

Effect of Salts on the Hardness of Cooked Beans(II)

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Summary

The conditions under which soybeans are soaked in salt solutions were investigated to define a useful and practical procedure for two-step soaking. The initial rate of water absorption increased with a rise in temperature up to 60 °C. The best ratio of soaking time in the first ferrous chloride solution to soaking time in the second sodium chloride solution was 5:3 when total soak time was 8 hr. Prolongation of the total soak time of 8 hr improved the softening effect little, whereas a very short soak time such as 4 hr was insufficient to soften the beans. A 0.02M or lower concentration of ferrous chloride in the first solution was recommended to avoid a coloration and off-flavor of the cooked beans. Divalent and trivalent metal ions other than ferrous ions hardened the beans or had a very little softening effect by following soaking in the second sodium chloride solution. Winged beans absorbed water and leaked sugars, amino acids and phosphates much more slowly than soybeans and aged soybeans. This contributes to the resistance to a softening by boiling with water. However, sodium maleate softened the winged beans to the extent of 40% relative hardness.

The geometries of the carboxylate ion-Mg²⁺ complexes were optimized using the STO-3G basis and the GAUS86 program system. The calculated stabilization energy for the maleate ion-Mg²⁺(1:1) complex was 273 Kcal/mol lower than that for the acetate ion-Mg²⁺(1:1) complex. The energy for the maleate ion-Mg²⁺(2:1) complex was 179 Kcal/mol lower than that for the acetate ion-Mg²⁺(2:1) complex. This suggests that maleic acid can form firmer complexes with Mg²⁺ than acetic acid, and offers a possible explanation of the difference in the softening effect between maleic acid and acetic acid.