폴리비닐알코올/키토산 블렌드 필름의 제조 및 그 특성에 관한 연구

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A Study on the Preparation and Properties of Poly(vinyl alcohol)/Chitosan Blend Films

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1. Introduction

Poly(vinyl alcohol) (PVA) is a polymeric biomaterial that obtained by the saponification of poly(vinyl acetate) (PVAc). It has a nontoxic and water-soluble synthetic polymer, and has excellent biodegradability, biocompatibility, ability of film forming, and hydrophilic property, which is widely used in biochemical and biomedical applications.[1)]

Chitosan is one of a few natural cationic polysaccharides that can be obtained by alkaline deacetylation of chitin which is the second most abundant polymeric material in the earth.[2)] Chitosan composed mainly of β-(1,4)-2-deoxy-2-amino-D-glucopyranose by (1→4)-linkages, which has excellent biocompatibility, biodegradability, and ability of film forming. Also, it shows mild antibacterial activity arising from its cationic residue, which is an important property in view of the use of chitosan as a biomedical polymeric material.[3)] The blend of PVA and chitosan have already been reported to having good mechanical properties because of the specific inter molecular interactions between PVA and chitosan molecular in the blends.[4)]

In the present study, the miscibility, crystallinity and mechanical properties of PVA/chitosan blend films were investigated from antibacterial activity test, Fourier-transform infrared spectroscopy (FT-IR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and tensile strength tester.

2. Experimental

2.1. Materials

Poly(vinyl alcohol) powder was kindly supplied by Hyosung Corporation (Korea), which was used without further purification. The weight average a degree of polymerization of PVA is 1700, and a degree of saponification is about 99.8%. Crab shell chitosan(deacetylated Minimum 99%, MW ca. 7.8×10^4) sample was purchased from Tae Hun Bio Corporation (Korea) and purified by the reprecipitation method.

2.2. Preparation of blend films

PVA and Chitosan blend films were prepared by the following procedure; PVA powder was dissolved in water at 80°c for 12 hours with stirring. And, chitosan aqueous solutions dissolved in acetic acid (2wt%) were added in the PVA aqueous solutions, and both components were mixed at room temperature for 12 hours with stirring. Mixed PVA/chitosan blend solutions were dried by film form in a vacuum at 50°c for 12 hours. Blend ratios of PVA and chitosan aqueous solutions were controlled to 100/0, 95/5, 90/10, 85/15, 80/20 and 0:100. The properties of blend films were analyzed through antibacterial activity test, Fourier-transform infrared spectroscopy, differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and tensile strength tester.

3. Results and Discussion

Table 1 shows Bacteriostatic ratio of pure chitosan and PVA/chitosan blend films with chitosan content. From table 1, antibacterial abilities of pure chitosan and all blend films were confirmed to superior. Bacteriostatic ratio of all samples were recorded over 99.9%.

Table 1. Bacteriostatic ratio of blend films with chitosan content

	Pure chitosan	5wt%	10wt%	15wt%	20wt%
Staphylococcus Aureus (ATCC 6538)	99.9	99.9	99.9	99.9	99.9
Klebsiella Pneuoniae (ATCC 4352)	99.9	99.9	99.9	99.9	99.9

According to the previous study, Coleman and Varnell applied infrared spectroscopy to study polymer blends and proved its usefulness.[5] Figure 1 shows Infrared spectra of PVA/chitosan blend films with chitosan content. The 3405cm^{-1} peak in the pure chitosan does not appear in the blend sample, and not only does the characteristic shape of chitosan spectrum change in the blend but the N-H band peak also shifts to a higher frequency at 1564cm^{-1}. The most intense band, at 1010cm^{-1}, in the pure state does not appear as a clear peak in the blend but as an unseparated shoulder. The change of the band shape in the OH stretching region indicate that there should be strong hydrogen-bond interactions between OH of PVA and OH or NH_2 of chitosan. Also, the inter molecular interactions seem to play an important role in formation of the amorphous regions.

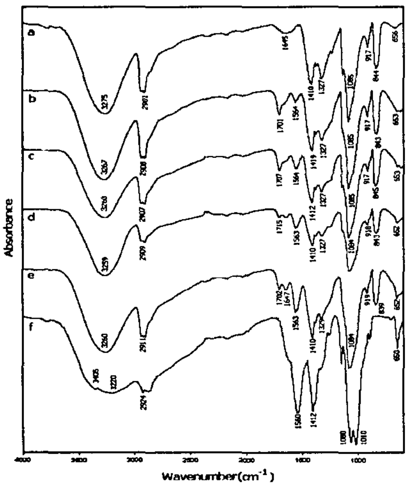

Figure 1. Infrared spectra of PVA/ chitosan blends in various ratio: (a)pure PVA, (b)95/5, (c)90/10, (d)85/15, (e)80/20, (f)pure chitosan

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4. References

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