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Effect of Sodium Chloride Concentration on the Reaction Rate of Amino Acid, Peptide and Protein with Glucose

Nguyen Van Chuyen, Keiko Yamaguchi and Yuri Nomi

Department of Food and Nutrition, Japan Women's University

Summary

Maillard reaction is a chemical reaction involving the amino group and carbonyl group, the reaction occur readily in food processing, storage and cooking process. The mechanism of Maillard reaction is generally divided into three stages, namely early, advance and late stage. In the early stage, a condensation occurs between an amino acid and a carbonyl group leading to the formation of a Schiff base and Amadori rearrangement product. In this early stage, amino compound reacts with carbonyl compound in the form of an anion. Therefore, it is considered that the ions generated from sodium chloride affect the rate of Mailard reaction. In this research, the amino acids such as alanine, glycine, lysine, the peptides such as alanylalanine, glycylglycine, glycylglycylglycine, and protein such as beta-galactobulin were used. The concentration of sodium chloride was set up at 0, 5 and 10%. Equimolar (0.2 M) of amino acid or peptide and glucose (in 0.2 M phosphate buffer, pH 6.0) was heated at 100℃ for 30, 60, 90 and 120 min. Then, the browning degree was measured at 470 nm. The results showed that for the case of amino acids, the rate of browning was inhibited by high concentration of sodium chloride. However, in the case of peptides, the browning rate was not inhibited by sodium chloride concentration. In the case of beta-Galactobulin, 0.1mM beta-Galactobulin and 0.1 M glucose was heated at 70℃ for 6, 12, 18, 24 h, then the browning was measured at 470 nm, while the polymerization of the protein was measured by SDS-PAGE. The results showed that the rate of browning of protein was also inhibited by the concentration of sodium chloride. Since the reaction rate of amino acid or protein was much lower than that of peptide with glucose, then it is estimated that the ionic strength affect the reaction rate of amino acids and protein, but not peptides in the reaction with glucose. In order to investigate that whether sodium ion or chloride ion affect the reaction rate, the same ionic strength at 0, 0.8 and 1.6 of sodium chloride, potassium chloride and sodium phosphate was used for the reaction of lysine with glucose. The result showed that the same tendency was observed for all three salts, thus it is estimated that the effect of ionic strength is more important than the kind of ion on the reaction rate of lysine with glucose. Besides, the same tendency was observed for the reaction at pH 4.5, 6.0 and 7.5. Consequently, sodium chloride can be used to control the rate of Maillard reaction in food industry.