Grinding Effect on Whole Sorghum Extrusion Performance and Products

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Abstract

Whole sorghum kernels, ground whole and ground whole sorghum with fines removed were tempered to 12, 14 or 16% moisture and extruded in a Madsen single screw friction type extruder to analyze the effect of grinding on the extrusion performance and product characteristics. Commercial yellow cornmeal at 16% moisture was extruded as control. The optimum moisture content for sorghum extrusion was 14%. Extrusion of whole sorghum kernels consumed less energy and were processed faster than ground sorghum samples. The energy consumed by the extruder was lower for all sorghum samples compared to cornmeal at the same moisture content. The extruder was able to process more sorghum per time unit than cornmeal. Whole sorghum kernel extrusion produced extrudates with lower bulk density than when ground samples were used. Good quality sorghum snack bars can be made from whole sorghum even without grinding. The texture of the extrudate was excellent.

Introduction

Expanded snacks are very popular because of their crunchy texture (Barrett and Peleg, 1992). Corn, wheat, and rice are the most common cereals used in the extrusion of snacks and breakfast cereals. Sorghum is less expensive than other cereals but is not a major ingredient in extruded snacks. Previously, Acosta et al. (2002) successfully extruded decorticated white sorghum to obtain snacks comparable in bulk density to those made from yellow cornmeal.

Acosta et al. (2002) also concluded that whole sorghum kernels can be extruded into snacks using a friction extruder. This method produced whole grain products with excellent taste, texture and acceptability.

Objective

Extrude whole sorghum kernels and ground whole sorghum meals at different moisture levels to determine extrudates properties and extrusion performance.

Materials and Methods

Samples

ATX631/RT4346 white food sorghum grown in College Station, TX. In 2001 was utilized.

Whole sorghum kernels, ground whole sorghum, and ground whole sorghum with fines removed were utilized. Yellow corn meal for snacks (ADM) was utilized for comparison.

Grinding

was with a Fitz Hammer-mill using a #10 US sieve (2 mm). Fines were removed using a #50 US standard sieve (0.3 mm).

Extrusion

was performed in a single screw, friction-type extruder model MX-3001, Madsen, Inc., Dallas, TX) with L/D ratio of 4. The sorghum treatments were tempered to 12, 14 or 16% moisture and extruded at 300 rpm speed using a die with 4 1/8 inch holes. The current required to extrude the raw materials was monitored. The power was obtained by multiplying the current (amps) by the voltage (460 V).

The time required to extrude 10 kg of raw material was measured to calculate feed rate.

Baking and packaging

After extrusion, the samples were baked in a convection oven at 100°C for 30 min. After baking, the samples were cooled and packaged in a metallic plastic film.

Bulk density

Weight of a 151 container filled with extrudates.

Figure 3. Processing capacity of the extruder

Power (kW)

Figure 4. Elastic (Young’s) modulus of extrudates as measured with a Texture Analyzer.

Figure 5. ESEM of extrudates made from whole (un-ground, left) and ground sorghum (right) extruded at 14% moisture.

Figure 6. Bulk density of extrudates.

Extrudates made from whole sorghum had larger pieces of pericarp compared to those made from ground sorghum. Larger pieces of pericarp in whole sorghum extrudates made small air cells collapse to form large air cells with thicker cell walls. Ground sorghum extrudates produced extrudates with smaller air cell more equally distributed.

Conclusions

Extrusion of whole sorghum kernels consumed less power and was processed faster than cornmeal. Whole sorghum extrudates were more expanded, less stiff, had larger air cells and pericarp pieces, and thicker walls than ground sorghum extrudates.

Extrudates from whole sorghum had higher density than those from ground sorghum. Bulk density of cornmeal extrudates was lower than those from sorghum.

References
