THE EFFECTS OF INCREASING DIETARY METHIONINE IN THE PHASE II STARTER PIG DIET[1]

K. Q Owen, J. L. Nelssen, M. D. Tokach, R. D. Goodband, L. J. Kats, K. G. Friesen, B. T. Richert, and R. Musser

Summary

A total of 216 pigs (initially 12.4 lb and 21 d of age) was used in a 28 d growth trial to determine the effects of increasing dieatary methionine in the phase II (d 7 to 28 postweaning) diet. Pigs were allotted by sex, weight, and ancestry and placed in pens containing six pigs each. All pigs were offered a common phase I diet for the first 7 d postweaning. The phase I diet contained 20% dried whey, 10% spray-dried porcine plasma (SDPP), 3% lactose, and 1.75% spray-dried blood meal (SDBM) and was formulated to contain 1.6% lysine and .44% methionine. After the phase I period, pigs were assigned to one of six treatments that contained either .27, .30, .33, .36, .39, or .42% dietary methionine. Methionine levels were obtained by adding increasing levels of DL-methionine to a common basal diet. The control diet was corn-soybean meal-based, contained 10% dried whey and 3% SDBM, and was formulated to contain 1.3% lysine and .27% methionine. During phase I (d 0 to 7 postweaning), average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were .68 lb, .67 lb, and 1.01, respectively. During the first week of phase II (d 7 to 14 postweaning), increasing dietary methionine resulted in improved ADG, ADFI, and F/G. For the cumulative period (d 7 to 28 postweaning), ADG and ADFI were not influenced by increasing dietary methionine; however, F/G was improved and appeared to be maximized at .36% methionine. These data suggest that the early-weaned pig requires .36% dietary methionine during d 7 to 28 postweaning to maximize growth performance when fed a diet containing 1.3% lysine. Also, when expressed relative to lysine, this represents a methionine:lysine ratio of 28%. This corresponds to the same methionine to lysine ratio found to optimize performance during the phase I trial.

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

Introduction

Recent work at Kansas State University has shown the methionine level in the phase I high nutrient dense diet (HNDD) to be substantially higher than the level previously being recommended. One of the primary reasons for a higher methionine requirement is the high level of blood products included in this phase I HNDD. Typically, if pigs are weaned at 21-d of age, they are fed the phase I diet for 1 week (21 to 28 d of age). A phase II diet is then fed for 2 to 3 weeks (28 to 49 d of age). Spray-dried blood meal has become a common protein source in the phase II diet. Because SDBM is deficient in methionine, DL-methionine is being added to this diet. However, results of the recent trial mentioned above have led us to question whether the methionine requirement in this diet is much higher than those currently being recommended. Thus, our objective was to determine the optimal

[1]The authors would like to thank Novus International, Inc., St. Louis, MO for financial support of this trial.

methionine level in the phase II starter diet.

Procedures

A total of 216 pigs (initially 12.4 lb and 21 d of age) were used in a 28 d growth trial. Pigs were allotted by sex, ancestry, and weight and placed in pens containing 6 pigs/pen. A common phase I diet was fed for the first 7 days postweaning. The phase I diet contained 20% dried whey, 10% SDPP, 3% lactose, and 1.75% SDBM and was formulated to 1.6% lysine and .44% methionine. After the phase I period, pigs were randomly assigned to one of six dietary treatments in a randomized complete block design. Throughout phase II (d 7 to 28 postweaning), pigs were fed diets containing either .27, .30, .33, .36, .39 or .42% total dietary methionine (Table 1). When expressed on a digestible basis, corresponding methionine levels were .249, .279, .309, .339, .369, and .399%. A basal diet was formulated to contain 1.3% lysine (1.09% digestible lysine), .27% methionine, .90% calcium, and .80% phosphorus. Sucrose was replaced by synthetic 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 .51%. 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 20 lb pig. Additionally, choline chloride was supplemented to all diets at .10%. The levels of corn, soybean meal, dried whey (10%) and SDBM (1.75%) remained constant in all experimental diets.

There were six pigs/pen with six pens per treatment. Pigs were housed in 3.5 ft × 5 ft pens with woven wire, expanded metal 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 28 to allow calculation of ADG, ADFI, and F/G. Blood samples were taken on day 14 and 28 to determine blood urea N and amino acids concentrations.

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 Phase I, ADG, ADFI, and F/G were .68 lb, .67 lb, and 1.01, respectively. From d 7 to 14 postweaning, increasing dietary methionine quadratically improved ADG ($P<.01$), ADFI ($P<.05$) and F/G ($P<.05$), with these response criteria appearing to be optimized at .36% dietary methionine. When expressed relative to lysine, with dietary methionine at .36% and dietary lysine at 1.3%, a ratio of 28% methionine to lysine was found. This is the same ratio found to optimize performance during phase I. Additionally, this is similar to the ratio suggested by researchers at the University of Illinois. Comparing the performance of pigs receiving .36% dietary methionine to pigs receiving .27 dietary methionine (which is close to the NRC (1988) estimates) showed improvements of 27%, 10%, and 29% for ADG, ADFI, and F/G, respectively.

From d 7 to 28 postweaning, increasing dietary methionine had no effect on ADG or ADFI, but F/G was quadratically ($P<.05$) improved. Even though ADG was not significantly influenced, pigs receiving the .36% dietary methionine treatment had the highest numerical value for ADG and were the most efficient (F/G).

Plasma urea N was not affected by dietary treatment. However, pigs receiving .33% and .36% dietary methionine had the lowest numerical values on d 14 postweaning. Pigs receiving the diet containing .30% dietary methionine had the lowest numerical value on d 28 postweaning.

These data suggest that the early-weaned pig requires .36% dietary methionine during d 7 to 28 postweaning to maximize growth performance when fed a diet containing 1.3% lysine. This corresponds to .339 digestible methionine. Also, when expressed on a ratio relative to lysine, this represents a methionine:lysine ratio of 28%. This corresponds to the same methionine to lysine ratio found to optimize performance during the phase I trial. These findings along with the phase I findings suggest that a methionine to lysine ratio of 28% is needed in diets fed to the early-weaned pig.

Table 1. Phase I and Basal Diet Composition, %[a]

Ingredient	Phase I	Basal
Corn	41.17	55.41
SBM, 48.5%	14.28	--
SBM, 44%	--	23.32
Dried whey	20.00	10.00
Porcine plasma	10.00	--
Lactose	3.00	--
Soybean oil	5.00	3.00
Monocalcium phosphate	2.01	1.94
Blood meal	1.75	3.00
Antibiotic[b]	1.00	1.00
Limestone	.66	.81
Vitamin premix	.25	.25
Mineral premix	.15	.15
L-lysine	.12	.15
Copper sulfate	.08	.08
Sucrose[c]	.04	.46
DL-methionine	.16	.06
L-isoleucine	.14	.02
L-cystine	.06	.28
L-threonine	.03	.04
Choline chloride	.10	.10
Total	100.0	100.0
Calculated Analysis, %		
Lysine	1.60	1.30
Methionine	.44	.27
Cystine	.56	.51
Threonine	.91	.85
Tryptophan	.23	.25
Isoleucine	.81	.78

[a]Phase I diets were formulated to contain 1.6% lysine, .28% methionine, .90% Ca, and .80% P; the phase II basal diet contained 1.30% lysine, .27% methionine, .90% Ca, and .80% P.
[b]Provided 50 g/ton carbodox.
[c]DL-methionine replaced corn starch on a lb/lb basis to achieve the .30, .33, .36, and .39% dietary methionine experimental diets.

Table 2. The Effect of Increased Dietary Methionine in the Phase II Diet on Growth Performance and Serum Urea Nitrogen[a]

	Dietary Methionine,%						
Item	.27	.30	.33	.36	.39	.42	CV
d 7 to 14							
ADG[c,d]	.40	.41	.50	.54	.53	.43	18.7
ADFI[e]	.87	.92	.97	.97	.96	.90	9.5
F/G[b,f]	2.53	2.42	1.99	1.80	1.85	2.13	16.6
d 7 to 28							
ADG	.88	.93	.95	.97	.92	.93	9.6
ADFI	1.47	1.47	1.55	1.51	1.51	1.52	7.8
F/G[e]	1.68	1.59	1.63	1.56	1.63	1.65	5.1
Serum urea N, mg/dl							
d 14	5.86	5.78	4.94	5.17	5.36	5.23	21.7
d 28	8.25	6.46	7.01	6.98	7.78	6.95	25.9

[a]Two hundred and sixteen weanling pigs were used (initially 12.4 lbs and 21 d of age), 6 pigs/pen with 6 pens per treatment. Pigs were fed a common phase I diet (d 0 to 7 postweaning).
[bc]Linear effects of dietary methionine (P<.05) and (P<.10), respectively.
[def]Quadratic effects of dietary methionine (P<.01), (P<.05), and (P<.10), respectively.