Phase Transitions in Amylose and Amylopectin Under the Influence of $Ca(OH)_2$ in Aqueous Solution

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Amylose (A_1) and amylopectin (A_2) are the two main constituent substances of most starches (75-80% in dry cornstarch). Endosperm of corn kernel contains, in general, 28% A_1 and 72% A_2. During cooking of corn starch in food preparation, specially those solved in water, the mixture of A_1 and A_2 experiences a phase transition from a pasty and weak-tied wet masa to a completely consistent dry material (gelatinization). Cooked corn tortillas, from dough prepared with 0.25% of $Ca(OH)_2$ in weight (México and Central America), have better mechanical, structural and rheological properties, beside a more accepted flavor. In order to understand the mechanism of phase transformation of wet dough of corn starch under the $Ca(OH)_2$ presence, A_1, A_2 and 28%A_1+72%A_2 (A_3) samples were prepared with and without $Ca(OH)_2$, which afterward were boiled. During this process part of Ca is incorporated in cooked samples. X-ray diffraction (XRD) analysis and thermal diffusivity (α) measurements were carried out in six samples: Three including $Ca(OH)_2$ and other three without it. Thermal diffusivity data were achieved by means of a photoacoustic system. XRD patterns show a more structured material when Ca^{2+} is present in the molecular structure of material. α data evidence an increase when Ca^{2+} is present in A_1 and A_2 samples, however, improves notably for the A_3. This result can indicate that Ca^{2+} enhances the crosslinking of polymeric chains, contributing to a better heat conduction.

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Corn food-stuffs, essentially tortillas, are among the most important products in every day meals in Mexico, Central America and, with minor importance, in the south of United States. The consume of tortillas is estimated to be around \$ $4x10^9$ US per year in Mexico. Demand of this product increases every year, which turns necessary massive production without diminishing the quality characteristics. Cooking of tortillas implies the mixture of dry corn-flour with 0.25% of $Ca(OH)_2$ in weight, to prepare the dough through water addition. Tortillas prepared in this manner have better mechanical, structural and rheological properties, beside a more accepted flavor. The objective of this work is the understanding of the role that Ca^{2+} plays in the physical and chemical properties of cooked tortillas, i.e., the phase transformation (cooking) from wet dough to tortillas under the influence of $Ca(OH)_2$ (the "nixtamalization" process). Amylose (A_1) and amylopectin (A_2) are the two main organic constituent substances of most starches (72-73% in dry corn starch).[1a] Endosperm of corn kernel contains starch with, generally, 28%A_1 + 72%A_2.[1b] By dissolving pure A_1, A_2 and the mixture 28%A_1 + 72%A_2 (A_3) in water, the phase transformation (due to cooking), from wet dough to cooked material, can be studied after the heating of solutions. These phase transformations are analyzed when solution are prepared with and without $Ca(OH)_2$. X-ray diffraction (XRD) analysis and thermal diffusivity measurements, this last one carried out by means of photoacoustic technique, were used to interpret the phase change phenomenon and the effects of Ca^{2+} ions presence into the molecular tissue of the material. Thermal properties of tortillas prepared directly from corn flour have been already studied as a function of the Ca^{2+} content. Optimal conditions were obtained for around 0.25% in weight of Ca concentration.[2-4] We have selected pure A_1 and A_2 components, because thermal properties of cooked starch depend on the different kinds of maizes.[5-7] The purpose of this work after all is, in an approximately way, to simulate the nixtamalization process.

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