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Preparation and properties of rice starch- chitosan blend film

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Abstract

Edible blend films from rice starch- chitosan were developed by casting film-solution on leveled trays. The influence of the ratio of starch and chitosan (2:1, 1.5:1, 1:1 and 0.5:1) on the mechanical properties, water barrier properties and miscibility of edible blend films were investigated. The edible blend film from rice starch- chitosan showed increase in tensile strength (TS) and water vapor permeability (WVP) and decreasing elongation at break (E) and film solubility (FS) after incorporation of chitosan. The introduction of chitosan increased the crystalline peak structure of starch film, however too high chitosan concentration yielded phase separation between starch and chitosan. The amino group band of chitosan molecule in the FTIR spectrum shifted from1541 cm^{-1} in the chitosan film to 1620 cm^{-1} in edible blend films. These results pointed out that there was a molecular miscibility between these two components.

Tensile strength (TS) and Elongation at break (E)

The results demonstrated that the TS of edible blend films increased with the addition of chitosan, maximum occurred at the rice starch and chitosan ratio of 1:1 and 0.5: 1.0. The increasing TS values of the edible blend films, with the increasing of rice starch and chitosan ratio from 2: 1 to 0.5: 1. However, the TS of edible blend film prepared at the starch to chitosan ratio of 1:1 and 0.5:1 was not significant different. The average E values of the edible blend film behaved inversely to the TS value, decreasing from 12.99% to a minimum 8.06% when the rice starch and chitosan ration of 0.5:1(Figure 1B).

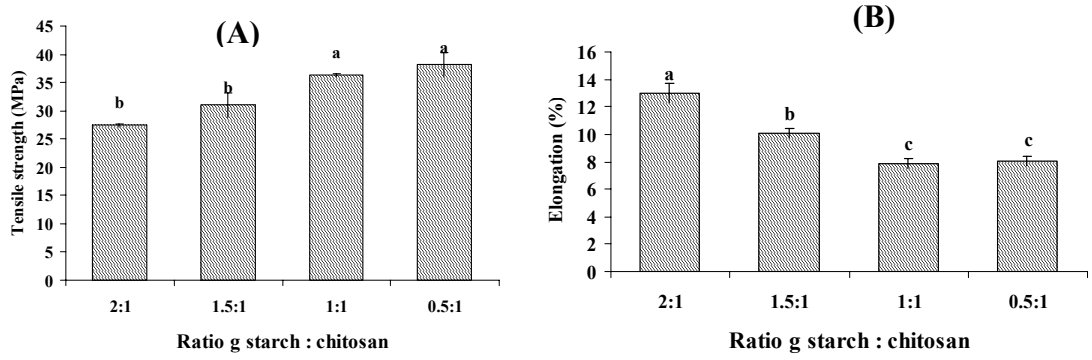

Figure1. Effects of chitosan ratios on (A) tensile strength (TS) and (B) elongation at break (E) of the edible blend films. a-c means with the different letters represent significantly different value at $p \leq 0.05$ using Duncan's Multiple Range Test.

Water vapor permeability (WVP)

The WVP of edible blend films with different ratio of rice to chitosan were examined at a vapor pressure difference of 0/60% across films. The results showed that the edible blend film WVP increased with an increase in the content of chitosan. The WVP of edible blend film increased from 4.11 g.mm/m^2.day. kPa to 7.80 g.mm/m^2.day. kPa, when the chitosan ratios increased from 2:1 to 0.5:1 and the maximum WVP occurred at the rice starch and chitosan ratio of 0.5:1 (Figure 2A).

Film solubility (FS)

The results demonstrated that the FS of edible blend films decreased with the addition of chitosan. The decreasing FS values of the edible blend films, with the rice starch and

chitosan ratio decreasing from 2: 1 to 0.5: 1 (Figure 2B). These results could be arise from the fact that, at higher chitosan content induced rice starch and chitosan interaction and resulted in decrease in FS.

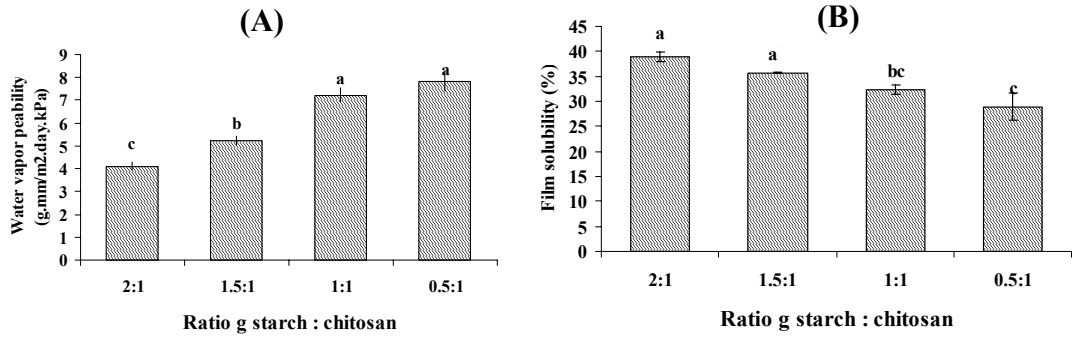

Figure2. Effects of chitosan ratios on (A) water vapor permeability (WVP) and (B) film solubility (FS) of the edible blend films. a-c means with the different letters represent significantly different value at $p \leq 0.05$ using Duncan's Multiple Range Test.

FTIR spectroscopy

FTIR spectroscopy was used to determine the interactions between rice starch and chitosan.The results demonstrated the amino group band of chitosan molecule in the FTIR spectrum shifted from1541 cm^{-1} in the chitosan film to 1620 cm^{-1} in edible blend films. These results pointed out that there was a molecular miscibility between these two components.

X- ray diffraction

The results demonstrated that, the chitosan powder was in a crystalline state because two main diffraction peaks ($2\theta = 11$ and 20^{o}) were observed in its X-ray diffraction pattern. After making the films, two crystalline still existed, but the intensity was less. When these two film forming components were mixed, increasing of the crystalline structure of rice starch film was noticed when higher chitosan content was used. The increase in crystalline peaks with increase in chitosan content might be explained by the incidence of a molecular miscibility between these two components.

Conclusions

Rice starch- chitosan blend films were prepared successfully by casting on leveled trays. The mechanical resistance of the starch films was improved largely by incorporating of chitosan into starch film. X- ray diffraction and FTIR analyses of starch-chitosan blend films indicated that introduction of chitosan increased the crystalline peak structure of starch film, however too high chitosan concentration yielded phase separation between starch and chitosan. The amino group band of chitosan molecule in the FTIR spectrum shifted from1541 cm^{-1} in the chitosan film to 1620 cm^{-1} in edible blend films. These results pointed out that there was a molecular miscibility between starch and chitosan.