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Effect of Added Salts on High-Pressure Control of Microorganisms

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Summary

High-pressure processing is one of non-thermal technologies for microbial inactivation, which can inactivate microorganisms with preventing alteration in the flavor and nutrient contents of fresh foods. Microorganisms in foods are always accompanied with polysaccharides, proteins, fats, salts, sugars, and other food components. Therefore, it is important to understand microbial inactivation behaviors in presence of coexistent materials. Using NaCl and KCl, which have monovalent cations with different hydration sizes, the behavior of high-pressure inactivation of *Escherichia coli* was investigated.

The cell suspension solutions of *E. coli* strain K12 were prepared with the salt solutions of NaCl or KCl in the concentration range between 0.1 and 0.3 mol/l. The cell suspension was then applied to high pressure treatment at 250 to 400 MPa at 20°C. The viable cell number of high pressure treated cell suspension was counted as colony forming unit to determine the surviving rates. Under all experimental conditions, high-pressure inactivation of *E. coli* followed first-order kinetics. With both salts added, the inactivation rate constant (k) showed the minimum value at 0.145 mol/l, which is equivalent to isotonic solution, and it increased with lower and higher osmolarities at the high pressure level (350 MPa in NaCl and 400 MPa in KCl). For each salt concentration and pressure level, the inactivation rate constant with NaCl solution was higher than that with KCl, suggesting that difference in cations could effect on the inactivation behaviors.

The activation volumes (ΔV^*) and the pre-exponential factor (k_0) of each salt concentration were determined based on the dependency of k on the pressure levels. For each salt concentration, the absolute value of activation volume with NaCl solution was higher than that with KCl solution, suggesting the volume change between initial state and activated state of inactivation reaction would depend on the coexistent cation. For each salt added, the relationship between salt concentration and the activation volume were analyzed. As a result, with both salts, the absolute value of the activation volume showed the minimum value at the concentration of 0.20 mol/l, decreased below 0.20 mol/l and increased over 0.20 mol/l with increase in concentration. In conclusion, this study indicated that there could be different inactivation mechanisms by high-pressure below and over the border salt concentration of 0.20 mol/l.