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METHIONINE ADDITION TO WEANLING PIG DIETS

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Summary

Three growth trials and two metabolism trials utilizing 236 pigs were conducted to evaluate the effects of amino acids additions to weanling pig diets and to estimate the methionine requirement of weanling pigs using growth and nitrogen retention as criteria. From these results, it was concluded that the total sulfur amino acid requirement of weanling pigs does not exceed 0.56% of the diet. Addition of methionine to a lysine supplemented 18% protein corn or sorghum-soybean meal did not improve pig performance.

Introduction

Synthetic DL-methionine and its analogues are widely used in poultry diets. For swine, DL-methionine is often added to starter diets. Very limited information is available on the sulfur amino acids requirement of pigs weaned at 3-weeks of age. This study was designed to determine the methionine requirement of weanling pigs approximately 21 days old and about 13 lb body weight.

Procedures

Pigs were weaned at an average age of 21 days in five trials. In growth trials, pigs were housed in an enviromentally controlled nursery in pens 4 x 5 ft with woven wire floors and V-flush gutter. Feed was offered ad libitum in self-feeders and water was supplied by nipple waterers. Initial and final weights were recorded and daily gain, daily feed intake, and feed efficiency were calculated at the conclusion of the trial. In digestion trials, pigs were housed individually in metabolism cages allowing for separate collection of feces and urine. Daily feed intake was constant and the pigs were fed equal amounts twice each day. At the time of feeding, water was added to the diet to make it into a thick gruel and after feeding the troughs were filled with fresh water. A 7-day adjustment period preceded each 5-day collection period. Ferric oxide was fed as a marker at the beginning and end of each 5-day period. Composition of the basal diets are shown in tables 1, 2, and 3. All essential amino acids except methionine exceeded the NRC (1979) recommended levels.

Trial 1. A growth trial was conducted using 80 crossbred (Yorkshire x Duroc) pigs averaging 14 lb. They were allotted to 20 pens representing four replications of five dietary treatments (four pigs per pen). The experiment, lasting 5 weeks, had the following dietary treatments: A) Corn-soy-whey basal diet; B) Basal + 0.1% DL-methionine; C) Basal + .1% L-threonine; D) Basal + 0.05% L-tryptophan; and E) Basal + .1% DL-methionine, + 0.1% L-threonine, and + 0.05% L-tryptophan.

Trial 2. A second growth trial was conducted to evaluate performance responses of graded levels of DL-methionine added to a sorghum diet containing a low level of total sulfur amino acid (TSAA). The trial consisted of 72 crossbred pigs (Yorkshire x Duroc) averaging 13.5 lb. They were allotted to 12 pens representing four replicates of three diets with six pigs per pen. The experiment, lasting 5 wk, had the following treatments: A) Sorghum-soy dried skim milk basal diet; B) Basal + 0.1% DL-methionine; and C) Basal + 0.2% DL-methionine.

Trial 3. A growth trial was conducted using 60 crossbred (Yorkshire x Duroc) pigs averaging 12 lb. These were allotted to 20 pens randomly representing five replications of four dietary treatments with three pigs per pen. The experiment, lasting 28 days, included the following dietary treatments: A) Basal diet; B) Basal + 0.1% DL-methionine; C) Basal + 0.2% DL-methionine; and D) Basal + 0.3% DL-methionine.

Two days before the end of the trial, blood was collected via anterior vena cava puncture with a vacutainer tube. Each blood sample was shaken gently and stored immediately on ice. Blood samples were centrifuged within 1 hr after sampling. Serum was decanted and refrigerated until analyzed for blood urea nitrogen (BUN).

Trial 4. A metabolism trial was conducted using 12 barrows (Yorkshire x Duroc) averaging 15 lb. Three groups of four littermates were used in a randomized complete block design and allotted to four treatments as in Trial 3. Treatments within groups were assigned randomly and fed for one period (12 days), after which treatments were reallotted for another period so as to provide a second replicate. Daily feed intake was 250 g for the first period and 280 g for the second period.

Trial 5. Another digestion trial was conducted using 12 Duroc x Yorkshire barrows averaging 15.5 lb. Three groups of four littermates were used in a randomized complete block design and allotted randomly to the four treatment as discussed in trial 4. The only difference was that a cross-over design was used. Daily feed intake was the same as in Trial 4.

Results and Discussion

Trial 1. The influence of adding different synthetic amino acids on the performance of pigs weaned at approximately 21 days of age is shown in table 4. There were no differences in average daily gain or daily feed intake between pigs fed the basal diet and those with the supplemented amino acids. However, pigs fed the diet with 0.1% DL-methionine added tended to consume slightly less feed than pigs fed the basal diet or diets with other synthetic amino acids added.

Trial 2. Performance of pigs fed diets containing various level of added DL-methionine is shown in table 5. There were no differences in average daily gain and feed consumption among treatments. Adding DL-methionine did not improve pig performance.

In trials 1 and 2, the addition of 0.1% or 0.2% DL-methionine to a basal corn-soy-whey diet or to a sorghum-soy-dried skim milk diet gave no improvement in the growth rate of pigs weaned at 21 days. This indicates that supplemental DL-methionine is not required to obtain maximum growth. Results of trial 1 suggest that a 18% protein corn-soy-whey diet meets the amino acid requirement of pigs weaned at 3 wk of age and supplementation with synthetic amino acids (except lysine) is not necessary.

Trial 3. Performance of weaned pigs fed semi-purified diets containing graded levels of DL-methionine is shown in table 6. There was a difference in growth rate and daily feed consumption between pigs fed the basal and methionine-supplemented diets. However, there was no difference within pigs fed the methionine-supplemented diets. Pigs fed the basal diet consumed less feed ($P<.05$) than those fed the diet with added methionine. In trial 3, the pigs fed the semi-purified diet with supplemental DL-methionine had significant improvements in average daily gain, feed intake, and feed efficiency. Adding 0.2% methionine, to give a TSAA of 0.56% resulted in maximum weight gain of weaned pigs. No further improvement in growth rate was seen at the 0.3% supplemental methionine level.

BUN concentrations decreased as the added DL-methionine level increased to 0.2%, where they leveled off. This reduction in BUN presumably reflected more efficient nitrogen utilization and less urea synthesis by the pigs that received the higher methionine levels.

Trial 4. Results of the digestion trial for diets containing graded levels of DL-methionine are shown in table 7. The apparent N digestibility was similar for pigs fed all diets. Nitrogen retention (grams per day) of pigs fed the basal diet was lower ($P<.05$) than supplemented diets with a plateau at 0.2% added DL-methionine. Nitrogen retention expressed as a percentage of intake also plateaued with 0.2% added DL-methionine.

Trial 5. The second digestion trial for diets containing graded levels of DL-methionine is shown in table 8. Results were similar to those in the previous digestion trial. These results suggest that .56% TSAA results in maximum nitrogen retention.

Our results suggest that the total sulfur amino acid requirement of pigs weaned at 3 wk of age does not exceed 0.56% of the diet. This is exactly the value of 1979 NRC recommendation. Since the commonly used practical diets meet this level of TSAA it is not necessary to supplement DL-methionine in diets for pigs weaned at 3-wk of age.

Table 1. Composition of Basal Diets for Trial 1

Ingredient	%
Yellow corn, ground	54.00
Soybean meal (44%)	22.50
Dried whey	20.00
Dicalcium phosphate	1.40
Ground limestone	0.80
Salt	0.20
Trace mineral premix[a]	0.10
Vitamin premix[b]	0.50
Antibiotic[c]	0.25
L-lysine HCl	0.35
Calculated analysis:	
Crude protein (%)	17.37
Lysine (%)	1.25
Tryptophan (%)	0.21
Threonine (%)	0.80
Methionine+cystine (%)	0.64
Metabolizable energy (kcal/lb)	1449

[a]Containing 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I and 0.1% Co.

[b]Each lb of premix contained the following: vitamin A 400,000 IU; vitamin D_3 30,000 IU; vitamin E 2,000 IU; riboflavin 450 mg; d-pantothenic acid 1,200 mg; choline 40 gm; niacin 2,500 mg; vitamin B_{12} 2.2 mg; menadione dymethylpyrimidinol bisulfite 250 mg; ethoxyquin 2850 mg.

[c]Contributed the following per lb of diet: chlortetracycline 50 mg; sulfamethazine 50 mg; penicillin 25 mg.

Table 2. Composition of Basal Diets for Trial 2

Ingredient	%
Ground sorghum grain	65.20
Dried skim milk	15.00
Soy protein concentrate 67.2%[a]	5.00
Soybean meal 44%	7.50
Dried fat 7-40	3.50
Dicalcium phosphate	1.60
Ground limestone	0.80
Salt	0.30
Trace mineral premix[b]	0.10
Vitamin premix[c]	0.50
Antibiotic[d]	0.25
L-lysine HCl	0.30
Calculated analysis:	
Crude protein (%)	17.51
Lysine (%)	1.17
Threonine (%)	0.69
Tryptophan (%)	0.22
Methionine+cystine (%)	0.59
Metabolizable energy (kcal/lb)	1449

[a]PROCON CMR® Staley, Decatur, IL 62525.

[b]Containing 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I and 0.1% Co.

[c]Each lb of premix contained the following: vitamin A 400,000 IU; vitamin D_3 30,000 IU; vitamin E 2,000 IU; riboflavin 450 mg; d-pantothenic acid 1,200 mg; choline 40 gm; niacin 2,500 mg; vitamin B_{12} 2.2 mg; menadione dymethylpyrimidinol bisulfite 250 mg; ethoxyquin 2850 mg.

[d]Contributed the following per lb of diet: chlortetracycline 50 mg; sulfamethazine 50 mg; penicillin 25 mg.

Table 3. Composition of Basal Diet for Trials 3, 4 and 5

Ingredient	%
Soy protein concentrate 67.2%[a]	20.00
Corn starch	70.50
Dried fat 7-60	5.00
Dicalcium phosphate	1.40
Ground limestone	0.80
Salt	0.50
Trace mineral premix[b]	0.10
Vitamin premix[c]	1.00
L-lysine HCl	0.40
L-threonine	0.10
Isoleucine	0.15
DL-tryptophan	0.04
Antibiotic[d]	0.25
Calculated analysis:	
Crude protein (%)	13.50
Lysine (%)	1.24
Threonine (%)	0.67
Tryptophan (%)	0.18
Isoleucine (%)	0.76
Methionine+cystine (%)	0.36
Metabolizable energy (kcal/lb)	1585

[a] PROCON CMR® Staley, Decatur, IL 62525.

[b] Containing 5.5% Mn, 10% Fe, 1.1% Cu, 20% Zn, 0.15% I and 0.1% Co.

[c] Each lb of premix contained the following: vitamin A 400,000 IU; vitamin D_3 30,000 IU; vitamin E 2,000 IU; riboflavin 450 mg; d-pantothenic acid 1,200 mg; choline 40 gm; niacin 2,500 mg; vitamin B_{12} 2.2 mg; menadione dymethypyrimidinol bisulfite 250 mg; ethoxyquin 2850 mg.

[d] Contributed the following per lb of diet: chlortetracycline 50 mg; sulfamethazine 50 mg; penicillin 25 mg.

Table 4. Performance of Weaned Pigs Fed Diets Supplemented With Various Essential Amino Acids (Trial 1)[ab]

Item	Diets					
	Basal	Basal + .1%DL-met	Basal + .1%L-thr	Basal + .05%L-trp	Basal + .1%DL-met + .1% L-thr + .05%L-trp	SE
Initial weight (lb)	14.06	13.88	13.73	13.93	13.86	.26
Final weight (lb)	44.46	43.06	43.76	42.48	44.75	1.19
Average daily gain (lb)	.86	.84	.86	.81	.88	.07
Daily feed intake (lb)	1.47	1.32	1.45	1.43	1.50	.11
Feed/gain	1.69	1.60	1.69	1.76	1.70	.10

[a] Each value is the mean of 16 pigs (4 pigs per pen and 4 replications per treatment).

Table 5. Performance of Weaned Pigs Fed Sorghum-Based Diets With Added Levels of DL-Methionine (Trial 2)[a]

Item	Diets			SE
	Basal	Basal + .1%DL-met	Basal + .2%DL-met	
Initial weight (lb)	13.29	14.39	13.31	1.14
Final weight (lb)	36.52	37.14	35.73	1.85
Average daily gain (lb)	.66	.66	.64	.07
Feed intake(lb/day)	1.06	1.06	1.03	.09
Feed/gain	1.57	1.62	1.60	.02

[a] Each value is the mean of 24 pigs (6 pigs per pen and 4 replications per treatment).

Table 6. Growth Performance and Blood Urea Nitrogen (BUN) Content of Weaned Pig Fed Semipurified Diets With Various Levels oF DL-Methionine (Trial 3)[abcd]

Item	Diet				SE
	Basal	Basal + .1%DL-met	Basal + .2%DL-met	Basal + .3%DL-met	
Initial weight (lb)	11.95	11.90	11.95	12.19	.04
Final weight (lb)	18.13	22.99	24.68	23.98	.55
Average daily gain (lb)	.22[b]	.40[c]	.46[c]	.44[c]	.04
Daily feed intake (lb)	.55[b]	.73[c]	.81[c]	.77[c]	.07
Feed / gain	2.55[b]	1.84[c]	1.80[c]	1.78[c]	.09
BUN (mg/100 ml)	6.31[b]	3.38[c]	1.14[d]	1.12[d]	.79

[a] Each value is the mean of 15 pigs (3 pigs per pen and 5 replication per treatment).

[bcd] Means within a row with different superscripts differ (P<.05).

Table 7. Nitrogen Digestibility and Retention of Weaned Pigs Fed Diets With Various Levels of DL-Methionine (Trial 4)[abcd]

Item	Diets				SE
	Basal	Basal + .1%DL-met	Basal + .2%DL-met	Basal + .3%DL-met	
N digestibility (%)	90.65[a]	90.25[a]	91.16[a]	90.48[a]	.93
Daily nitrogen (g/day)					
Intake	6.24[a]	6.41[a]	6.54[a]	6.37[a]	.25
Excreted in urine	1.91[a]	1.17[b]	.70[c]	.82[c]	.10
Excreted in feces	.59[a]	.62[a]	.58[a]	.61[a]	.03
Retention	3.74[a]	4.62[b]	5.26[c]	4.94[bc]	.17
Percentage of N retention to N intake (%)	60.36[a]	72.28[b]	80.57[c]	77.58[d]	.86

[abcd] Means within a row with different superscripts differ (P<.05).

Table 8. Nitrogen Digestibility and Retention of Weaned Pigs Fed Added Levels of DL-Methionine (Trial 5)[abcd]

Item	Diets				SE
	Basal	Basal + .1%DL-met	Basal + .2%DL-met	Basal + .3%DL-met	
N digestibility (%)	88.01[a]	88.06[a]	88.26[a]	89.37[a]	.88
Daily nitrogen (g/day)					
Intake	7.04[a]	7.44[b]	7.10[c]	6.88[d]	.03
Excreted in urine	2.35[a]	1.55[ab]	.98[b]	1.59[ab]	.44
Excreted in feces	.84[ab]	.88[a]	.83[ab]	.73[b]	.05
Retention	3.85[a]	5.01[ab]	5.29[b]	4.56[ab]	.40
Percentage of N retention to N intake (%)	54.59[a]	67.14[ab]	74.52[b]	66.80[ab]	6.21

[abcd] Means within a row with different superscripts differ (P<.05).