The Effects of a Rice Based Emulsifier on Extruded Corn Meal

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Abstract

Commercial de-germed corn meals with and without 0.5% of a rice based emulsifier were extruded using a single screw high temperature-high shear baking extruder. The physical, texture, and microstructure of the two samples were compared. The extrudates containing 0.5% of the rice based emulsifier had a lower bulk density compared to the control. Viewed with environmental scanning electron microscopy, the extrudates without the emulsifier had thicker cell wall junctions, which contributed to a tougher texture. Extrudates with emulsifier had more evenly distributed air cells with thinner air cell walls that had a more consistent size and shape. Extrudates with emulsifier were tender and had lighter structures. The addition of the rice based emulsifier distributes air cells in the extrudates more evenly and contributed to a more tender texture in the collets.

Objective

Determine the effect a rice based emulsifier has on physical, texture, and the microstructure of a direct-expanded corn extrudates.

Materials and Methods

Materials

Degerminated yellow corn meal from ADM Milling., was used. The rice based emulsifier (Nu-Rice) was provided by Ribus, Inc. (St. Louis, Missouri 63105, USA).

Sample Preparation

For the control ten kilograms of degerminated yellow corn meal was tempered to 14% moisture content. Another ten kilograms of degerminated yellow corn meal was mixed with 0.5% of the emulsifier and was tempered to a moisture content of 14%.

Extrusion

The corn meal was extruded using a single screw, LD friction-type Maddox Extruder Model MX 3001. A screw speed of 300 rpm and average barrel temperature of 308oC were the running conditions. A 6 hole die with 1/8 inch

Bulk density

The bulk density (g/L) was obtained by dividing the weight of the extrudates that fill a container by the known volume of the container.

Texture

The texture of the extrudates was evaluated with a Texture Analyzer TA-XT2i (Texture Technologies Corp., Scarsdale, NY/Stable Micro systems, Godamlming, Surrey UK) using an aluminum blade as a probe. Forty randomly selected extrudates per treatment were analyzed.

ESEM

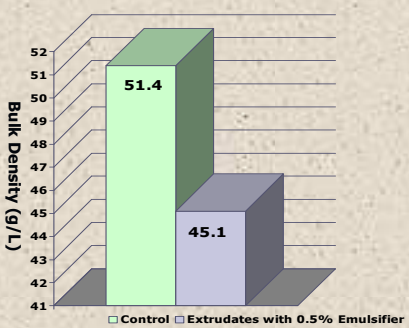
Extrudates were mounted on aluminum stubs with conductive. Model E-3 Environmental Scanning Electron Microscope.(ESEM Elctroscan Corp., Willington, MA) operating voltage of 20kV.

Results

Table 1. Particle Size Distribution of Corn Meal

U.S. Standard Sieve	
#10	0.0
#20	3.6
#30	51.2
#40	40.8
#60	4.1
#80	0.3
#100	0.0
Bottom	0.0

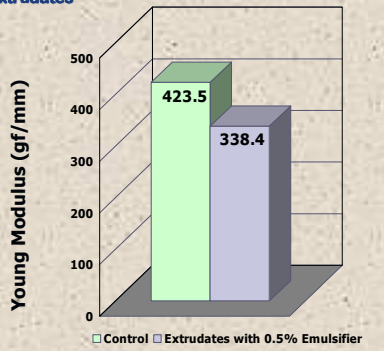
Figure 1. Bulk Density (g/L) of Corn Extrudates



•There was a decrease in bulk density in the extrudates containing 0.5% Emulsifier.

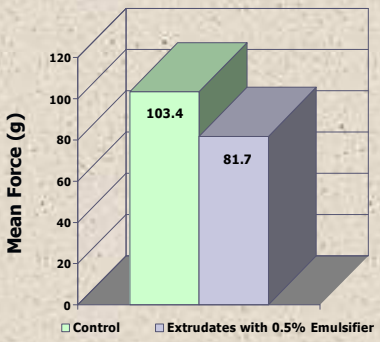
Figure 1. Corn Extrudates

Figure 2. Elastic (Young's) Modulus of Corn Extrudates



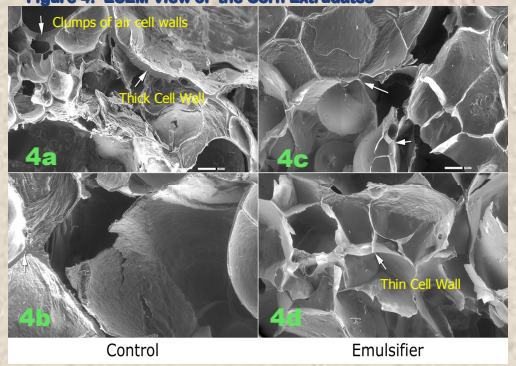
•Less force was required to deform extrudates from corn with emulsifier.
•Thus, cell walls from the extrudates with emulsifier are probably thinner.
•This can be correlated with the images in Fig. 4c

Figure 3. Mean – Force (g) to Puncture Extrudates



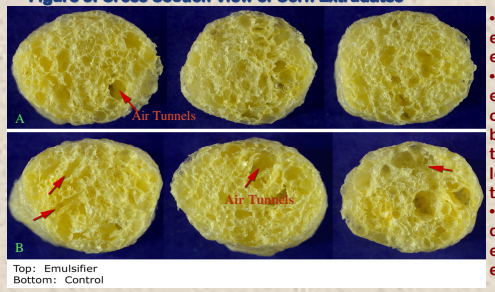
•Less force was required to puncture extrudates with emulsifier.
•Probably because lower elastic modulus, less distance required to break the cell wall.
•Extrudates with emulsifier were softer.

Figure 4. ESEM View of the Corn Extrudates



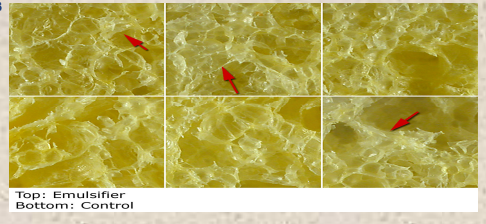
•Control sample had thicker cell walls, which contribute to a rougher texture compared to the emulsified samples. Indicated by the arrows in Figure 2. (top control picture)
•The smooth character of the emulsified air cells indicated that during melting the continuous phase had fewer lumps and more amorphous, which probably flowed better through the barrel than the control.
•Control extrudates had more clumps of air cell wall junctions (top control picture), several small air cells congregated together during drying and could create a tough spot that will be present in the bite of the product.
•Extrudates containing the emulsifier had fewer tough spots and more even distribution of air cells.

Figure 5. Cross Section View of Corn Extrudates



•Air cells were slightly more evenly distributed in the emulsifier sample.
•There was a tunneling effect that was evident in the control causing air cells to become very elongated, traveling either longitudinally or radially throughout the collets.
•The tunneling effect was diminished in the collets with emulsifier, but not eliminated.

Figure 6. Marco View of Corn Extrudates



•Air cell walls in the extrudates containing the emulsifier were more translucent than the control, indicating the smoother surface texture and thinner cell walls.
•Control air cell walls were textured, reflecting light rather than allowing it to pass through, contributing to a more yellow appearance.

Conclusions

A 0.5% addition of the rice based emulsifier to degerminated yellow corn meal did effect the physical, texture, and microstructure. There was a decrease in bulk density. The addition of the rice based emulsifier produced extrudates with thinner cell wall structures, that are more evenly dispersed. Due to the thinner cell structure less force is needed to puncture the extrudates providing a soft and crisper texture. There was a reduction in clumping of air cell structures, and thickness in the cell walls. Rice based emulsifier diminished the tunneling effect creating a more uniform cell structure in the extrudates.