



Preparation and characterization of tragacanth–locust bean gum edible blend films



Fatemeh Sadat Mostafavi^{a,*}, Rassoul Kadkhodae^a, Bahareh Emadzadeh^a,
Arash Koocheki^b

^a Department of Food Nanotechnology, Research Institute of Food Science and Technology, PO Box: 91735-147, Mashhad, Iran

^b Department of Food Science and Technology, Ferdowsi University of Mashhad (FUM), PO Box: 91775-1163, Mashhad, Iran

ARTICLE INFO

Article history:

Received 30 April 2015

Received in revised form 3 November 2015

Accepted 26 November 2015

Available online 30 November 2015

Keywords:

Edible films

Synergism

Blend film

Gum tragacanth

Locust bean gum

ABSTRACT

The present work introduces the structure and physicochemical properties of a novel blend film made from binary solutions of gum tragacanth (GT) and locust bean gum (LBG) at different mixing ratios. Apparent viscosities and surface tensions of individual and blend gum solutions were also investigated. The viscosity data indicated that there was a distinct synergism between the two gums at all mixing ratios. FTIR spectra showed the existence of noncovalent intermolecular interactions between gums. The surface tensions of binary solutions were significantly lower than those of individual gums which is advantageous for coating applications. All films had homogenous and smooth surface morphology and their transparency, water vapour barrier and mechanical properties were improved by incorporating LBG in blend. The results of this study suggest that GT–LBG blend film, owing to its desirable properties, has the potential to be used as a new degradable food packaging material.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

The increased production and wide application of synthetic petroleum based films and coatings have grown rapidly over the past few decades which has caused serious environmental pollution due to the fact that they are non-biodegradable (Muscat, Adhikari, Adhikari, & Chaudhary, 2012). In order to solve this problem, researchers have focused on using biodegradable materials for food packaging purposes (Khwaldia, Arab-Tehrany, & Desobry, 2010; Persin et al., 2011).

Edible films and coatings are natural and biodegradable compounds that can potentially be used for packaging of various food products to extend their shelf life and prevent their quality loss by preventing the transfer of moisture, lipids, flavours or gases across the package. Moreover, they can minimize mechanical damage during handling by forming a continuous solid layer around the food surface. Also, they can be used as a carrier of desirable additives such as flavours, nutrients, colourings and antimicrobials (Pavlah & Orts, 2009).

Materials used for production of edible films are usually proteins, polysaccharides or lipids. The potential of polysaccharides as edible films and coatings has long been recognized (Nieto, 2009). They usually have the ability to create a continuous network which is responsible for the film functional properties (Falguera, Quintero, Jiménez, Muñoz, & Ibarz, 2011; Giancone, Torrieri, Masi, & Michon, 2009). Increasing shelf life of fruit and vegetables, reducing oil uptake during frying and retarding the loss of flavours and vitamins in the course of processing and storage of food products are some of the various applications of polysaccharide films and coatings (Albert & Mittal, 2002; Chien, Sheu, & Yang, 2007; Garcia, Ferrero, Bertola, Martino, & Zartitzky, 2002; Kim, Lim, Bae, Lee, & Lee, 2011; Maftoonazad & Ramaswamy, 2005; Marcuzzo, Sensidoni, Debeaufort, & Voilley, 2010; Teng, Luo, & Wang, 2013).

Over the few past decades, various polysaccharides have been evaluated and introduced as novel film-forming materials for food packaging purposes. However, there is still a considerable requirement for the development of new edible packaging materials to fulfil the increasing consumer demands for more natural foods which need to be packed and also to meet the environmental concerns (Jouki, Tabatabaei Yazdi, Mortazavi, & Koocheki, 2013). Previous works have shown that a number of biopolymers which are currently known as food thickeners or stabilizers could also be used for film formation or coating applications (Phan The, Debeaufort, Voilley, & Luu, 2009). In our preliminary studies, capabilities of gum tragacanth (GT) were investigated as a new film

* Corresponding author. Tel.: +98 9151194101; fax: +98 5135425422.

E-mail addresses: f.mostafavi@rifst.ac.ir (F.S. Mostafavi),

r.kadkhodae@rifst.ac.ir (R. Kadkhodae), b.emadzadeh@rifst.ac.ir (B. Emadzadeh), koocheki@um.ac.ir (A. Koocheki).

forming agent and it was found to have appropriate properties to be considered for this purpose.

GT, also known as katira, is a dried exudate obtained from trunks and branches of different species of *Astragalus* and grows wildly in South West Asia, particularly in Iran and Turkey. Chemically, GT is a complex, highly branched and anionic polysaccharide consisting of small proportions of protein. It is comprised of two main fractions termed as tragacanthin which is soluble in water and bassorin which represents 60–70% of the total gum and has the capacity to swell and form a gel (Weiping, Phillips, & Williams, 2000). Since 1961 GT has been accepted as GRAS at the level of 0.2–1.3% (Balaghi, Mohammadifar, Zargaraan, Gavlighi, & Mohammadi, 2011). This gum has been employed as a stabiliser, thickener, emulsifier and suspending agent in food products such as sauces, drinks, jellies and frozen desserts due to its high water binding ability, efficient suspending action and effective surface-active and emulsifying properties (Nussinovitch, 2009; Weiping et al., 2000). However a few studies have investigated the properties of GT as a coating or film forming material (Shrestha, Arcot, & Paterson, 2003; Şükran & BAYRAKTAR, in pressŞükran and BAYRAKTAR—ALPMEN).

Locust bean gum (LBG) is also a suitable candidate for food packaging material among natural polysaccharides. This gum which is a non-ionic hydrocolloid, naturally exists in the endosperm of *Cerentonia siliqua* seeds (Martins et al., 2012; Mikkonen, Heikkilä, Helén, Hyvönen, & Tenkanen, 2010). It consists of a β -(1-4)-D-mannopyranosyl backbone with α -D-galactopyranosyl substituted on C₆ of mannose and hence they are known as galactomannan. The ratio of mannose to galactose in this gum is approximately 3.5:1. LBG is only slightly soluble in cold water and requires heating to become fully hydrated and achieve maximum viscosity. It has the ability to form viscous solutions at relatively low concentrations and produce compact and dense films and coatings with good mechanical and water vapour barrier properties. LBG has been extensively studied for film formation and coating applications (Aloui et al., 2014; Bozdemir & Tutas, 2003; Cerqueira, Lima, Teixeira, Moreira, & Vicente, 2009; Chen & Nussinovitch, 2000, 2001; Mikkonen et al., 2010).

The blending of two or more biopolymers could effectively change the rheological properties of hydrocolloids solutions and improve physic-mechanical properties of corresponding film or coating (Phan The et al., 2009). Martins et al. (2012) reported that synergistic interactions between LBG and κ -carrageenan could effectively improve the visual, structural, mechanical and barrier properties of the obtained blend films. Moreover, a number of other studies have been carried out to investigate the properties of blend films made from Konjac glucomannan and curdlan, cassava starch and arabinoxylan, Konjac glucomannan and gellan gum and also chitosan and aloe vera gel (Khoshgozaran-Abras, Azizi, Hamidy, & Bagheripoor-Fallah, 2012; Phan The et al., 2009; Wu et al., 2012; Xu, Li, Kennedy, Xie, & Huang, 2007).

However, no attempt has yet been made to study the characteristics and applications of LBG/GT blend as an edible film forming agent. The objective of the present study was, therefore, to evaluate the interactions between LBG and GT at different ratios and to develop films made from blending these two biopolymers with potential applications as edible films and coatings. Furthermore, the viscosity of film forming solution and also the miscibility, structural and mechanical properties of blend films were investigated by viscometer, FT-IR, SEM and tensile analyzer.

2. Materials and methods

2.1. Materials

GT exudates and carob seeds were purchased from local markets in Isfahan, Iran and Kazeroon, Iran, respectively. Ethanol and

Table 1
Combination ratios of GT and LBG in the binary blends for 100 ml of solvent.

GT/LBG ratio	GT (g)	LBG (g)
100/0	1.00	0.00
75/25	0.75	0.25
50/50	0.50	0.50
25/75	0.25	0.75
0/100	0.00	1.00

acetone reagents used for extraction and purification of gums were of analytical grade from Mojallal, Mashhad, Iran. Diethyl ether reagent was purchased from Merck, Darmstadt, Germany.

2.2. Gum preparation

LBG was extracted and purified based on the procedures described by Dakia, Blecker, Robert, Wathelet, and Paquot (2008) and da Silva and Gonçalves (1990), respectively with some modifications. Briefly carob seeds were immersed in distilled water at 100 for 1 h. The seeds were then removed from water and the endosperms were separated, dried and powdered. A 2% (w/w) dispersion of the endosperm powder in distilled water was made and after stirring moderately for 1 h, it was heated at 80 °C for 2 h with continuous stirring. The resulting solution was allowed to cool, centrifuged for 15 min at 20,000 × g (25 °C) and the supernatant was recovered. The solubilized galactomannan was precipitated from the crude LBG solution by pouring into a two volume excess of ethanol. The white precipitate was collected by filtration and washed with isopropanol, acetone and diethyl ether. LBG was freeze-dried after purification and kept in desiccator until further use. GT exudates were prepared according to the method described by Azarikia and Abbasi (2010) and Balaghi et al. (2011). They were powdered by an electric mill and sieved using a laboratory screen (mesh No: 45) to obtain particles of the same size.

2.3. Film preparation

All edible films were prepared by using the casting method. Individual film-forming solutions were prepared by dissolving 1% (w/w) of each gum powder in deionized water. LBG required heating for complete solubilisation. Therefore it was heated at 80 °C for 1 h using magnetic stirrer. After dissolution the gum solutions were left to stand overnight at 4 °C. Binary solutions of gums were prepared according to the formulations presented in Table 1 followed by stirring for 10 min at room temperature. Film-forming solutions were centrifuged at 1500 rpm for 5 min to remove air bubbles before casting into plates. 40 ml of each gum solution was casted into Teflon plates of 10 cm in diameter and dried using air oven at 30 °C for 24 h. They were then carefully peeled off the plates and kept in a conditioning desiccator containing saturated Mg(NO₃)₂ to create 52.80 ± 0.20% relative humidity (RH) at 23 °C to reach a constant weight.

2.4. Determination of physical properties of film-forming solutions

2.4.1. Apparent viscosity

Apparent viscosities of individual gum solutions at different concentrations (0.25, 0.5, 0.75 and 1% w/w) were investigated. Also the apparent viscosities of blend gum solutions having 1% w/w gum concentrations at different GT/LBG ratios (25/75, 50/50 and 75/25) were measured by a rotational viscometer (DV III ULTRA, Brookfield Engineering Laboratories, USA) using spindle No SC4-18 at constant temperature of 25 ± 0.5 °C and shear rate of 11 s⁻¹. All measurements were carried out in duplicate.

Download English Version:

<https://daneshyari.com/en/article/1374818>

Download Persian Version:

<https://daneshyari.com/article/1374818>

[Daneshyari.com](https://daneshyari.com)