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Effects of Salts on the Conversion Behavior of Saccharides in Subcritical Water

Takashi Kobayashi

Graduate School of Agriculture, Kyoto University

Summary

Fructose and glucose were treated in salty subcritical water to analyze their decomposition behavior. Fructose and glucose were dissolved in saline solution (NaCl=0~20%), and the solution was treated in a tubular reactor kept at 180–220ºC with the residence times of 20–400 s. The resulting mixture was analyzed using HPLC to quantify the products.

When the treatment temperature was higher, decomposition rate of glucose and fructose increased despite the presence of the salt. However, at the latter stage of the reaction, decomposition of glucose became slower. Kinetic analysis for the glucose decomposition was then performed, and the reaction rate could be expressed by the Weibull equation. The formation of fructose and small amount of mannose was observed during the subcritical water treatment of glucose.

In the case of fructose treatment, however, the reaction rate increased at the latter stage compared to that assuming the first-order reaction. This tendency was not remarkable at lower temperature; but became greater at elevated temperature. Kinetic analysis for the fructose decomposition indicated that the first half of the reaction was the first-order reaction, and the latter-stage one was the autocatalytic reaction. The acceleration at the latter stage would be due to the formation of organic acids, such as formic acid and levulinic acid. Formation of glucose and mannose from fructose was not observed, indicating that aldose-to-ketose isomerization only occurred in salty subcritical water and the reverse reaction rarely occurred.

Effects of the salt concentration were evaluated on the decomposition behavior of glucose and fructose during the subcritical water treatment. Glucose decomposition was slightly affected by the difference of the salt concentration; while that for fructose was greatly did.

These results indicate that the presence of sodium chloride greatly affected the decomposition of ketose in subcritical water. This would contribute to advance in the interpretation and application of subcritical water treatment of food-based stuffs.