65

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Influence of boswellic acid on multifunctional properties of chitosan/poly (vinyl alcohol) films for active food packaging

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ABSTRACT

Present work aimed to develop active packaging films based on chitosan (CS), poly (vinyl alcohol) (PVA) and boswellic acid (BA), and to evaluate the effect of BA on multifunctional properties of CS/PVA (CPBA) active films. Different compositions of active packaging films were prepared by the solvent casting method. The results indicated that incorporation of BA enhanced the ultraviolet blocking, morphology, mechanical properties, water solubility and hydrophilicity of the CPBA active films. Significant improvement in the barriers properties of BA incorporated CPBA active films were observed. The microbiological screening has demonstrated the antimicrobial activity of the films against *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans*. Furthermore, the prepared active films do not deteriorate the thermal properties after incorporation of BA. The overall migration values of the CPBA active films in contact with food simulants were within the permitted limits. The obtained results indicate that the CPBA active film may be a promising material for food packaging applications.

1. Introduction

Packaging is a key element in recent years as almost all products are sold packed. Plastic is the second most used material in the packaging industry as it possess excellent mechanical and barrier properties [1] combined with easy processability and relatively low cost. However, synthetic polymers (plastics) are not readily biodegradable and such polymers particularly used as food packaging materials because of their relatively short lifetime produces a large amount of packaging waste [1,2] causing serious environmental waste disposal problems. Hence, raw materials which can be used as alternatives to plastics have attracted considerable attention of food industry in recent years.

Biopolymers are highly advantageous compare to petroleum based synthetic plastics as they are renewable, biodegradable, biocompatible, mostly non-toxic and derived from biological origin [3]. Natural biopolymers such as proteins, starch cellulose, chitosan, etc. have been explored mainly due to their environmentally-friendly nature and their potential use in the food packaging applications. Among these, chitosan could be a prospective candidate due to its unique properties such as non-toxicity, biodegradability, biocompatibility and antimicrobial activity. Chitosan is soluble in dilute organic solvents and has excellent film forming ability [4]. However, the applicability of chitosan in food packaging has been limited because of their poor barrier to moisture and mechanical properties compared to petroleum-based packaging materials. In order to improve the mechanical and water resistance properties of chitosan various strategies, such as chemical crosslinking, incorporation of plasticizers, polymer blending etc., have been suggested in the literature [5]. Among these, polymer blending is simple and cost-effective method used to design new polymeric material with a wide range of attractive applications, which cannot be achieved by a single polymer alone. The blending of a biopolymer with a synthetic biopolymer constitute a new class of materials with improved properties [6]. Chitosan is often blended with PVA to develop films with improved properties with promising application in food packaging. PVA is a water soluble synthetic polymer with excellent flexibility, transparency, non-toxicity, biocompatibility, biodegradability and film forming ability and has been widely used in various fields such as food packaging, biomedicine and agriculture [7,8]. The intermolecular hydrogen bonds between chitosan and PVA molecules promoted the fabrication of the films. Several CS/PVA blend films with various blend ratios were reported in the literature [9–17]. Miya et al. [12], Park et al. [15] and Srinivasa et al. [17] have reported the poor miscibility and existence of weak hydrogen bonding interactions between CS and PVA. Phase separation and low thermal stability of CS/PVA blend films has been reported by Chuang et al. [11] and Lewandowska Lewandowska [18] respectively. These reported studies indicated that the physical, thermal and mechanical properties of CS/PVA blend films are still not satisfactory and find difficulties in many applications. Therefore, much attention has been given to the modification of CS/PVA binary blends.

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54