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Reactivity of Chitosan with Glucose

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Chitosan is a deacetylated product of chitin that is extracted from crab and shrimp shells. Recently, chitosan has received attention as a promising biomass resource. As chitosan has an amino group in the chemical structure, chitosan exhibits a polycationic nature. On the other hand, wood is also the most abundant and available biomass resource, and shows generally polyanionic nature. Therefore, they are expected to cause a certain intermolecular interaction and affinity. Research on the interaction of chitosan with wood or wood components has become of interest in recent years. In our laboratory, the interaction of chitosan with wood model compound based on the Maillard reaction has been investigated.

Generally, the Maillard reaction brings the browning of compounds due to the interactions between carbonyl group such as reducing sugars and amino compounds such as amines, amino acids, peptides, or proteins. It is well known that this reaction occurs during the heating, storage, and processing of foods. The Maillard reaction follows a complex mechanism, and the final reaction products yield high molecular weight compounds called melanoidins. The studies on the Maillard reaction between chitosan and reducing sugars are limited and the fundamental information is not yet provided enough. As a recent topic, we introduce the characterization of the Maillard product obtained from the reaction between chitosan and glucose.

Chitosan was dissolved in 1 wt% acetic acid solution, and glucose was added to the chitosan solution. The weight ratios of chitosan and the sugar were adjusted to 10:0, 9:1, 8:2, 5:5, and 3:7. The solutions were stirred at room temperature and then filtered through a filter paper. After removal of air bubbles, the solutions were poured into a small plastic tray and were dried in an oven at 50°C for about 20 h. The films obtained were immersed in an ethanol and 4% sodium hydroxide mixture to remove residual acetic acid and washed thoroughly with an ethanol and distilled water mixture to remove alkali and residual sugar. After the washings showed a neutral pH, the films were vacuum-dried at 50°C for 15 h.

Figure 1 shows the insoluble matter of each chitosan film in 5wt% acetic acid. The insoluble matter increased with increasing glucose addition and then decreased. The maximum value of the insoluble matter recorded was 93% in 20wt% addition. Generally, chitosan is soluble in a dilute acid to form the salt. However, it was demonstrated that chitosan changed easily to insoluble matter by adding glucose. The decrease of the insoluble matter in high addition amount would be due to some acetic acid-soluble substances formed by the Maillard reaction. Figure 2 shows the addition effects of glucose on the tensile properties of chitosan film. The tensile strength steadily increased and then decreased gradually. The maximum average value recorded was 64.8 MPa in 20wt% addition. Compared to pure chitosan film, the tensile strength improved about 45%. Therefore, it was made clear that the insoluble matter to dilute acetic acid and the tensile strength were easily improved by a small amount addition of glucose.

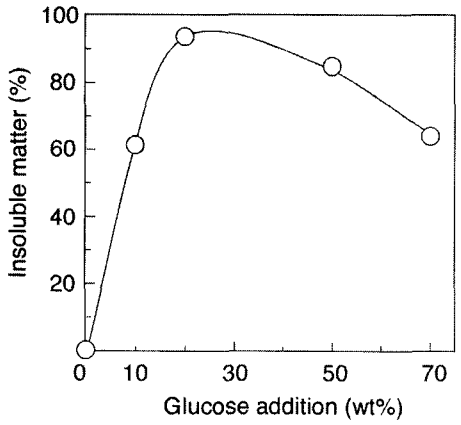

Fig.1. Insoluble matter of the glucose-added chitosan films in 5% acetic acid solution.

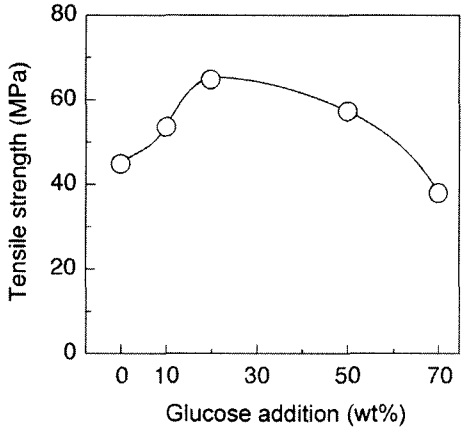

Fig.2. Tensile strength of glucose-added chitosan films.