INFLUENCE OF BUFFERED PROPIONIC AND FUMARIC ACIDS ON STARTER PIG PERFORMANCE [1]

J. R. Bergstrom, M. D. Tokach, R. D. Goodband, J. L. Nelssen, and T. L. Signer

Summary

A 28 d growth trial was conducted to determine the effects of adding organic acids to a Phase I starter diet on pig performance. At weaning (13 ± 2 d of age and 8.86 lb), 300 pigs were blocked by weight and allotted to each of five diets. The control diet was corn-soybean meal based; contained 20% dried whey, 7.5% spray-dried porcine plasma, and 1.75% spray-dried blood meal; and was formulated to 1.5% lysine, .9% Ca, and .8% P. Luprosil NC (.4%; a buffered liquid propionic acid), Luprosil salt (.4%; a buffered dry propionic acid), fumaric acid (1.5%), and a combination of Luprosil NC (.4%) and fumaric acid (1.5%) replaced corn in the control diet to provide the four additional experimental treatments. Pigs fed diets containing any of the acid sources had improved average daily gain (ADG) and feed efficiency (F/G) during Phase I (d 0 to 14 postweaning) compared with those fed the control diet. No differences occurred in ADG among pigs fed any of the acid sources; however, pigs fed the diet containing fumaric acid had improved F/G when compared to those fed Luprosil salt during Phase I. No differences occurred in growth performance when pigs were fed a common diet during Phase II (d 14 to 28 postweaning), but ADG and F/G were improved during the overall 28 d trial when the pigs were fed acidified diets during Phase I. These results suggest that adding organic acids (buffered propionic or fumaric acid) to a diet containing 20% dried whey and 7.5% porcine plasma enhances growth performance from d 0 to 14 postweaning.

(Key Words: Starter, Acid, Diet, Performance.)

Introduction

Previous research at Kansas State University demonstrated that adding fumaric acid to a Phase I starter diet (containing 20% dried whey and 10% porcine plasma) resulted in tendencies for improved ADG and F/G. Buffered propionic acid (Luprosil NC) has also been shown to improve growth performance in swine and offers the advantages of having lower inclusion rate and corrosion potential than nonbuffered propionic acid. Luprosil NC, which contains 53.5% propionic acid, 9.5% ammonia, 11.5% propylene glycol, and 25.5% water, is a liquid preservative of processed feedstuffs. Buffered propionic acid is also available in a dry form, known as Luprosil salt, also a feed preservative. This is a fine, nearly white powder that contains 77% propionic acid and 21% calcium.

The inclusion of acids in starter diets has not been as beneficial when the diets contained higher levels of milk products. How-

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ever, with the increased use of spray-dried blood meal and plasma protein to replace a portion of the milk products in high nutrient density starter diets, a re-evaluation of organic acids and their impact on starter pig performance is necessary. The purpose of this trial was to compare fumaric acid, Luprosil NC, and Luprosil salt as acidifiers in high nutrient density diets (HNDD) for early-weaned pigs.

Procedures

A total of 300 pigs (initially 13 ± 2 d of age and 7 to 13.7 lb) was used in a 28 d growth trial. Pigs were blocked by weight and allotted to one of five diets, with a total of 10 pigs/pen and six pens/treatment. The five diets were: 1) control diet (without acid), 2) .4% Luprosil NC 3) 1.5% fumaric acid, 4) .4% Luprosil NC and 1.5% fumaric acid (combined), and 5) .4% Luprosil salt.

This trial was divided into two phases. During Phase I (d 0 to 14 postweaning), a pelleted diet containing 20% dried whey, 7.5% porcine plasma, and 1.75% spray-dried blood meal and formulated to contain 1.5% lysine, .9% Ca, and .8% P was fed (Table 1). The Luprosil NC, Luprosil salt, fumaric acid, and the combination of Luprosil NC and fumaric acid each replaced corn to achieve the five experimental diets. During Phase II (d 14 to 28 postweaning), all pigs were fed a common diet without acid. This diet contained 10% dried whey and 2.5% spray-dried blood meal and was formulated to 1.25% lysine, .9% Ca, and .8% P (Table 1).

Pigs were housed in an environmentally controlled nursery in 5 × 5 ft pens. Pens were equipped with one self-feeder and two nipple waterers to provide ad libitum access to feed and water.

The pigs were weighed and feed disappearance was determined on d 7, 14, 21, and 28 postweaning. Average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were determined.

Results

During d 0 to 7 postweaning, pigs fed acidified diets had improved ADG ($P<.01$) compared with pigs fed the control diet (Table 2). Pigs fed the diet containing Luprosil NC had improved ADG ($P<.06$) when compared with those fed the diet containing the combination of Luprosil NC and fumaric acid. Pigs fed either of the other acid sources had intermediate ADG. The addition of acid to the diet had mixed effects on ADFI. Pigs fed Luprosil NC had the greatest ADFI, which was different from that of pigs fed either the fumaric acid diet or Luprosil salt diet ($P<.02$). Pigs fed the control diet or other acid sources had intermediate ADFI. Feeding pigs acidified diets improved F/G ($P<.01$), when compared with feeding pigs the control diet; however, no differences in F/G occurred among the pigs fed the various acid sources.

During Phase I (d 0 to 14 postweaning), ADG ($P<.02$) was greatest for pigs fed diets containing acid compared with those fed the control diet. Pigs fed the diets containing Luprosil NC or fumaric acid had numerically the greatest ADG of pigs fed acidified diets. Although no differences occurred in ADFI, F/G ($P<.01$) was improved for pigs fed acidified diets. Among the acid sources, the greatest improvement in F/G resulted from feeding the diet containing fumaric acid, when compared with pigs fed the diet containing Luprosil salt ($P<.03$).

During Phase II (d 14 to 28 postweaning), when all pigs were fed a common diet, no differences occurred in growth performance. Thus, for the overall 28 d trial, ADG ($P\leq.13$) and F/G ($P<.10$) tended to be improved by feeding an acidified diet during d 0 to 14 postweaning.

Discussion

The results of this trial agree with previous research regarding the inclusion of organic acids in starter diets. Although the inclusion of acids in diets containing high levels of milk products (40%) does not affect pig performance, including acids in lower milk product HNDD, such as those used in this trial tends to improve pig performance.

How organic acids improve pig performance is not quite clear. Research conducted at Purdue University indicated that stress associated with weaning often causes an undesirable shift in digestive tract microflora, which results in increased gut pH and reduced nutrient digestion and absorption. Most organic acids seem to prevent this undesirable shift by indirectly reducing gut pH, which improves nutrient digestion, absorption, and overall pig performance.

Although all of the organic acids used in this trial improved pig performance during Phase I, differences between the acids were observed. The data from this trial seem to suggest that fumaric acid improves ADG primarily by increased feed utilization, whereas the Luprosil increases ADG by stimulating feed intake.

Fumaric acid, Luprosil NC, and Luprosil salt can be obtained for about $.26, $.61, and $.56 per lb, respectively. With a corn price of $2.36/bu and the inclusion rates used in this trial, additional costs are $6.69 (fumaric), $4.56 (Luprosil NC), or $4.16 (Luprosil salt) per ton of complete feed.

Although a slight increase in feed cost/ton is associated with adding an acid to a Phase I starter diet, the improvement in ADG and F/G result in lower feed cost per pig. Based on the Kansas State recommendation of feeding a Phase I diet to pigs from 11 to 15 lb, the improvement in F/G (.16) from adding an acid to the diet in this trial would reduce total feed cost per pig by $.16 in addition to the improvement in ADG.

In conclusion, the organic acids tested in this trial resulted in an economical improvement in ADG and F/G when added to the Phase I diet. However, no additive effects resulted from adding different organic acids in combination.

Table 1. Composition of Diets[a]

Ingredient, %	Phase I	Phase II
Corn	44.32[b]	60.27
Soybean meal (46.5% CP)	16.81	22.81
Dried whey	20.00	10.00
Spray dried plasma	7.50	—
Spray dried blood meal	1.75	2.50
Soybean oil	5.00	—
Monocalcium phosphate (21% P)	1.90	1.90
Limestone	.69	.84
Antibiotic[c]	1.00	1.00
Zinc oxide (72%)	.38	—
Copper sulfate	—	.08
L-lysine HCl	.10	.15
DL-methionine	.15	.05
Vitamin premix	.25	.25
Trace mineral premix	.15	.15
Total	100.00	100.00
Calculated analysis, %		
CP	21.57	19.38
Lysine	1.50	1.25
Methionine	.45	.36
Ca	.90	.90
P	.80	.80

[a]Pigs were fed the Phase I and II diets from d 0 to 14 and d 14 to 28, respectively.
[b]Luprosil NC (.4%), Luprisil salt (.4%), fumaric acid (1.5%), and Luprosil NC (.4%) with fumaric acid (1.5%) each replaced corn to form the four additional Phase I experimental diets.
[c]Provided 150 g/ton apramyacin in Phase I and 50 g/ton carbadox in Phase II.

Table 2. Influence of Fumaric Acid, Luprosil NC, Fumaric Acid and Luprosil NC in Combination, and Luprosil Salt on Starter Pig Performance[a]

		Organic acid				
Item	Control	Fum. acid	Lup. NC	Combined	Lup. salt	CV
d 0 to 7						
ADG, lb[bc]	.28	.33	.36	.32	.35	11.1
ADFI, lb[d]	.42	.40	.47	.41	.44	9.8
F/G[be]	1.52	1.22	.130	1.30	1.27	9.7
d 0 to 14						
ADG, lb[f]	.46	.52	.53	.49	.49	7.8
ADFI, lb	.63	.59	.64	.59	.63	8.5
F/G	1.89	1.96	1.92	1.85	1.85	8.0
d 0 to 28						
ADG, lb[g]	.58	.61	.63	.61	.62	8.4
ADFI, lb	.97	.97	1.02	.98	1.00	7.8
F/G[g]	1.69	1.61	1.61	1.61	1.61	5.0

[a]Means represent 10 pigs per pen with 6 replications per treatment. Pigs were weaned at 13 $\pm$ 2 d of age and 8.86 lb.
[b]Mean of pigs fed acidified diets vs control ($P<.01$).
[c]Luprosil NC vs combined ($P<.06$).
[d]Fumaric acid vs Luprosil NC ($P<.05$).
[e]Fumaric acid vs Luprosil salt ($P<.05$).
[f]Mean of pigs fed acidified diets vs control ($P<.05$).
[g]Mean of pigs fed acidified diets vs control ($P\leq.13$).