Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 264

1983

Effect of particle size of corn and sorghum grain on performance and digestibility for weaned pigs

S J. Oh

G L. Allee

Keith C. Behnke

See next page for additional authors

Effect of particle size of corn and sorghum grain on performance and digestibility for weaned pigs

Authors

S J. Oh, G L. Allee, Keith C. Behnke, and C W. Deyoe

EFFECT OF PARTICLE SIZE OF CORN AND SORGHUM GRAIN ON PERFORMANCE AND DIGESTIBILITY FOR WEANED PIGS

Sang J. Ohh[1], Gary L. Allee, Keith C. Behnke,[1] and Charles W. Deyoe[1]

Summary

A 2 x 2 x 2 factorial experiment was conducted to evaluate the effects of two grain sources (corn or sorghum grain), two processing methods (hammer mill or roller mill), and two particle sizes (fine and coarse) on performance and nutrient digestibility of weaned pigs. Each grain was ground through a hammer mill with either a 1/8" (fine) or a 1/4" (coarse) screen. Average daily gain was not influenced by particle size, grain source or method of processing. Feed intake tended to increase as particle size increased, with the lowest feed intake on the fine particle size hammer-milled diet. Feed conversion improved as particle size decreased with both grain sources. Digestibilities of dry matter, nitrogen and energy improved as particle size decreased with both corn and sorghum grain.

Introduction

Reduction in particle size of cereal grains by the use of mechanical force to break the kernel by cracking, crimping, rolling or grinding increases the surface area and results in improved digestibility and pig performance. Hammer milling is probably the most commonly used method to reduce the particle size of cereal grains for swine. However, roller mills are also used. Little information is available on the effects of the hammer mill vs the roller mill on nutritional value of cereal grains for swine.

The purpose of this study was to investigate the effects of particle size of two grains, corn and sorghum grain, processed either by a hammer mill or a roller mill, on performance and digestibility of nutrients by weaned pigs.

Experimental Procedures

Corn and sorghum grain were ground by either a hammer mill or a roller mill to obtain two different particle sizes. Each grain was ground through a hammer mill with either a 1/8" (fine) or a 1/4" (coarse) screen. Each grain was also rolled either coarse or fine by adjusting roll width and feeding rate.

Particle size distribution of each processed grain was measured by sifting the grains through stepwise screens with a shaker. Modulus of fineness, average particle size diameter and geometric surface area per gram were determined.

---

[1]Department of Grain Science and Industry.

For the growth trial, 192 crossbred weaned pigs weighing 15 to 18 pounds each were assigned randomly to 32 pens, with six pigs per pen and four replications of the eight treatments. Feed and water were supplied ad libitum for the six week trial.

Digestibility was determined with 24 pigs weighing 15 to 18 pounds each housed in individual cages. After an eight day adjustment period, feces were collected for six days.

Results and Discussion

A summary of the particle size analysis of the various diets is shown in Table 1. The coarse grinding and fine roller-mill processing resulted in similar mean particle size diameters. Hammer-mill processing resulted in a larger number of fine particles.

The effects of grain source and particle size on the performance of young pigs is shown in Table 2. Average daily gain was not influenced by particle size, grain source, or method of processing. The lowest average daily gain was observed on the coarse particle size, roller-milled sorghum diet. Feed intake tended to be greater on the roller-mill processed diets. Processing the grains with the roller mill resulted in fewer fine particles, which may be more acceptable to pigs.

Feed conversion improved ($P<.05$) as the particle size decreased, regardless of grain type. Digestibilities of dry matter, nitrogen and energy were improved ($P<.05$) as particle size decreased with both corn and sorghum grain (Table 3 and 4). Increased surface area and increased mixing of digesta with secretions may account for the improvement in digestibility and feed efficiency. These data suggest that particle size of the grain will have more of an effect on digestibility and feed efficiency than method of particle size reduction.

Table 1. Particle Size Analysis of Corn and Sorghum Based Diets.

Grain	Mill type	Particle size classif.	Mean particle diameter	Geometric standard deviation	Surface area (cm^2/gm)	Modulus of fineness[a]	Fine particle proportion[b] (%)
Corn	Hammer mill	Fine	624	2.26	87	2.50	5.6
		Coarse	877	2.25	67	3.17	1.8
	Roller mill	Fine	822	2.04	73	2.95	1.3
		Coarse	1147	1.99	47	3.59	0.8
Sorghum	Hammer mill	Fine	539	2.10	97	2.23	8.8
		Coarse	722	2.07	79	2.70	2.7
	Roller mill	Fine	885	1.81	61	3.32	0.4
		Coarse	1217	1.74	45	3.70	0.3

[a]Data based on corn or sorghum only before making diet.
[b]Proportion of finer particles less than .145 mm in diameter.

Table 2. Effect of Particle Size of Corn and Sorghum Based Diets on Starter Pig Performance

Grain	Mill type	Particle size classification	Mean particle size diameter (μ)	Average daily gain (kg)	Daily feed intake[a] (kg)	Feed/gain[a]
Corn	Hammer mill	Fine	624	.460	.783	1.70
		Coarse	877	.450	.802	1.78
	Roller mill	Fine	822	.464	.841	1.81
		Coarse	1,147	.473	.905	1.92
Sorghum	Hammer mill	Fine	539	.437	.779	1.78
		Coarse	722	.453	.813	1.79
	Roller mill	Fine	885	.452	.866	1.92
		Coarse	1,217	.428	.827	1.94

[a]Mill type significant ($P<.05$).

Table 3. Effect of Particle Size of Corn and Sorghum on Apparent Digestibilities

Grain	Mill type	Particle size	Digestibilities (%) DM	N	GE	dgw
Corn	Hammer mill	F	87.3[a]	87.5[a]	87.4[a]	624
		C	84.2[d]	81.2[c]	83.5[bc]	877
	Roller mill	F	87.0[ab]	86.0[a]	87.1[a]	822
		C	85.8[bc]	83.6[b]	85.1[b]	1,147
Sorghum	Hammer mill	F	84.9[cd]	78.2[d]	84.1[bc]	539
		C	84.7[cd]	77.8[d]	84.1[bc]	722
	Roller mill	F	83.7[d]	76.8[d]	82.8[c]	855
		C	81.7[e]	74.5[e]	80.2[d]	1,217

Table 4. Effect of Particle Size on Nutrient Digestibility and Feed Efficiency

Particle size (u)	Digestibilities (%) DM[a]	N[a]	GE[a]	Feed:gain[a]
< 700	86.1	82.9	85.8	1.74
700 to 1,000	84.9	80.5	84.4	1.82
> 1,000	83.7	79.1	82.6	1.93

[a]Linear effect (P<.05).