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Abstract
This experiment demonstrated no advantage in using a waxy sorghum over a conventional sorghum for steam flaking. Even though the waxy variety had a slight increase in in-vitro gas production after flaking, the benefit was outweighed by the significant increase in energy requirement and significant decrease in production rate during processing.

Keywords
Cattlemen's Day, 1999; Kansas Agricultural Experiment Station contribution; no. 99-339-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 831; Beef; Waxy sorghum; Steam flaking

THE EFFECT OF DECREASING SORGHUM AMYLOSE CONTENT ON STEAM-FLAKING PRODUCTION CHARACTERISTICS

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Summary

This experiment demonstrated no advantage in using a waxy sorghum over a conventional sorghum for steam flaking. Even though the waxy variety had a slight increase in in-vitro gas production after flaking, the benefit was outweighed by the significant increase in energy requirement and significant decrease in production rate during processing.

(Key Words: Waxy Sorghum, Steam Flaking.)

Introduction

Sorghum is considered to have a lower feeding value than corn. That difference can be largely equalized by steam flaking. In an attempt to improve the feeding value of sorghum, varieties with altered starch compositions have been developed. Conventional sorghum starch is about 25% amylose. Waxy varieties have an amylose content near 0% and a concomitant increase in amylopectin.

In-vitro gas production is a test that mimics rumen fermentation and is used commonly to measure the extent of improvement from processes such as steam flaking or grinding. Previous data showed dramatically higher in-vitro gas production for a waxy sorghum variety compared to a conventional sorghum variety. In addition to waxy varieties, new varieties have been developed with an amylose content lower than that of conventional varieties but higher than that of waxy varieties. These varieties are known as heterowaxy.

The purpose of this experiment was to determine the steam-flaking production characteristics and in-vitro gas production potential of heterowaxy and waxy sorghum grains in comparison to conventional sorghum grain.

Experimental Procedures

Four sorghum hybrids were obtained from NC+ Hybrids, Colwich, KS. The hybrids varied in amylose content, and the starch composition was verified by an endosperm iodine staining test. NC-262 was classified as conventional, and XFG-739 was classified as waxy. Varieties X-602 and XFG-665 were classified as heterowaxy.

The sorghum grains were cleaned prior to addition to a steam chamber located directly above a Roskamp Model K flaking mill equipped with a 25 hp drive motor. The 16.5 in. diameter × 11.7 in. wide rolls were driven at a differential of 1:1. They had a spiral of 1.5 in./foot of run and a pitch of 16.0 corrugations/in. The gap (.003 inches) was set to achieve an apparent density of 28.0 lbs./ft^3 using mill run sorghum prior to the start of the experiment. Prior to flaking, the sorghum was held in the steam chamber for approximately 45 minutes and exposed to steam until the temperature of the grain was approximately 185EF. Feed rate was set using mill run sorghum and was held con-

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stant for all treatments to allow for the collection of production data. Each variety was flaked independently in lots of approximately 1,500 lbs. Voltage and amperage were recorded to allow calculation of energy consumption. Samples were collected prior to cooling for the determination of apparent bulk density and in-vitro gas production. Data were analyzed with a one-way analysis of variance. Treatments were separated by the least significant difference test. Level of significance was established prior to the analysis at the 5% level.

Results and Discussion

The results of the experiment are reported in Table 1. As the amount of amylose in the endosperm decreased, production rate decreased. The waxy variety (XFG-739) had the lowest production rate and tended to stick to the rolls. This "sticking" may have contributed to the dramatically reduced production rate. The lower production rate also contributed to the increased energy requirement per ton processed in comparison to the conventional or heterowaxy varieties.

Although gas production from raw grain was slightly higher for the waxy variety, differences were not statistically significant. For flaked grain, one of the heterowaxy varieties (XFG-665) had a significantly higher gas production value than all others tested. When gas production was expressed on a percentage increase basis (raw grain vs. flaked grain), the waxy variety had the lowest increase. The variety with the highest increase was the heterowaxy, XFG-665. However, the dramatic increase in gas production potential probably was offset by the increased energy required.

The heterowaxy variety, XFG-665 produced a significantly more dense flake than the waxy variety. No differences occurred in dry matter contents of the four varieties after flaking.

Overall, the waxy sorghum grain required significantly more energy to process and had a dramatically lower production rate than the conventional variety. Both heterowaxy varieties supported greater production rates than the waxy variety, and the heterowaxy variety XFG-665 benefitted the most from flaking as assessed by in-vitro gas production.

Table 1. Steam Flaking Production Characteristics for Four Sorghum Varieties that Vary in Endosperm Amylose Content

	Variety				
Item	NC-262	X-602	XFG-665	XFG-739	SE
Iodine staining test classification	Normal	Heterowaxy	Heterowaxy	Waxy	
Amylose content[c], %	25.0	12.5	12.5	0.0	-
Production rate, lbs/hr	1,995[a]	1,786[a]	1,685[a]	1,203[b]	64.20
Energy consumption, kWh/ton	13.3[a]	15.3[a]	16.3[a]	21.0[b]	.48
Hot flake density, lbs/ft^3	27.8[a,b]	27.7[a,b]	29.0[a]	27.2[b]	.25
In-vitro gas production, ml gas/g DM					
Raw grain	5.48	6.22	5.15	6.52	-
Flaked grain	9.79[a]	10.49[a]	11.48[b]	9.91[a]	.14
Gas production increase, %	44.0	40.7	55.1	34.2	-
Dry matter, %	85.1	85.8	84.2	84.2	-

[a,b]Means within the same row with differing superscripts vary significantly (P<.05).
[c]Approximate percentage; based on information supplied by NC+ Hybrids.