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K**S****U****THE EFFECTS OF BARLEY PARTICLE SIZE
ON FINISHING-PIG PERFORMANCE**R.D. Goodband and R.H. Hines

Summary

Two trials utilizing 280 finishing pigs were conducted to evaluate the effects of barley particle size on finishing-pig performance. In Experiment 1, pigs fed barley ground through a hammermill with a 1/8-in screen were not different in average daily gain (ADG) or feed efficiency (F/G) from pigs fed a milo-based diet ground through a 3/16-in screen. Pigs fed either 3/16 or 1/4-in ground barley grew slower and were less efficient ($P<.02$) than those fed either the milo or finely ground barley diet. Experiment 2 was conducted in a similar manner, with the exception that mill run barley was used instead of a specific variety. In Experiment 2, ADG and average daily feed intake (ADFI) were not different between dietary treatments. This response resulted in a trial x treatment interaction for these criteria. Results for feed efficiency were similar to those in Experiment 1; pigs fed 3/16 or 1/4-in ground barley diets were less efficient ($P<.02$) than those fed 1/8-in ground barley or 3/16-in ground milo. These results suggest that the variety of barley is an important criteria in determining feeding value for finishing-pigs, and that reducing particle size of the diet by fine grinding improves feed efficiency.

Introduction

Barley production in Kansas has risen dramatically in the past 3 years. As a result, barley is more available as a grain substitute in swine diets. Recent studies at Kansas State indicate that adding fat to or pelleting barley finishing diets results in pig performance similar to that from a milo-soybean meal finishing diet. In these experiments, it was noted that the ground barley diets contained a large portion of unground hulls and were dustier than the milo-based diets. Therefore, it was felt that the particle size of the barley might influence its acceptability by pigs and, therefore, affect pig performance. The objective of this study was to evaluate the performance of pigs fed finishing diets composed of barley processed through a hammermill equipped with either a 1/8, 3/16, or 1/4-in screen.

Experimental Procedures

In experiment 1, 120 finishing pigs averaging 102.8 lbs were assigned to one of four dietary treatments. Treatments included a control diet (14% crude protein, .6% lysine) based on 3/16-in ground milo or an equal substitution of milo by barley that was ground through a hammermill equipped with either a 1/8, 3/16, or 1/4-in screen (Table 1). The variety of barley used was Kanby, a 6-row, feed-grade variety. There were 10 pigs/pen with 3 pens/treatment. Pigs were weighed at 3-

week intervals, and feed intake and feed efficiency were determined. Feed and water were provided ad libitum. The trial was conducted from August 20 through October 21, 1985 (63 days). On the last day of the experiment, pigs were probed for last rib fat depth with a Scanoprobe.

In Experiment 2, 160 finishing pigs averaging 83.7 lbs were assigned to the same four dietary treatments used in Experiment 1. There were 10 pigs/pen and 4 pens/treatment. The trial was conducted from July 9 through September 19, 1986 (71 days). All other procedures were as outlined in Experiment 1, with the exception that mill run barley from an out of state elevator was used. Two ground grain and feed samples were obtained from each trial for particle size analysis according to the procedures of the American Society of Agricultural Engineers Handbook.

Results and Discussion

Particle size analysis of the ground grain and diets is presented in Tables 2 and 3, respectively. Decreasing hammermill screen size resulted in decreased mean particle size and increased surface area of both ground grain and mixed diets. The 1/8-in ground barley and the 3/16-in ground milo control diet had similar particle size and surface area.

Results of finishing Experiments 1 and 2 are presented in Table 4. There was a trial x treatment interaction ($P < .02$) between experiments for ADG and ADFI. This may have been a result of the different varieties of barley used in each experiment. The barley in Experiment 1 was Kanby (46 lb/bu test wt), whereas mill run barley (48 lb/bu test wt) was utilized in Experiment 2. In Experiment 1, pigs fed barley processed through a 1/8-in screen were not different in ADG from those pigs fed the milo diet ground through a 3/16-in screen. Pigs fed barley diets processed through a 3/16 or 1/4-in screen grew slower than pigs fed either the milo or finely ground barley diets. In Experiment 2, processing had no effect on ADG, since pig performance between treatments was similar. ADFI was highest ($P < .02$) for pigs fed the milo control diet in Experiment 1, but no differences were observed in ADFI in Experiment 2.

There were no trial x treatment interactions between Experiments 1 and 2 for feed efficiency or last rib fat depth, therefore, these results were pooled. Pigs fed finely ground barley were similar in F/G to those fed the milo control diet, whereas pigs fed 3/16 or 1/4-in ground barley were less efficient ($P < .02$). Regression analysis of pigs fed fine, medium, and coarsely ground barley diets revealed a quadratic effect ($P < .01$) of barley particle size on feed efficiency. Last rib fat depth was unaffected by dietary treatment.

Fine grinding of barley decreases the particle size of the diet and increases its surface area. Therefore, the improvement in feed efficiency for pigs fed finely ground barley may reflect the possible increase in nutrient digestibility resulting from greater surface area interaction of the feedstuff with digestive enzymes.

Fine grinding of grains has been associated with several disadvantages. These include reduced feed intake, increased incidence of gastric ulcers, and

decreased mill capacity. In this study, feed intake was not reduced by grinding barley through a 1/8 in screen, nor did gastric ulcers appear to be a problem, since pig health was very good during both trials. However, mill capacity was decreased approximately 50% when barley was processed through a 1/8-in screen compared to a 1/4-in screen. The extra energy costs involved with fine processing need to be considered against the expected improvement in feed efficiency.

The results of these studies indicate that the variety of barley is an important factor in assessing its feeding value for swine. Furthermore, reducing the particle size of barley-based diets by fine grinding improves their feeding value for finishing pigs.

Table 1. Composition of Finishing Diets.^a

Ingredients, %	Treatments	
	Milo	Barley
Milo	81.85	—
Barley	—	82.05
Soybean meal (44%)	15.0	15.0
Dicalcium phosphate (21% P)	1.25	.85
Limestone	.95	1.15
Salt	.50	.50
Trace mineral premix ^b	.10	.10
Vitamin premix ^c	.25	.25
Antibiotic	.10	.10
	100.00	100.00

^aMilo was processed through a hammermill with a 3/16-in screen.

Barley was processed through a hammermill with either a 1/8, 3/16, or 1/4-in screen.

^bContaining 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I, and 0.1% Co.

^cEach lb of premix contains the following: vitamin A 4000,000 IU, vitamin D 30,000 IU, vitamin E 2,000 IU, riboflavin 450 mg d-pantothenic acid 1,200 mg, choline 40 g, niacin 2,500 mg B₁₂ 2.2 mg, menadione dymethylpyrimidinol bisulfite 250 mg.

^dAntibiotic contained 44 g cholortetracycline, 44 g sulfamethazine and 22 g penicillin per kg.

Table 2. Particle Size Analysis of Ground Milo and Barley Grain.

Item	Grain: Screen Size, in:	Treatments			
		Milo 3/16	Barley 1/8	Barley 3/16	Barley 1/4
Particle size diameter (microns)		756.3	663.1	850.8	1278.5
Surface area (cm ² /g)		82.1	82.1	69.3	45.1

Table 3. Particle Size Analysis of Milo and Barley Diets.

Item	Grain: Screen Size, in:	Treatments			
		Milo 3/16	Barley 1/8	Barley 3/16	Barley 1/4
Particle size diameter (microns)		698.1	714.5	902.3	1146.5
Surface area (cm ² /g)		86.7	76.0	61.1	49.5

Table 4. Effect of Barley Particle Size in Finishing Diets^a.

Item	Grain: Screen Size in:	Treatments			
		Milo 3/16	Barley 1/8	Barley 3/16	Barley 1/4
<u>Average daily gain, lbs</u>					
Experiment 1 ^b		2.06 ^c	1.96 ^c	1.80 ^d	1.78 ^d
Experiment 2		1.70	1.71	1.70	1.70
<u>Average daily feed intake, lbs</u>					
Experiment 1 ^b		6.94 ^c	6.49 ^d	6.21 ^d	6.51 ^d
Experiment 2		5.72	6.11	6.29	6.19
<u>Feed efficiency^e</u>					
Experiments 1 & 2		3.39 ^c	3.45 ^c	3.63 ^d	3.70 ^d
<u>Last rib fat depth, in^f</u>					
Experiments 1 & 2		.79	.76	.74	.76

^aA total of 280 finishing pigs, 10 pigs/pen with 7 pens/treatments average initial wt 93.0 lbs, average final wt 212.6 lbs.

^bTrial x treatment interaction (P<.02).

^{cd}Means on the same row with different superscripts differ (P<.02).

^eQuadratic barley particle size effect (P<.01).

^fAverage final wt was used as a covariate.