

Characterization of Potato Starch/Guar Gum Composite Film Modified by Ecofriendly Cross-Linkers

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Abstract : Synthetic plastics are preferred for food packaging due to high strength, stretch-ability, good water vapor and gas barrier properties, transparency and low cost. However, environmental pollution generated by these synthetic plastics is a major concern of modern human civilization. Therefore, use of biodegradable polymers as a substitute for synthetic non-biodegradable polymers are encouraged to be used even after considering drawbacks related to mechanical and barrier properties of the films. Starch is considered one of the potential raw material for the biodegradable polymer, encounters poor water barrier property and mechanical properties due to its hydrophilic nature. That apart, recrystallization of starch molecules occurs during aging which decreases flexibility and increases elastic modulus of the film. The recrystallization process can be minimized by blending of other hydrocolloids having similar structural compatibility, into the starch matrix. Therefore, incorporation of guar gum having a similar structural backbone, into the starch matrix can introduce a potential film into the realm of biodegradable polymer. However, hydrophilic nature of both starch and guar gum, water barrier property of the film is low. One of the prospective solution to enhance this could be modification of the potato starch/guar gum (PSGG) composite film using cross-linker. Over the years, several cross-linking agents such as phosphorus oxychloride, sodium trimetaphosphate, etc. have been used to improve water vapor permeability (WVP) of the films. However, these chemical cross-linking agents are toxic, expensive and take longer time to degrade. Therefore, naturally available carboxylic acid (tartaric acid, malonic acid, succinic acid, etc.) had been used as a cross-linker and found that water barrier property enhanced substantially. As per our knowledge, no works have been reported with tartaric acid and succinic acid as a cross-linking agent blended with the PSGG films. Therefore, the objective of the present study was to examine the changes in water vapor barrier property and mechanical properties of the PSGG films after cross-linked with tartaric acid (TA) and succinic acid (SA). The cross-linkers were blended with PSGG film-forming solution at four different concentrations (4, 8, 12 & 16%) and cast on teflon plate at 37°C for 20 h. From the fourier-transform infrared spectroscopy (FTIR) study of the developed films, a band at 1720cm⁻¹ was observed which is attributed to the formation of ester group in the developed films. On the other hand, it was observed that tensile strength (TS) of the cross-linked film decreased compared to non-cross linked films, whereas strain at break increased by several folds. Moreover, the results depicted that tensile strength diminished with increasing the concentration of TA or SA and lowest TS (1.62 MPa) was observed for 16% SA. That apart, maximum strain at break was also observed for TA at 16% and the reason behind this could be a lesser degree of crystallinity of the TA cross-linked films compared to SA. However, water vapor permeability of succinic acid cross-linked film was reduced significantly, but it was enhanced significantly by addition of tartaric acid.

Keywords : cross linking agent, guar gum, organic acids, potato starch

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