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EFFECTS OF ADDING WHEAT MIDDS TO LOW CRUDE PROTEIN, AMINO ACID SUPLEMENTED DIETS ON GROWTH PERFORMANCE AND CARCASS TRAITS OF FINISHING PIGS

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Story in Brief

An experiment was conducted using 96 pigs, initially weighing 60 lb, to evaluate the effects of adding wheat midds to low crude protein, amino acid supplemented diets on growth performance, carcass traits, and plasma urea nitrogen (PUN) of finishing pigs. Pigs were blocked by birth weight, sex, and litter and allotted randomly to four dietary treatments (6 reps of 4 pigs/pen). Dietary treatments were 1) fortified corn-soybean meal (Control), 2) as Diet 1 with crude protein lowered by four percentage units and supplemented with lysine, threonine, methionine, and tryptophan (LPAA), 3) as Diet 2 plus 10% wheat midds, and 4) as Diet 2 with 20% wheat midds. Wheat midds (.64% lysine) were added to the LPAA diets at the expense of corn and soybean meal. Lysine HCl was added to make all diets isolysinic, and threonine, methionine, and tryptophan were added to Diets 2 to 4 on an ideal basis. Growth rate was reduced by feeding the LPAA diet. Addition of wheat midds to the low crude protein, amino acid supplemented diet did not affect growth performance. Pigs fed the low protein, amino acid diets had smaller longissimus muscle area, but 10^{th} rib fat depth and percent lean were not affected by diet. Pigs were bled at the end of each phase for determination of plasma urea nitrogen. Reducing crude protein and adding amino acid reduced plasma urea nitrogen, but addition of wheat midds did not affect plasma urea nitrogen. These data suggest that reducing crude protein by four percentage units and adding amino acid reduces growth rate of finishing pigs; however, the addition of 10 or 20% wheat midds to a LPAA diet had little effect on growth performance, carcass traits, or plasma urea nitrogen.

Key Words: Pigs, Amino Acids, Growth Performance, Carcass Traits

Introduction

It is well known that the crude protein concentration of diets for growing-finishing swine can be reduced by two percentage units with the addition of crystalline lysine without sacrificing growth performance. Reduction of dietary protein by more than two percentage units requires addition of crystalline methionine, threonine, and tryptophan in corn-soybean meal diets. Reduction of dietary protein by four percentage units with addition of lysine, methionine, threonine, and tryptophan results in a significant reduction in nitrogen excretion from growing-finishing pigs (Carter et al., 1996). However, reduction of crude protein by four percentage units may decrease daily gain and increase backfat in finishing pigs (Schoenherr, 1992; Tuitoek et al., 1997). The increase in backfat may be explained by a decrease in the energy required to metabolize excess amino acids thereby increasing the net energy available for fat deposition. Therefore, an experiment was conducted to evaluate the effects of reducing net energy in low crude protein, amino acid supplemented diets on growth performance and carcass traits of finishing pigs.

Materials and Methods

Ninety-six pigs, initially weighing 60 lb, were blocked by weight, sex, and genotype and allotted randomly to four dietary treatments in a randomized block design. There were six pen replicates per treatment of four pigs per pen. Dietary treatments were 1) fortified corn-soybean meal based diet serving as the control, 2) as Diet 1 with the exception that dietary

crude protein was lowered by four percentage units with addition of L-lysine HCl, DL-methionine, L-threonine, and L-tryptophan (LPAA), 3) as Diet 2 plus addition of 10% wheat midds (LPAA + 10%WM), and 4) as Diet 2 plus addition of 20% wheat midds (LPAA + 20% WM). Wheat midds (.64% lysine) were added to Diets 3 and 4 at the expense of corn and soybean meal (Table 1). Crystalline amino acids were added to Diets 2 to 4 to achieve an ideal ratio to digestible lysine (Chung and Baker, 1992). Pigs were fed diets in three dietary phases. Phase 1 diets (60 110 lb) were formulated to .95% lysine, Phase 2 (111 180 lb) diets contained .80% lysine, and Phase 3 (181 250 lb) diets contained .65% total lysine. Dietary crude protein of the control diet was 17, 15, and 13% for the three phases, respectively. Dietary crude protein of Diets 2 to 4 was reduced by four percentage units in each phase. All other nutrients met or exceeded NRC (1988) standards. Pigs were allowed ad libitum access to feed and water throughout the test period. Pigs and feeders were weighed at 2-wk intervals for the determination of ADG, ADFI, and F:G.

Pigs were bled by jugular venipuncture at the end of each dietary phase. Blood was centrifuged and plasma harvested for plasma urea nitrogen analysis. Plasma urea nitrogen was determined by colorimetric procedures. When pigs reached approximately 250 lb, they were transported to a commercial packing plant and were humanely killed (electrocution followed by exsanguination). Following scalding, scraping, and evisceration, the carcasses were weighed and chilled for 24 h. Standard carcass measures including backfat and longissimus muscle area at the 10^{th} rib were collected. Dressing percent was calculated by dividing hot carcass weight by live weight. Carcass lean percentage (containing 5% fat) was calculated using hot carcass weight, 10^{th} rib backfat and longissimus muscle area (NPPC, 1991).

Data were analyzed as a randomized complete block design using analysis of variance procedures as described by Steele and Torrie (1997). Pen served as the experimental unit. Non-orthogonal contrasts were used to compare treatment means.

Results and Discussion

The effect of diet on pig performance is shown in Table 2. Pigs fed the low crude protein, amino acid supplemented diet tended to grow slower ($P<.10$) during Phase 2 and for the overall test period as compared with those fed the control diet. This response is consistent with previous reports (Knowles et al., 1998; Friesen et al., 1999) where growth rate has been reduced by feeding low protein, amino acid supplemented diets. Pigs fed low protein, amino acid supplemented diets also had poorer F:G during Phases 1 and 2 as compared with control pigs. However, for the overall grow-finish period, F:G was similar among treatments. Daily feed intake was not affected by feeding the low protein, amino acid supplemented diet. The addition of 10 or 20% wheat midds to the low protein, amino acid diet did not affect ($P>.10$) pig performance.

No effects ($P>.10$) of diet on carcass traits were observed with the exception of longissimus muscle area (Table 3). Longissimus muscle area was reduced in pigs fed the low protein, amino acid diet with or without the addition of wheat midds. This response is consistent with previous reports (Carter et al., 1996; Friesen et al., 1999) where a reduction in muscling in pigs fed low protein, amino acids diets has been reported. Suprisingly, diet had no effect ($P>.10$) on 10^{th} rib backfat or percent muscling. This is contrary to previous reports where backfat has been increased in pigs fed low protein, amino acid supplemented diets (Schoenherr, 1992; Tuitoek et al., 1997). Based on the increase in carcass fat deposition in pigs fed low protein, amino acid supplement diets, wheat midds were added in the present experiment to lower the net energy concentration of the low protein, amino acid diet. However, this reduction in net energy had minimal effects on pig performance and carcass traits. These results are consistent with other recent reports (Knowles et al., 1998; Friesen et al., 1999) where altering the net energy content of low protein, amino acid

supplemented diets did not affect carcass traits.

Recent research suggests that the reduction in pig performance associated with feeding low protein, amino acid supplemented diets may be due to a deficiency of other amino acids, in particular isoleucine and valine. Although, our diets were formulated to meet the ideal pattern of amino acids in relation to lysine, we cannot discount that a deficiency of one or more amino acids may have occured. Liu et al. (1999) recently reported that addition of isoleucine and valine to low protein, amino acid supplemented diets tended to alleviate the reduction in performance of pigs fed low protein, amino acid diets. In the present experiment, addition of wheat midds to the low protein amino acid diet tended to improve growth rate. This response may have been due to wheat midds supplying an amino acid that was marginally deficient in the low protein, amino acid diet, thus alleviating some of the growth retardation observed in the low protein, amino acid diet.

As expected, plasma urea nitrogen concentrations were reduced ($P<.01$) markedly by lowering crude protein and adding amino acids. Addition of wheat midds to the low protein, amino acid diet had only small effects on PUN. The reduction in PUN in pigs fed the low protein, amino acid diets is indicative of a reduction in excess amino acids in these diets.

Implications

Reducing crude protein concentration of the diet of growing-finishing pigs with amino acid supplementation can markedly reduce nitrogen excretion. However, based on results from this experiment, feeding low protein, amino acid supplemented diets to growing-finishing pigs results in a slight reduction in growth performance and carcass muscle. However, addition of a low cost feedstuff such as wheat midds to a low protein, amino acid supplemented diet did not affect growth performance or carcass traits. Swine producers looking for alternatives to reduce the amount of nitrogen excreted from swine should consider the use of low protein, amino acid supplemented diets. Although pig performance may be reduced, addition of relatively inexpensive feedstuffs (i.e., wheat midds) to low protein, amino acid diets may reduce cost of gain while at the same time markedly reducing nitrogen excretion.

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Table 1. Composition of Phase 1 (60 □ 110 lb) diets[ab].

	Diet[c]			
Ingredients, %	Control	LPAA	LPAA + 10% WM	LPAA + 20% WM
Corn, dent grain	72.10	82.90	75.20	67.50
SBM, dehulled	25.10	13.30	11.70	.09
Wheat midds	--	--	10.00	20.00
L-lysine HCL	--	.42	.45	.47
L-threonine	--	.19	.21	.22
DL-methionine	--	.13	.13	.13
L-tryptophan	--	.05	.05	.05
Dicalcium phos.	1.40	1.70	1.40	1.10
Limestone	.81	.71	.87	.10
Salt	.25	.25	.25	.25
TM & Vitamin premix	.25	.25	.25	.25
Tylan 40	.05	.05	.05	.05
Calculated Analysis				
Crude Protein, %	17	13	13	13
Lysine, %	.95	.95	.95	.95
AA ratios (as % of dig. Lys)				
Lysine	100	100	100	100
Threonine	67	67	67	67
Methionine	65	65	65	65
Tryptophan	19	19	19	19

[a]As fed basis.

[b]Phase 2 and 3 diets were similar and formulated to .95% lysine, .70% Ca, and .60% P for 60 to 110 lb; .80% lysine, .65% Ca, and .55% P for 111 to 180 lb; and .65% lysine, .60% Ca, and .50% P for 181 to 250 lb.

[c]Control = fortified corn-soybean meal diet: LPAA = Low protein amino

acid supplemented diet: LPAA + 10% WM = Low protein amino acid supplemented diet

plus 10% wheat midds: and LPAA + 20% WM = Low protein amino acid supplemented diet with 20% wheat midds.

Table 2. Pig performance[a].

	Diet[b]				
Item	Control	LPAA	LPAA + 10% WM	LPAA + 20% WM	SE
ADG, lb					
Phase I	1.51	1.55	1.44	1.52	.05
Phase II	1.52[c]	1.33[d]	1.57[c]	1.47[c]	.06
Phase III	1.92	1.79	1.75	1.88	.08
Overall	1.65[c]	1.55[d]	1.59[cd]	1.62[cd]	.04
ADFI, lb					
Phase I	4.41	3.79	3.93	4.00	.23
Phase II	5.67	5.11	5.30	5.41	.27
Phase III	6.56	5.99	6.16	6.44	.30
Overall	5.39	5.10	5.21	5.32	.18
Feed Gain					
Phase I	2.95[c]	2.46[d]	2.74[c]	2.62[cd]	.15
PhaseII	3.71[c]	3.88[d]	3.40[c]	3.73[cd]	.14
Phase III	3.47	3.46	3.54	3.43	.16
Overall	3.41	3.33	3.29	3.29	.12
PUN, mg/dl					
Phase I	12.00[c]	3.90[d]	4.50[d]	4.20[d]	.46
PhaseII	12.00[c]	6.00[d]	4.90[d]	4.20[d]	.66
Phase III	13.20[c]	6.90[d]	7.80[d]	6.50[d]	.65

[a]A total of 96 pigs with an avg. BW of 60 lb.

[b]Control = fortified corn-soybean meal diet: LPAA = Low protein amino

acid supplemented diet: LPAA + 10% WM = Low protein amino acid supplemented diet plus 10% wheat midds: and LPAA + 20% WM = Low protein amino acid supplemented diet with 20% wheat midds.

[c,d]Means within row with different superscripts are different (P<.10).

Table 3. Carcass characteristics[a].

	Diet[b]				
	Control	LPAA	LPAA + 10% WM	LPAA + 20% WM	SE
Dressing %	75.63	76.08	75.80	75.37	.29
10th rib BF, in	.878	.819	.945	.878	.047
LMA, in	7.07[c]	6.60[d]	6.67[c]	6.46[d]	.157
% lean	53.39	52.82	51.87	52.08	1.1

[a]Hot carcass weight used as covariate.

[b]Control = fortified corn-soybean meal diet: LPAA = Low protein amino

acid supplemented diet: LPAA + 10% WM = Low protein amino acid supplemented diet plus 10% wheat midds: and LPAA + 20% WM = Low protein amino acid supplemented diet with 20% wheat midds.

[c,d]Means within row with different superscripts are different (P<.10).

1999 Research Report - Table of Contents