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## Effect of processing on physical characteristics, handling properties and utilization of wheat middlings

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## EFFECT OF PROCESSING ON PHYSICAL CHARACTERISTICS, HANDLING PROPERTIES AND UTILIZATION OF WHEAT MIDLINGS

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### Summary

Wheat middlings were pelleted and ground through different types of grinders. The resulting products were incorporated into finishing pig diets and a digestion trial was conducted to determine the effect of processing on nutrient utilization. Pelleting and grinding midds prior to use in pelleted finishing diets improved pelleting throughput and efficiency. Results of the digestion study showed there were no detrimental effects on nutrient utilization because of processing. This, along with reduced shipping costs and improved handling characteristics, indicate that pelleting wheat midds at the flour mill would be beneficial to the feed industry and could result in lower feed costs for the swine producer.

### Introduction

Wheat millfeeds are second only to soybean meal as the by-product most used in feed manufacturing. Higher protein and a lower price make wheat middlings most competitive with corn as a feed ingredient. Although the cost of wheat middlings is often favorable at the flour mill, the cost of shipping can substantially increase the cost to the feed mill because of the low bulk density. Pelleting can increase the bulk density and improve the handling characteristics of feed ingredients that are too bulky to flow easily. Pelleting of swine diets also has been shown to improve gain and feed efficiency when compared to unpelleted diets.

The purpose of this study was to investigate the effects of pelleting and grinding on the physical characteristics and handling properties of wheat middlings, and their subsequent utilization by finishing pigs. Processing parameters, such as production rate and electrical efficiency, were carefully monitored in order to determine costs associated with each processing step.

### Procedures

A portion of a single identifiable batch of wheat middlings was pelleted. Pelleted midds then were ground through a hammermill, roller mill, or pin mill. Grinding parameters, including throughput and energy consumption, were measured. All diets were pelleted through a 3/16 X 1 1/2 in straight bore die. Pelleting parameters monitored included motor load, conditioned mash temperature, throughput, energy efficiency, and pellet quality.

A digestion trial was conducted in which 16 crossbred barrows averaging 152 lb were randomly assigned to one of four dietary treatments (Table 1). Treatments were designated as (1) control (no grinding), (2) pelleted and ground through a hammermill (PHMG); (3) pelleted and ground through a roller mill (PRMG), and (4) pelleted and ground through the pin mill (PPMG).

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Pigs were placed in individual crates and were acclimated to diets and cages for 7 days. Five days of collection, using a marker to marker technique, followed the adaptation period.

Pigs were then reassigned, with one pig remaining on the same diet and the other three assigned to different diets. After a 5-day adaptation period, a second collection was made.

Samples of the midds, feed, and feces were analyzed for dry matter, protein, ash, crude fiber, acid detergent fiber, neutral detergent fiber, and gross energy.

### Results and Discussion

Pelleting parameters are presented in Table 2. Production rates of all diets made from pre-processed midds were higher than that of the control diet. Less energy was required for the PHMG and PRMG diets than for the control; but, the control and PPMG treatments required equivalent amounts of energy. Pellet quality was good for all treatments, although, values were higher than those normally seen in finishing swine diets because of the high level of wheat midds in the diet.

Apparent nutrient digestibilities are given in Table 3. There were no differences ( $P < .05$ ) between treatments in apparent digestibility of dry matter, gross energy, or NDF. There was no difference ( $P < .05$ ) in apparent protein digestibility between the control, PRMG, and PPMG treatments. Although protein digestibility of the PHMG treatment was greater ( $P < .05$ ) than that of the control, it did not differ significantly from any of the other treatments.

Apparent crude fiber digestibility of the PPMG diet was greater ( $P < .05$ ) than that of any other diet. There were no significant differences in apparent crude fiber digestibility between the control, PHMG, and PRMG diets. Crude fiber digestibility of the PRMG diet was higher than that of the PHMG diet.

Apparent ADF digestibility of the control and PPMG diets did not differ ( $P < .05$ ) and were greater than those of the PHMG and PRMG diets. The PHMG and PRMG diets did not differ significantly. In all cases, digestibility of nutrients from diets containing pre-processed midds was greater than or no different from that of the control diet.

Table 1. Composition of Diets Made from Pelleted-Reground Wheat Midds for Finishing Pigs

Ingredient	International Reference No.	% <sup>a</sup>
Wheat midds, (control, PHMG, PRMG, PPMG)	4-05-205	50.0
Sorghum, ground	4-20-893	43.8
Soybean meal, 44%	5-20-637	3.3
Limestone, minimum 38% Ca	6-01-069	1.7
Salt	6-04-152	0.2
Premix <sup>b</sup>		1.0

<sup>a</sup>Values expressed on an as-fed basis.

<sup>b</sup>Contributed the following per kilogram of diet: A, 4400 IU; D<sub>3</sub>, 330 IU; E, 22 IU; Riboflavin, 5 mg; d-Pantothenic acid, 13.4 mg; Niacin, 27.9 mg; B<sub>12</sub>, 24.5 g; Menadione sodium bisulfite, 1.7 mg; Zn, 100 mg; Fe, 100 mg; Mn, 100 mg; Cu, 10 mg; I, 3 mg; Ca, 50 mg maximum; Lysine, 0.8 gm as lysine HCl (98%); Tylosin, 44 mg.

Table 2. Production Parameters of Finishing Swine Diets Containing Pelleted-Reground Wheat Midds

Treatment	Motor load (%)	Mash temp (C)	Production rate (lb/hr)	Electrical efficiency (kwh <sup>a</sup> /ton)	PDI <sup>b</sup> (%)
Control	60-65	75	3421	7.06	96.8
PHMG	65-70	75	3826	6.94	96.5
PRMG	65-70	75	3707	6.84	94.6
PPMG	65-70	75	3762	7.06	97.0

<sup>a</sup>Kilowatt hr.

<sup>b</sup>Whole pellets remaining after tumbling for 15 min.

Table 3. Effect of Processing on Apparent Digestibilities of Dry Matter, Protein, Energy, Crude Fiber, ADF, and NDD in Swine Finishing Rations Made from Hammermilled, Roller Milled, or Pin Milled Wheat Midds<sup>a</sup>

Parameter	Processing Treatment			
	Control	PHMG	PRMG	PPMG
	----- % -----			
Dry matter	75.1 <sup>b</sup>	76.1 <sup>b</sup>	75.5 <sup>b</sup>	74.7 <sup>b</sup>
Protein	72.1 <sup>b</sup>	76.6 <sup>c</sup>	74.7 <sup>bc</sup>	73.0 <sup>bc</sup>
Gross energy	74.9 <sup>b</sup>	76.7 <sup>b</sup>	75.3 <sup>b</sup>	74.7 <sup>b</sup>
Crude fiber	34.2 <sup>bc</sup>	28.3 <sup>b</sup>	37.4 <sup>c</sup>	45.8 <sup>d</sup>
ADF	42.2 <sup>ab</sup>	41.7 <sup>c</sup>	40.4 <sup>c</sup>	46.8 <sup>b</sup>
NDF	53.2 <sup>b</sup>	51.3 <sup>b</sup>	50.1 <sup>b</sup>	53.5 <sup>b</sup>

<sup>a</sup>Dry matter basis.

<sup>bcd</sup>Means in the same row that do not share a common superscript letter differ (P<.05).