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Involvement of Electrostatic Effects in the Gelatinization of Starch

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Summary

A number of trials have been carried out in an effort to improve foods by adding deep sea water. However, few reproducible results have been obtained due to the existence of, and variation in, other components. Moreover, it is unclear whether or not the addition of deep sea water actually influences food properties. Thus, we attempted to create a simple model to test the effects of deep sea water on the properties of baked starch-containing foods. We focused on silica components, due to their being key components of deep sea water. SiO_2 nanoparticles with a diameter of 7 nm were added to the mixture during the baking of starch products.

After baking, levels of gelatinization were measured using a new improved method, which was developed by modifying a previous method. It resulted in soluble substances being ignored during the calculation of their concentrations in supernatants. The electrostatic interaction induced by adding SiO_2 nanoparticles was measured for permittivity, and was found to be 0.2 μSi/cm for distilled water, 5-fold higher for a 120 mg/ml equivalent SiO_2 group, and 10-fold higher for a 1200 mg/ml eq. SiO_2 group. In spite of these differences in permittivity, the gelatinization parameters were found to be the same as in distilled water, with the exception of the η values. With regard to the η values for defatted baked starch products in water, a significant difference was detected between mixtures containing distilled water and 120 mg/ml eq. SiO_2 nanoparticles. However, increasing the amount of SiO_2 nanoparticles in the mixture to 1200 mg/ml eq. SiO_2 had no significant effect on the value of η. Several changes in η as a function of incubation time were observed for starch and SiO_2 in water, including in the 120 mg/ml eq. SiO_2 group.

We conclude that, irrespective of the effect of SiO_2 nanoparticles on electric interactions, the presence of other substances in defatted baked starch products may interfere with the direct electric effects on starch gelatinization.