Kinetic Approach to Nixtamalization of Corn Pericarp

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ABSTRACT

The nixtamalization of the pericarp isolated from grains of corn was studied with 2, 5, 10, 20 and 40% Ca(OH)2 based upon the mass of the pericarp. For 2 and 5% Ca(OH)2 a small loss of the mass of the pericarp takes place quickly which is accompanied by an abrupt fall of the concentration of the OH ions. A suitable kinetic model for the decrease of the mass of the pericarp is a two phases exponential equation. The second phase is the slowest and it depends on the quantity of Ca(OH)2 employed.

MATERIALS AND METHODS

Materials

Ca(OH)2 from Merck was used to degrade corn pericarp. Percentage of Ca(OH)2 employed in this work is based upon the mass of pericarp. Corn grain (cultivar Toluca from Mexico, 1998) was soaked in water, and the pericarp was separated manually to prevent the endosperm from contaminating it.

Methods

To measure the mass change of pericarp and the pH level of the cook solution during nixtamalization, several Erlemeyer flasks containing similar mixtures of 1–2 g of pericarp and 0.025–0.4 g of Ca(OH)2 in 20–40 mL of water (Table I) were placed in a thermostatic bath at 80°C (τ = 0). Flasks were removed from the bath at 5, 10, 15, 20, 30, 90, and 120 min, and nixtamalization was stopped abruptly by immersing each flask in an ice water bath. The pH level was measured at room temperature and the mixture was vacuum-filtered through a Whatman 40 filter paper. The pericarps were washed with 200 mL of water. The dry mass of pericarp was determined by placing the samples on filter paper in a forced-air oven at 130°C for 1 hr. They were allowed to cool down in a desiccator before weighing.

To measure viscosity, the pericarp was ground in a hammer mill and dry samples of milled pericarp (2 g) that passed through a 0.147-mm sieve, 10 mL of water, and either 5, 20, or 40% Ca(OH)2 were employed in the assays. Measurements of viscosity (cP) were conducted in Rapid Visco Analyser instrument (RVA) (Newport Scientific) to detect the solubilization of hemicellulose in water during nixtamalization. Samples were heated at 15°C/min to 80°C, maintained at this temperature for 5 min, and finally cooled to 40°C.

The hemicellulose in solution was separated by precipitation in ethanol. NMR 13C spectra were recorded using a Jeol Eclipse spectrometer at 270 MHz. Samples (100 mg) were dissolved in 0.7 mL of deuterated water.

RESULTS AND DISCUSSION

Nixtamalization of isolated pericarp produces the rupture of the cellulose-hemicellulose-lignin structure and the incorporation to the solution of hemicellulose and small quantities of lignin and proteins. The hemicellulose isolated from cooking liquor is mainly galacto glucurono arabinoxylans according to 13C NMR spectrum, which agrees with that reported and discussed by Saulnier et al (1993) in the studies of polysaccharides solubilized during nixtamalization of maize kernels.

The extraction of the hemicellulose during the nixtamalization was complex. The rate at which the first process takes place has been studied (Dolk et al 1989) but not the second process.

The objective of our work was to determine the nixtamalization rate of corn pericarp, i.e., the rate at which the isolated corn pericarp is degraded by Ca(OH)2.

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