Kansas Agricultural Experiment Station Research Reports

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

Article 311

1985

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Recommended Citation

Goodband, Robert D. and Hines, Robert H. (1985) "Effect of barley in starter diets for swine," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 10. https://doi.org/10.4148/2378-5977.6151

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Abstract

Two-hundred and forty weanling pigs averaging 14.0 lbs. were utilized in two growth trials to evaluate the effects of increasing levels of barley in the diet. Milo was replaced by barley pound for pound at levels of 10, 20, 30, and 40% of the diet. Neither average daily gain, feed intake, nor feed efficiency were affected by the increasing levels of barley. These results indicate that barley may replace all of the milo in a 20%-whey nursery diet.; Swine Day, Manhattan, KS, November 21, 1985

Keywords

Swine day, 1985; Kansas Agricultural Experiment Station contribution; no. 86-145-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 486; Swine; Barley; Starter diets

EFFECT OF BARLEY IN STARTER DIETS FOR SWINE

Robert D. Goodband and Robert H. Hines

Summary

Two-hundred and forty weanling pigs averaging 14.0 lbs. were utilized in two growth trials to evaluate the effects of increasing levels of barley in the diet. Milo was replaced by barley pound for pound at levels of 10, 20, 30, and 40% of the diet. Neither average daily gain, feed intake, nor feed efficiency were affected by the increasing levels of barley. These results indicate that barley may replace all of the milo in a 20%-whey nursery diet.

Introduction

With gradual decreases in ground water reserves and increasing irrigation costs, more farmers are turning to dryland crop production. Barley is one alternative in this type of cropping program, and is gaining in popularity across the state. Barley requires the same amount of rainfall as wheat, yet can out-yield wheat by 25%. Winter barley also can be harvested about two weeks earlier than wheat, thus allowing for more double-crop possibilities. This study was conducted to evaluate the level at which barley could be substituted for milo in starter diets.

Experimental Procedure

In Experiment 1, 140 pigs weaned at approximately 21 days of age and averaging 13.8 lbs. were allotted randomly to one of five dietary treatments with seven pigs per pen and four replicates per treatment. The basal diet consisted of milo-soybean meal with 1.25% lysine and 20% whey (Table 1). Barley then was substituted pound for pound for milo at levels of 10, 20, 30, and 40% of the diet. Feed and water were supplied ad libitum. Pigs were weighed and feed intake and feed efficiency were determined weekly for the duration of the 5 week trial. Experiment 2 was conducted in a similar manner, except that the pigs' inital weight averaged 14.1 lbs. and there were five replications per treatment with four pigs per pen. In both experiments, pigs were observed daily and given an average pen scour score based on 1=firm feces, 2=soft feces, 3=loose feces, and 4=watery feces.

Results and Discussion

Additions of up to 40% barley did not affect overall average daily gain, feed intake, or feed efficiency in either trial. However, in Experiment 1, there was a trend approaching significance ($P<.06$) towards increased feed efficiency with the 10 and 30% barley diets (Table 2). Feed efficiency would normally be expected to increase with increasing levels of fiber in the diet, but this increase would appear to be the result of numerical differences in daily gain and feed intake contributing to the trend, rather than actual treatment differences.

In Experiment 2, there was a significant decrease (P<.01) in feed intake and a corresponding decline (P<.02) in average daily gain at the highest level of barley during the first week. This might reflect the normal post-weaning inappetence compounded by a slight palatability problem. These pigs quickly compensated in the second week, and overall performance was equal to the control group (Table 3). Increasing fiber levels in the diet did not affect the overall incidence of scours. However, in Experiment 2, there was a significant increase (P<.03) in scours for the 20% barley diet during the first week. The results of these experiment indicate that barley may be substituted for all of the milo in starter diets without affecting overall performance.

Table 1. Composition of Nursery Diets.

	Treatments				
Ingredients	A	B	C	D	E
Milo	802	601	401	201	—
Barley	---	201	401	601	805
Soybean meal	640	640	640	640	640
Whey	400	400	400	400	400
Soy oil	80	80	80	80	80
Dical (21% P)	38	38	38	38	36
Limestone	16	16	16	16	16
L-Lysine HCL	6.5	6.5	6	6	6
Salt	3	3	3	3	3
T.M. premix[a]	2	2	2	2	2
Vitamin premix[b]	5	5	5	5	5
Se premix	3	3	3	3	3
$CuSO_4$	2	2	2	2	2
Antibiotic[c]	2	2	2	2	2
Calculated Analysis:					
% Protein	20.40	20.60	20.70	20.90	21.00
% Lysine	1.25	1.27	1.28	1.28	1.25
% C. fiber	3.16	3.60	4.02	4.45	4.88
% Ca	.81	.82	.82	.81	.79
% P	.70	.72	.73	.75	.74
ME Kcal/lb	1466	1454	1442	1430	1418

[a]Containing 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I, and 0.1% Co.
[b]Each lb of premix contains the following: vitamin A 400,000 IU, vitamin D 30,000 IU, vitamin E 2,000 IU, riboflavin 450 mg, d-pantothenic acid 1200 mg, choline 40 g, niacin 2500 mg, B_{12} 2.2 mg, menadione dymethylpyrimidinol bisulfite 250 mg, ethoxyquin 2850 mg.
[c]Cloretetracyline 50g/lb.

Table 2. Effect of Barley in Starter Diets. Experiment 1.

	Treatments				
Item	Barley: / Milo:	—- / 40%	10% / 30%	20% / 20%	30% / 10%	40% / —-
Average daily gain lbs.[a]		.89	.83	.86	.84	.86
Daily feed intake lbs.		1.39	1.41	1.31	1.35	1.37
Feed/gain		1.56[b]	1.68[c]	1.52[b]	1.61[bc]	1.59[b]
Scour score[d]		1.57	1.57	1.42	1.58	1.40

[a]Total of 140 pigs (7 pigs/pen with 4 pens/treatment), avarage initial wt. 13.8 lbs. and trial length was 5 wks.
[bc]Means on the same line with different superscripts differ (P>.06).
[d]Average daily pen scour score based on 1= firm feces, 2= soft feces, 3= loose feces, and 4= watery feces.

Table 3. Effect of Barley in Starter Diets. Experiment 2.

	Treatments				
Item	Barley: / Milo:	--- / 40%	10% / 30%	20% / 20%	30% / 10%	40% / —-
Average daily gain lbs.[a]		.98	.99	1.00	1.01	.97
Daily feed intake lbs.		1.47	1.51	1.49	1.59	1.46
Feed/gain		1.51	1.53	1.52	1.58	1.51
Scour score[b]		1.37	1.23	1.31	1.47	1.24

[a]Total of 100 pigs (4 pigs/pen with 5 pens/treatment), avarage initial wt. 14.1 lbs. and trial length was 5 wks.
[b]Average daily pen scour score based on 1= firm feces, 2= soft feces, 3= loose feces, and 4=watery feces.

Corn By-products

Corn gluten feed (CGF) is a by-product of wet milling of corn. Until recently, most corn gluten was exported. However, recently corn gluten feed has become readily available at an attractive price, which has generated numerous questions on its use in swine diets. As shown in Table 1, corn gluten feed contains about 22% protein and 10% fiber. Recent data from Iowa State suggest that corn gluten feed has about 77% the net energy of corn.

A recent report from Iowa State (Table 9) suggests that CGF could be used to replace corn as 25% of the diet for growing-finishing pigs without reducing performance and reduced cost of gain. A recent Illinois study (Table 10) evaluated CGF as an energy and amino acid source for growing-finishing pigs. This study demonstrated that CGF is deficient in lysine and tryptophan for finishing pigs.

Fats and Oils

Fats and oils such as tallow, lard, corn oil, and soybean oil contain over twice as much digestible energy as corn. In recent years, there has been a great deal of interest in the use of fats and oils in swine diets.

The addition of fat increases the energy density of the diet and, therefore, reduces feed intake. It is essential that the reduction in feed intake does not cause a deficiency of other nutrients, which will result in a reduction in gain and energy efficiency. Numerous studies at Kansas State have demonstrated the importance of energy to protein ratio when fat is added to swine diets.

Addition of fat to the diet of finishing pigs while maintaining a constant calorie:protein ratio increased daily gain and improved feed efficiency (Table 11). Calorie:protein ratio had a significant ($P<.05$) effect on daily gain, feed efficiency, and loin-eye area.

Data from Nebraska demonstrated that adding 2.6, 5.2, or 7.9% tallow to a corn-soybean diet containing 14% protein and .7% lysine resulted in a linear improvement in daily gain and feed efficiency (Table 12). The lack of improvement in performance at the higher levels of added fat (10.5 and 13.0%) was probably due to another nutrient in the diet limiting performance, since feed intake was reduced by one pound per day by the addition of 13% fat.

Recently, Kentucky and Georgia have reported that the greatest benefits from added fat occur during periods of heat stress. Fat reduces the heat increment of the diet and, therefore, should help minimize the reduction in feed intake normally observed during summer months.

In addition to the beneficial effects of adding fat on rate and efficiency of gain, recent studies from Nebraska have demonstrated that 5% added fat resulted in marked reduction in dust concentration and particulate matter in MOF finishing buildings.

Since adding fat improves performance of growing-finishing pigs, the decision on the use of fat becomes one of economics. What level of added fat gives the lowest feed cost per unit of gain? Most studies with growing-finishing pigs have evaluated 3 to 6% added fat. A summary of the percentage improvement in gain and feed efficiency from adding various levels of fat is shown in Table 13.

What can you afford to pay for added fat in the diet of growing-finishing pigs? The answer to the question depends on what assumption you make on the benefits of added fat. The data in Table 14 provide an estimate for the added value of diets containing fat, based on various costs of feed with either 2½ or 5% added fat.

Fat is a difficult ingredient to use in most on-the-farm feed mixing systems. Several "dried-fat" products are commercially available to reduce the problems of adding liquid fat. These products are normally more expensive than liquid fat. Recent studies at Kansas State have demonstrated that dried fat products vary considerably in digestibility. This difference between fat products may be related to fatty acid composition and/or method of processing to produce a free flowing product.

Swine producers should not hestitate to use alternative energy sources in swine diets when it is economically feasible. However, we must understand the nutrient limitation, effects on palatability, unique processing and mixing problems of these alternative energy sources.

Table 1. Nutritive Comparisons.

Item	Corn	Milo	Wheat	Wheat Midds	Corn Gluten Feed	Dried Bakery Product	Hominy Feed
Crude protein, %	8.8	8.9	12	16.0	22.0	8.5	10.0
Fat, %	3.8	2.8	1.9	3.0	2.5	10.0	6.9
Crude fiber, %	2.2	2.3	2.4	7.0	10.0	1.6	6.0
ME, kcal/lb	1511	1468	1463	1336	1150	1650	1529
Lysine, %	.24	.22	.35	.69	.63	.32	.40
Tryptophan, %	.05	.10	.18	.20	.10	.04	.10
Threonine, %	.39	.27	.37	.49	.89	.60	.40
Calcium, %	.02	.03	.05	.12	.40	.10	.04
Phosphorus, %	.28	.28	.37	.90	.80	.19	.50

Table 2. Corn vs Sorghum for Growing-Finishing Pigs.[a]

Item	Corn	Sorghum
Daily gain, lb	1.60	1.57
Feed/gain	3.33	3.44

[a]Cromwell, G.L. 1984. A summary of 10 experiments (Kentucky, Kansas, and Texas Tech), 508 pigs, 51 to 221 pounds.

Table 3. Corn vs Wheat for Growing-Finishing Pigs.[a]

Item	Corn	Wheat
Daily gain, lb	1.67	1.68
Feed/gain	3.19	3.17

[a]Cromwell, G.L. 1984. A summary of 15 experiments (Kentucky, Kansas, and Texas Tech), 984 pigs, 47 to 215 pounds.

Table 4. Soft Versus Hard Wheat for Finishing Pigs.[a]

			Wheat Type			
			Hard		Soft	
Trial	No. Pigs	Initial-Final wt, lb	ADG,lb	F/G	ADG,lb	F/G
1	54	135-266	1.79	3.67	1.86	3.69
2	1.66	148-229	1.66	3.92	1.66	3.94
3	1.88	146-215	1.88	3.29	1.79	3.46

[a]Hines, R.H. 1982.

Table 5. Effect of Test Weight of Wheat on Performance of Finishing Pigs.[a]

	Bushel Wt, lb			Milo +
Item	59	51	45	45 lb Wheat
Daily gain, lbs	1.78	1.79	1.81	1.76
Daily feed intake, lbs[b]	6.53	6.98	7.16	6.87
Feed/gain[b]	3.67	3.91	3.97	3.89

[a]Hines, R.H. 1982. Each mean was an average of 6 pens of 3 pigs; average initial wt. 135 lb.; average final wt, 266 lb.
[b]Linear effect of bushel weight ($P<.05$).

Table 6. Performance of Finishing Pigs Fed Dried Bakery Products.[a]

Criteria	Dried Bakery Product, %			
	0	10	20	30
Daily gain, lb	1.51	1.59	1.58	1.57
Daily feed intake, lb	5.16	5.01	4.98	5.01
Feed/gain[b]	3.42	3.23	3.15	3.19

[a]Allee, G.L. 1977. Average initial weight 95.9 pounds. Final weight 219.5 pounds.

[b]Significant (P<.05) linear effect.

Table 7. Performance of Growing-Finishing Pigs as Influenced by Level of Wheat Midds.[a]

Item	Wheat Midds, %			
	0	20	40	60
Daily gain, lb				
Grower[b]	1.69	1.63	1.54	1.54
Finisher[b]	1.96	1.85	1.85	1.78
Overall[b]	1.78	1.69	1.65	1.65
Daily feed, lb				
Grower	4.27	3.82	4.03	3.93
Finisher	6.18	6.12	6.31	6.14
Overall	4.95	4.71	4.80	4.77
Feed/gain				
Grower	2.52	2.35	2.61	2.56
Finisher[b]	3.16	3.31	3.42	3.45
Overall[b]	2.78	2.78	2.90	2.89

[a]Erickson, J.P. et al. 1985.

[b]Linear effect of wheat midds (P<.01).

Table 8. Performance of Finishing Pigs Fed Wheat Bran.[a]

Item	% Wheat Bran				
	0	10	20	30	40
Daily gain, lb	1.62	1.54	1.56	1.58	1.41
Daily feed intake, lb	5.73	5.24	5.43	5.78	5.36
Feed/gain	3.54	3.40	3.48	3.66	3.80

[a]Hines, R.H. 1980. Wheat bran replaced milo. Average initial weight, 132 lb; final weight, 215 pounds.

Table 9. Corn Gluten Feed for Growing-Finishing Pigs.[ab]

Item	Corn Gluten Feed, %		
	0	25	50
Feed intake, lb	4.98	4.77	4.54
Daily gain, lb	1.85	1.79	1.41
Feed/gain	2.69	2.66	3.22
Ration cost ($/ton)	109.20	103.00	97.60
Feed cost/lb gain (¢1 lb)	14.69	13.70	15.71

[a]Honeyman and Zimmerman, 1985.

[b]Pigs from 80 to 130 pounds. Assuming $2.66/bu. corn; $130/ton SBM and $75/ton for corn gluten feed.

Table 10. Corn Gluten Feed for Growing-Finishing Pigs.[a]

% CGF	0	10	20	40	40
AA Added	—	Lys	Lys	Lys	Lys + Trp
Daily gain, lb	1.76	1.66	1.63	1.14	1 .59
Daily feed, lb	6.62	6.56	6.36	5.63	6.38
Feed/gain	3.76	3.95	3.90	4.94	4.01

[a]University of Illinois, 1985.

Table 11. Effect of Fat Level and Calorie:Protein Ratio on Performance of Finishing Pigs.[a]

Added fat, %	0	3	6	9	9
Calorie:protein ratio	24	24	24	24	29
Daily gain[b,c], lb	1.52	1.65	1.61	1.72	1 .58
Feed intake[b], lb	5.44	5.34	5.10	5.02	5.32
Feed/gain[b,c]	3.65	3.30	3.18	2.92	3.31

[a]Allee, G.L. 1976. Each value is the mean for three replicate pens of eight pigs each; pigs averaged 116 pounds initially.

[b]Fat level significant ($P<.05$).

[c]Calorie:protein ratio significant ($P<.05$).

Table 12. Effect of Adding Fat to Growing-Finishing Diets.[a]

Fat added, %	0	2.6	5.2	7.9	10. 5	13.0
ME (kcal/lb)	1474	1526	1578	1630	1683	1735
Daily gain, lb	1.59	1.63	1.65	1.68	1.69	1.62
Daily feed, lb	5.67	5.49	5.25	5.16	4.81	4.67
Feed/gain	3.57	3.37	3.18	3.07	2.85	2.88
Backfat, in	1.43	1.32	1.37	1.41	1.41	1.49

[a]Moser, B.D. 1977. All diets contained 14% protein and .7% lysine.

Table 13. Response (Percentage Improvement) of Growing-Finishing Pigs to Added Fat.[a]

Response	Added fat, %				
	2.5	3	4	5	6
Gain	0-4	6.0	4.6	5.6	6.2
Feed/gain	6.0	9.5	9.0	10.7	12.9

[a]Summary of 21 experiments.

Table 14. Additional Value ($/100#) of a Pig Diet With Added Fat.

Cost of feed ($/100#)	Fat added, %	
	2 1/2	5
5	.32	.56
6	.39	.66
8	.52	.89
10	.65	1.11
12	.78	1.33

Assumptions:
Pigs from 50 - 230 lbs
3.2 feed conversion
F/G improvements
2 1/2% added fat = 6%
5% added fat = 10%