AMINO ACID SUPPLEMENTATION OF REDUCED PROTEIN WHEAT DIETS FOR GROWING-FINISHING SWINE.

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Story in Brief

Three feeding trials utilizing 743 growing-finishing pigs were conducted to determine the effect of supplementation of a reduced protein hard red winter wheat based diet during the growing period are a diet devoid of soybean meal during the finishing period on performance of growing-finishing swine. Amino acids supplemented were lysine, lysine plus threonine,lysine plus threonine plus methionine or lysine plus threonine plus methionine plus isoleucine. Supplementing either a reduced protein diet during the growing period or a diet devoid of soybean meal during the finishing period with lysine resulted in reduced performance when compared to performance of pigs fed the wheat-soybean meal control diet. The addition of isoleucine in combination with threonine and methionine resulted in performance similar to that observed in both growing and finishing pigs fed the wheat-soybean meal control diet. Additional studies are needed to determine if the isoleucine response is elicited in the absence of either threonine and/or methionine.

(Key Words: Wheat, Protein Level, Amino Acid Level, Growing-Finishing Swine)

Introduction

Several studies have been conducted to determine the feasibility of replacing a portion of the soybean meal in sorghum grain or corn based swine rations with semipurified amino acids. Although wheat excels both sorghum grain and corn in the limiting amino acids for growth (lysine, sulfur amino acids, threonine, isoleucine) and perhaps contains sufficient tryptophan to meet requirements for growth, research to determine the feasibility of replacing all or a portion of the soybean meal in wheat based diets with semipurified amino acids is not available. This approach is particularly intriguing since many of the limiting amino acids are either currently available or the technology for their production in feed grade quantities is available and the level of supplementation required to attain performance equivalent with swine fed wheat-soybean meal rations should be less than is currently needed for corn or sorghum grain based rations. This study was conducted to determine the effect of supplementing reduced protein wheat diets during the growing period or diets devoid of soybean meal during the finishing period with lysine, lysine plus threonine, lysine plus threonine plus methionine or lysine plus threonine plus methionine plus isoleucine on performance of growing-finishing swine.

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Materials and Methods

Three trials conducted at the Southwestern Livestock and Forage Research Station at El Reno, Oklahoma with a total of 743 pigs were utilized as the complete data base for this study. Pigs from a rapid growth line were randomly allotted to three treatments in trial 1 and four treatments in trials 2 and 3. All diets were formulated to contain .65% available lysine in the growing phase and .53% available lysine during the finishing phase. The three treatments in trial 1 consisted of: (1)Control wheat-soybean meal diet; (2)Wheat diet formulated to meet the minimum calculated threonine (second limiting amino acid) requirement and supplemented with lysine levels equivalent to the wheat-soybean meal control diet. Note that these levels of amino acids were met with a diet containing only 7 percent soybean meal during the growing phase and no supplemental protein during the finishing phase. (3)treatment 2 supplemented with threonine to provide levels equivalent to 120% of NRC recommended levels. In Trial 2, the same treatments were used and an additional treatment (treatment 4) consisting of treatment 3 supplemented with .08% methionine was added. In trial 3, Treatment 3 was omitted and an additional treatment (treatment 5) consisting of treatment 4 supplemented with .06 percent isoleucine during the growing period and .05 percent isoleucine during the finishing period was added. Table 1.

Data from all trials were combined to evaluate all treatments simultaneously. Treatments 1 and 2 were examined in all three trials so the remaining treatments could be compared based upon their performance relative to these.

Results and Discussion

During the growing period (Table 2), feeding a reduced protein wheat diet supplemented with lysine resulted in only a non-significant 2.0 percent reduction in average daily gain (treatment 1 vs. treatment 2). The addition of threonine (treatment 3) or threonine and methionine (treatment 4) resulted in a further reduction in gain resulting in a net reduction of 3.8 percent and 7.6 percent ($P<.05$), respectively when compared to the wheat-soy control diet (treatment 1). The addition of isoleucine in combination with the other amino acids (treatment 5) restored average daily gain to levels above those observed in pigs fed the control diet. Feed efficiency was reduced by 4.7 percent ($P<.05$) in pigs fed the reduced protein wheat diet supplemented with lysine (treatment 2) when compared to those fed the wheat-soybean meal control diet (treatment 1). Addition of threonine (treatment 3), threonine plus methionine (treatment 4) or a combination of threonine plus methionine and isoleucine (treatment 5) resulted in improvement in efficiency of gain similar to that observed in pigs fed the wheat-soybean meal control diet. Pigs fed the reduced protein wheat diet supplemented with all amino acids (treatment 5) had a better feed efficiency ($P<.05$) than those fed diets supplemented only with lysine (Treatment 2) or Lysine and Threonine (treatment 3). Average daily feed intake was not significantly different among pigs fed any diets, but less feed was consumed by pigs fed Treatment 4.

These data indicate that a reduced protein wheat based diet supplemented only with lysine did not support optimum gain and efficiency of gain. The failure of a growth response with the addition of threonine or a combination of threonine and methionine suggest that

Table 1. Composition of Experimental Rations[a]

	Grower Diets				
	1 Wheat	2 Wheat + Lys	3 Wheat + Lys + Thr	4 Wheat + Lys + Thr + Met	5 Wheat + Lys + Thr + Met + Isol
Wheat, hard red winter	80.62	92.79	92.79	92.71	92.65
Soybean meal (44%)	15.75	3.00	3.00	3.00	3.00
Dicalcium phosphate	1.46	1.65	1.65	1.65	1.65
Calcium carbonate	.92	.88	.88	.88	.88
Salt	.50	.50	.50	.50	.50
Vit. TM Premix[b]	.25	.25	.25	.25	.25
Lysine hydrochloride	0	.37	.37	.37	.37
Threonine	0	0	.06	.06	.06
Methionine	0	0	0	.08	.08
Isoleucine	0	0	0	0	.06
Tylan 10[c]	.50	.50	.50	.50	.50
Calculated Analysis, %					
Protein	16.77	2.65	12.64	12.63	2.62
Lysine	.75	.72	.72	.72	.72
Available lysine	.65	.65	.65	.65	.65
Met & Cys	.48	.37	.37	.45	.45
Threonine	.59	.40	.46	.46	.46
Available threonine	.45	.30	.36	.36	.36
Isoleucine	.59	.58	.58	.58	.64
Calcium	.75	.75	.75	.75	.75
Phosphorus	.65	.65	.65	.65	.65
	Finisher Diets				
Wheat, hard red winter	86.7	96.53	96.48	96.40	96.35
Soybean meal (44%)	10.25	0	0	0	0
Dicalicum phosphate	1.25	1.40	1.40	1.40	1.40
Calcium carbonate	.95	.91	.91	.91	.91
Salt	.50	.50	.50	.50	.50
Vit. TM Premix[b]	.25	.25	.25	.25	.25
Lysine hydrochloride	0	.31	.31	.31	.31
Threonine	0	0	.05	.05	.05
Methionine	0	0	0	.08	.08
Isoleucine	0	0	0	0	.05
Tylan 10[c]	.10	.10	.10	.10	.10
Caluclated Analysis,%					
Protein	15.09	11.78	11.77	11.76	11.76
Lysine	.62	.60	.60	.60	.60
Available lysine	.53	.53	.53	.53	.53
Met + Cys	.44	.35	.35	.43	.43
Threonine	.51	.36	.41	.41	.41
Available threonine	.39	.26	.31	.31	.31
Isoleucine	.59	.58	.58	.58	.63
Calcium	.70	.70	.70	.70	.70
Phosphorus	.60	.60	.60	.60	.60

[a] Composition as fed
[b] Maxwell,C.V. et al. 1985
[c] 10g tylan/lb.

Table 2. The effect of amino acid supplementation of reduced protein wheat diets on average daily gain, feed intake and feed efficiency during the growing period.

	Treatment				
	1 W[a]	2 WL[a]	3 WLT[a]	4 WLTM[a]	5 WLTMI[a]
Pigs per treatment No.	198	204	111	152	81
Pens per treatment No.	12	12	7	9	5
Average daily gain, lb.	1.58[b]	1.55[b]	1.52[bc]	1.46[c]	1.63[b]
Average daily feed intake, lb.	4.36	4.42	4.30	3.97	4.16
Feed per lb. gain, lb.	2.74[bc]	2.87[de]	2.81[ce]	2.70[cf]	2.60[bf]

[bcdef]Means in the same row with different superscripts differ(P .05)
[a]Treatment abbreviation
W - Treatment 1 - Wheat-soy diet
WL - Treatment 2 - Wheat diets supplemented with lysine.
WLT - Treatment 2 supplemented with threonine
WLTM - Treatment 3 supplemented with methionine.
WLTMI - Treatment 4 supplemented with Isoleucine.

these amino acids may not be the second and third limiting amino acids in a reduced protein wheat diet as calculated values indicate. The response in growth and efficiency of gain to isoleucine suggest that isoleucine may be the second limiting amino acid and may be limiting gain and efficiency of gain. The actual depression in growth among pigs on treatments 3 and 4 is consistent with an amino acid imbalance response observed when an amino acid which is not first limiting for growth is added in small amounts to the diet. The fact that both average daily gain and efficiency were restored in swine fed a reduced protein diet supplemented with lysine, threonine, methionine and isoleucine (treatment 5) suggest that these represent all the amino acids which may be limiting performance in swine fed a reduced protein wheat diet. However, additional studies are needed to determine if threonine and/or methionine will elicit a response in swine fed a reduced protein wheat diet supplemented only with lysine and isoleucine.

During the finishing phase (table 3), pigs fed a wheat based diet devoid of soybean meal and supplemented only with lysine (treatment 2) had a lower average daily gain ($P<.05$) than pigs fed the wheat-soybean meal control diet (treatment 1). The addition of threonine (treatment 3) or threonine plus methionine (treatment 4) failed to improve average daily gain to the level observed in pigs fed the wheat-soybean meal control diet (treatment 4). However, pigs fed the reduced protien diet

Table 3. The effect of amino acid addition to wheat based diets devoid of soybean meal on average daily gain, feed intake, feed efficiency and backfat thickness in finishing swine.

	Treatment				
	1 W[a]	2 WL[a]	3 WLT[a]	4 WLTM[a]	5 WLTMI[a]
Pigs per treatment No.	198	204	110	151	81
Pigs per treatment No.	12	12	7	9	5
Average daily gain, lb.	2.01[b]	1.86[c]	1.91[cd]	1.88[cd]	1.95[bd]
Average daily feed intake, lb.	6.56	6.30	6.19	6.14	6.17
Feed per lb. gain, lb.	3.37	3.46	3.38	3.43	3.34
Backfat, in	1.21[b]	1.26[c]	1.24[cd]	1.22[bd]	1.22[bd]

[a] - Treatment abreviations
W - Treatment 1 - Wheat-soy diet
WL - Treatment 2 - Wheat diets supplemented with lysine
WLT - Treatment 2 - Supplemented with threonine.
WLTM - Treatment 3 - Supplemented with methionine.
WLTMI - Treatment 4 - Supplemented with isoleucine.
bcd - Means in the same row with different superscripts differ ($P < .05$)

supplemented with lysine, threonine, methionine and isoleucine (treatment 4), had a similar gain to those fed the wheat-soybean meal control diet (treatment 1). Neither feed efficiency nor average daily feed intake were significantly affected by any of the treatments during the finishing phase.

Backfat thickness was increased ($P<.05$) in pigs fed the reduced protein wheat diet supplemented with lysine (Treatment 1) or lysine and threonine (treatment 2) when compared to those fed the wheat-soybean meal control diet (treatment 1). Pigs fed diets with further addition of methionine (treatment 4) or methionine and isoleucine (treatment 5) had backfat thickness similar to those fed the wheat-soybean meal control diet (treatment 1).

This study suggests that a hard red winter wheat based diet supplemented only with lysine will not meet the requirements for optimum performance of finishing swine. The demonstration of a significant growth response with isoleucine when added in addition to threonine and

methionine to a wheat based diet devoid of soybean meal (treatment 5) suggest that isoleucine may be the second limiting amino acid. However additional studies are needed to determine if a similar isoleucine response is observed in the absence of threonine and methionine.

Liturature Cited

Maxwell, C.V. et al., 1986. Amino acid supplementation of wheat diets for growing-finishing swine. Okla. Agr. Exp. Sta. MP 117:391