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The effect of increasing dietary methionine on performance of the early-weaned pig

Abstract

A total of 216 pigs (initially 10.8 lb and 21 d of age) was used in a 35 d growth trial to determine the effect of increased dietary methionine on growth performance for the early-weaned pig when offered a porcine plasma-based diet. During d 0 to 21 postweaning, increasing methionine levels were obtained by adding DL-methionine to a common basal diet. The control diet was corn-soybean meal-based; contained 10% spray-dried porcine plasma (SDPP), 20% dried whey, 3% lactose, and 1.75% spray-dried blood meal (SDBM); and was formulated to contain 1.6% lysine and .28% methionine. DL-methionine replaced sucrose in the control diet to achieve the experimental dietary methionine levels of .28, .32, .36, .40, .44, and .48%. Six pigs were housed per pen with six pens per treatment. From d 21 to 35 postweaning, all pigs were switched to a common diet containing 10% dried whey and 2.5% SDBM and formulated to contain 1.25% lysine. During d 0 to 21, average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were improved quadratically as dietary methionine increased, with maximum growth performance being obtained between .40 and .44% dietary methionine. Average daily gain was not affected during the second half (d 21 to 35) of the trial. However, both ADFI and feed efficiency were improved with increasing methionine level fed during phase I. On d 7 and 14 postweaning, blood urea N was reduced as dietary methionine increased. Pigs fed .40% dietary methionine had the lowest blood urea N concentration on d 14 compared to pigs fed the other methionine levels. Cumulative (d 0 to 35) ADG and ADFI were maximized between .40 and .44% dietary methionine. These data suggest that the early-weaned pig requires approximately .40 to .44% dietary methionine to optimize growth performance. This corresponds to .345 to .385% digestible methionine and 1.27 and 1.55 g/d of methionine intake from d 0 to 14 postweaning. These requirements are substantially higher than those previously recommended.; Swine Day, Manhattan, KS, November 18,1993

Keywords

Swine day, 1993; Kansas Agricultural Experiment Station contribution; no. 94-194-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 695; Swine; Methionine; Starter pigs; Performance

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THE EFFECT OF INCREASING DIETARY METHIONINE ON PERFORMANCE OF THE EARLY-WEANED PIG[1]

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Summary

A total of 216 pigs (initially 10.8 lb and 21 d of age) was used in a 35 d growth trial to determine the effect of increased dietary methionine on growth performance for the early-weaned pig when offered a porcine plasma-based diet. During d 0 to 21 postweaning, increasing methionine levels were obtained by adding DL-methionine to a common basal diet. The control diet was corn-soybean meal-based; contained 10% spray-dried porcine plasma (SDPP), 20% dried whey, 3% lactose, and 1.75% spray-dried blood meal (SDBM); and was formulated to contain 1.6% lysine and .28% methionine. DL-methionine replaced sucrose in the control diet to achieve the experimental dietary methionine levels of .28, .32, .36, .40, .44, and .48%. Six pigs were housed per pen with six pens per treatment. From d 21 to 35 postweaning, all pigs were switched to a common diet containing 10% dried whey and 2.5% SDBM and formulated to contain 1.25% lysine. During d 0 to 21, average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were improved quadratically as dietary methionine increased, with maximum growth performance being obtained between .40 and .44% dietary methionine. Average daily gain was not affected during the second half (d 21 to 35) of the trial. However, both ADFI and feed efficiency were improved with increasing methionine level fed during phase I. On d 7 and 14 postweaning, blood urea N was reduced as dietary methionine increased. Pigs fed .40% dietary methionine had the lowest blood urea N concentration on d 14 compared to pigs fed the other methionine levels. Cumulative (d 0 to 35) ADG and ADFI were maximized between .40 and .44% dietary methionine. These data suggest that the early-weaned pig requires approximately .40 to .44% dietary methionine to optimize growth performance. This corresponds to .345 to .385% digestible methionine and 1.27 and 1.55 g/d of methionine intake from d 0 to 14 postweaning. These requirements are substantially higher than those previously recommended.

(Key Words: Methionine, Starter Pigs, Performance.)

Introduction

The recent addition of high levels of SDPP and SDBM to starter pig diets has generated interest in the need for synthetic methionine additions. Both of these protein sources are deficient in methionine. Recently, two trials conducted at Kansas State University demonstrated that DL-methionine is essential to maximize growth performance and feed efficiency when spray-dried blood products are included in starter pig diets. However, no research has been conducted addressing the methionine requirement when spray-dried blood products are included in the phase I high nutrient dense diet (HNDD). Therefore, this re-

[1]The authors would like to thank the Degussa Corp., Allendale, NJ for providing the amino acids used in this experiment.

search was conducted to determine the effect of increased dietary methionine on growth performance for the early-weaned pig when offered a porcine plasma-based diet.

Procedures

Two hundred and sixteen pigs (initially 10.8 lb and 21 d of age) were randomly allotted by weight to one of six experimental treatments. Throughout the first 21 d of the experiment, pigs were fed diets containing either .28, .32, .36, .40, .44, or .48% dietary methionine (Table 1). When expressed on a digestible amino acid basis, corresponding methionine levels were .225, .265, .305, .345, .385, and .425%. A control diet was formulated to contain 1.6% lysine (1.37% digestible lysine), .28% methionine, .90% calcium, and .80% phosphorus. Sucrose was replaced by DL-methionine to achieve the experimental methionine levels. Because cystine can meet half the total sulphur amino acid requirement, cystine content of all diets was .62%. This exceeds the amount needed to meet the highest level of methionine (based on a 50:50 mixture of methionine and cystine). To ensure that methionine was first limiting, dietary isoleucine, threonine, and tryptophan were maintained relative to lysine according to the ratio proposed by researchers at the University of Illinois for the 11 to 22 lb pig. Additionally, choline chloride was supplemented to all diets at .10%. The levels of corn, soybean meal, dried whey (20%), SDPP (10%), and SDBM (1.75%) remained constant in all experimental diets.

There were six pens per treatment with six pigs/pen. Pigs were housed in 3.5 ft × 5 ft pens with woven wire flooring. Each pen had a self-feeder and nippled waterer to allow ad libitum consumption of feed and water. Pigs and feeders were weighed on d 7, 14, 21, and 35 to allow calculation of ADG, ADFI, and F/G. Blood samples were taken on day 7, 14, and 21 to determine blood urea N. On d 21, all pigs were switched to a common diet containing 10% dried whey and 2.5% SDBM and formulated to contain 1.25% lysine. This diet was fed from d 21 to 35 postweaning.

Data were analyzed as a randomized complete block design. General linear model procedures were used, with initial weight, sex and ancestry serving as the blocking factors. Orthoganol polynomial contrasts were used to determine linear and quadratic effects.

Results and Discussion

During d 0 to 21 postweaning, ADG, ADFI, and feed efficiency were improved quadratically ($P<.01$) when dietary methionine increased. Plateaus in ADG and ADFI were detected at approximately .44% dietary methionine, whereas feed efficiency reached a plateau at approximately .40 to .44% dietary methionine. When the dietary methionine requirement (.44%) is expressed as a percentage of lysine (1.60%), this ratio of methionine to lysine is approximately 28%. This is similar to the ratio proposed by researchers at the University of Illinois but, higher than a lysine to methionine ratio suggested by the NRC (1988). Additionally, this methionine requirement is substantially higher than that previously recommended for use in the KSU phase I high nutrient density diet.

From d 21 to 35 (when a common diet was fed), no treatment effects were detected for ADG when dietary methionine levels increased during d 0 to 21. However, quadratic responses were observed for ADFI ($P<.07$) and feed efficiency ($P<.08$). During this phase, an interesting observation was noted. Pigs on the two lowest methionine levels (.28 and .32%) during d 0 to 21 were 10 and 7% more efficient than pigs receiving the diet containing .44% dietary methionine, respectively. However, overall (d 0 to 35) ADG and ADFI were improved quadratically ($P<.01$) and appeared to be maximized at approximately .44% dietary methionine. Although no differences were observed for feed efficiency, F/G appeared to be optimized at .40%

dietary methionine. The responses observed for the entire trial were the same responses seen during d 0 to 21, indicating that the performance during this first phase is very crucial for the overall performance. On d 35, pigs receiving the diet containing .44% dietary methionine were 20 and 5% heavier than those consuming the diets containing .28 or .32% dietary methionine, respectively.

On d 7 and 14, blood urea N was reduced quadratically as dietary methionine increased (Table 2). Pigs fed .40% dietary methionine had the lowest blood urea N concentration on d 14 when compared to the other treatments.

These data suggest that the early-weaned pig requires approximately .40 to .44% dietary methionine to maximize growth performance. This corresponds to .345 to .385% digestible methionine and 1.27 and 1.55 g/d of methionine intake from d 0 to 14 postweaning. These requirements are substantially higher than those previously recommended.

Table 1. Control and Phase II Diet Composition,%[a]

Ingredient	Control	Phase II
Corn	41.17	58.92
SBM, 48.5%	14.28	21.03
Dried whey	20.00	10.00
Porcine plasma	10.00	--
Lactose	3.00	--
Soybean oil	5.00	3.00
Monocalcium phosphate	2.01	1.97
Spray dried blood meal	1.75	2.50
Antibiotic[b]	1.00	1.00
Limestone	.66	.83
Vitamin premix	.25	.25
Mineral premix	.15	.15
L-lysine	.12	.15
Copper sulfate	.08	.08
Sucrose[c]	.20	--
DL-methionine	--	.06
L-isoleucine	.14	--
L-cystine	.06	--
L-threonine	.03	--
Choline chloride	.10	--
Total	100.0	100.0
<u>Calculated Analysis, %</u>		
Lysine	1.60	1.25
Methionine	.28	.33
Cystine		.56.34
Threonine	.91	.80
Tryptophan	.23	.24
Isoleucine	.81	.75

[a]Control diet (phase I) was formulated to contain 1.6% lysine, .28% methionine, .90% Ca, and .80% P, and the phase II diet contained 1.25% lysine.
[b]Provided 50 g/ton carbadox.
[c]DL-methionine replaced sucrose to provide .32, .36, .40, .44%, and .48% dietary methionine in experimental diets.

Table 2. The Effect of Increased Dietary Methionine on Growth Performance and Serum Urea Nitrogen in the Early-Weaned Pig[a]

	Dietary Methionine,%						
Item	.28	.32	.36	.40	.44	.48	CV
d 0 to 14							
ADG[b,d]	.40	.58	.68	.70	.76	.69	9.2
ADFI[b,d]	.50	.64	.71	.70	.78	.71	8.3
F/G[b,d]	1.26	1.11	1.03	1.00	1.02	1.04	6.3
d 0 to 21							
ADG[b,d]	.54	.74	.79	.82	.87	.80	7.7
ADFI[b,d]	.71	.88	.92	.91	.98	.92	7.9
F/G[b,d]	1.33	1.18	1.16	1.10	1.13	1.16	6.0
d 21 to 35							
ADG	1.03	1.12	1.07	1.10	1.05	1.08	11.9
ADFI[c,e]	1.66	1.84	1.98	1.92	1.87	1.88	9.6
F/G[c,f] 1.61	1.65	1.87	1.75	1.78	1.76	9.1	
d 0 to 35							
ADG[b,d]	.74	.89	.90	.93	.94	.91	8.2
ADFI[b,d]	1.09	1.26	1.34	1.31	1.34	1.31	7.9
F/G	1.48	1.42	1.49	1.40	1.42	1.44	4.5
Serum urea N, mg/dl							
d 7[b,d]	13.16	7.68	5.87	5.45	5.48	5.34	39.6
d 14[b,d]	8.79	7.42	5.67	4.45	4.95	4.48	20.1
d 21[b]	10.25	8.72	8.61	7.28	9.33	6.60	22.1

[a]Two hundred and sixteen weanling pigs were used (initially 10.8 lbs and 21 d of age), 6 pigs/pen with 6 pens per treatment.
[b,c]Linear effects of dietary methionine ($P<.01$) and ($P<.10$), respectively.
[d,e,f]Quadratic effects of dietary methionine ($P<.01$), ($P<.05$), and ($P<.10$), respectively.