content and solubility rate were conducted by standard. Tensile strength (TS) and elongation at break (EAB) were determined using an Instron universal testing machine (Model TVT 300 Xp, Sweden) operated according to the ASTM standard method D882-01(ASTM, 2002). Statistical Analysis performed by software of SPSS, ver. 20. Normality of data and homogeneity of data were conducted by Kolmogorov-Smirnov and Levene tests, respectively. For significance of treatments effect One-Way Anova and for statistical comparison of data Duncan test were performed.

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Results and discussion: The results showed that blended film of 50:50, as well as pure CMC film, had a smooth, flat surface without crack, showing that both polymers were properly blended. Among three blend proportions of two polymers, tensile strength was greatest in 50:50 whereas this amount in proportions of 50:50, 75:25 and 25:75 was recorded 44.59, 32.82 and 26.59 MPa, respectively. These results were in line with Ghanbarzadeh et al. (2011), who indicated the quality of maize starch-based films was suited by CMC and citric acid. With decrease of CMC content in blended films the elongation rate of films significantly decreased. This can be attributed to suitable interactions of the two polymers. This is in accordance with report of Tongdeesoontorn et al. (2011) and Mu et al. (2012), who found the different contents of CMC positively affected the films properties. Water vapor permeability was of better status at 50:50 and 25:75 than at 75:25. Solubility in water did not differ among three blend films but it had better conditions in pure CMC film whereas the blend films showed a decrease about 52 to 58% in solubility compared to the pure CMC film. The results of our research is consistent with findings of Tong et al. (2008), who investigated preparation and properties of pullulan -alginate- CMC blend films. The decrease of solubility can probably be due to proper interactions between CMC and tragacanth. Likewise, blending two polymers at different proportions decreased the moisture content of films. It can be stated that because of the linkages between tragacanth and carboxymethyl cellulose polymer chains, a compact structure has been created that not allows water molecules to presence and thus leads to a reduction in moisture content of films. This is in accordance with findings of Gutierrez et al. (2012), who reported that the increase of leaf extract in plant of murta improved the quality properties of the CMC films. Generally, from this investigation it is deduced that blending the two polymers in different proportions can improve some physico-chemical properties of the CMC- tragacanth edible film.

Keywords: Edible film, Carboxymethyl cellulose, Tragacanth, Physical properties, Mechanical properties