ABSTRACT

Physicochemical Characteristics of Fresh Masa from Alkaline Processed Corn and Sorghum and of Corn Dry Masa Flour.

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Changes in the structure, physical and physico-chemical properties of corn and sorghum during nixtamalization and production of tortillas were documented using a combination of masa fractionation, x-ray diffraction, microscopy and HPLC-SEC separation of starches.

After 10 min alkaline-cooking, the moisture content of the grains increased from about 12.0 to 30.0%. Although, starch granules in the endosperm were exposed to low-moisture conditions and restricted by protein matrix and cell walls, they absorbed water and swelled (incomplete gelatinization). Nixtamals contained about 42.0 to 44.0% moisture at the end of cooking.

Steeping of cooked grains caused additional water absorption of 4-6%. Also, softening of the endosperm cells and further hydration of the starch granules occurred. Starch molecules from partially gelatinized granules, containing about 50 % water at > 65 °C, were reoriented in a polymeric structure or annealed. The annealed starch structure with the other "nixtamalized" kernel components may be responsible for the unique rheological properties of masa.

Most of the pericarp was removed from the grains during alkaline-cooking, steeping and washing operations.

Grinding of the nixtamal yielded swollen, birefringent free starch granules, cell fragments and dispersed solids. Fractions of different particle sizes of fresh masas had different proximate compositions depending upon the

location of pericarp, germ or endosperm pieces after nixtamal grinding. A "glue-like" material held the masa particles together. A plastic, cohesive system was developed from corn and sorghum, where large kernel pieces were dispersed among fine particles and held together with a solution/emulsion of carbohydrates and free lipids in water.

Alkaline-cooking, steeping and stone-grinding did not depolymerize the cereal starch. The amount of starch solubilized by boiling and sonication from corn and sorghum masas was lower than that from corn meals.The amount of solubilized starch in the dissolved solids fraction of masa increased with decreasing particle size and with longer cooking times. The amount of solubilized starch from masa decreased with decreasing particle size and increasing cooking-times. Starches from corn and sorghum masas were similarly affected by nixtamalization, although sorghum starches were modified to a greater extent than corn starches.

A loss of starch crystallinity and birefringence occurred when masa disks were baked to produce tortillas. The formation of a new crystalline structure of starch between amorphous and V-patterns occurred after frying corn and sorghum tortillas. Corn and sorghum chips contained gelatinized starch.

Fractions of different particle size of dry masa flours (DMF's) had similar proximate compositions because dry masa components (pericarp, germ and endosperm pieces) behaved in a similar way during re-grinding. The change in the X-ray diagrams of dry masa flours (DMF) indicated that starch crystallinity was reduced primarily by the heat treatment during drying and re-grinding operations. The starch in the large particles of DMF, less damaged during grinding, had a high amount of solubilized starch (via boiling and sonication). The starch in the smaller particles of the same DMF was more gelatinized and mechanically damaged. Large particles in DMF developed the proper textural characteristics during baking and frying, while the more gelatinized particles developed cohesiveness, plasticity and smoothness when DMF was mixed with water.