INFLUENCE OF FUMARIC ACID AND CALCIUM FORMATE ON STARTER PIG PERFORMANCE[1]

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Summary

A 25 d growth trial utilizing 198 pigs was conducted to determine the influence of fumaric acid and calcium formate on starter pig performance. At weaning (19 d of age and 11.9 lb), pigs were blocked by weight and allotted to one of three dietary treatments: a control diet without acid addition or diets containing 1.5% fumaric acid or 1.5% calcium formate. Adding calcium formate to the diet had no influence on average daily gain (ADG), average daily feed intake (ADFI), or feed efficiency (F/G). Pigs fed the diet containing fumaric acid had improved feed efficiency during the first 2 weeks postweaning compared to pigs fed the other two diets. These results do not support the addition of calcium formate to the starter diet. However, results warrant additional research to determine the efficacy of fumaric acid in high nutrient density starter diets.

(Key Words: Starter, Performance, Fumaric acid, Calcium formate.)

Introduction

Previous research has demonstrated that adding organic acids to corn-soybean meal starter diets improves pig performance. However, similar results have not been found when adding organic acids to diets containing high levels of milk products. The high nutrient density diet, which has become the standard diet for the early-weaned pig, traditionally contains high levels of milk products. Recent availability of spray-dried blood products has reduced the use of milk products in these diets. Therefore, the addition of acids to these low milk product, high nutrient density diets should be assessed. This trial was conducted to compare fumaric acid and calcium formate as acidifiers in diets for early-weaned pigs and to determine their influence on pig performance.

Procedures

A total of 198 pigs (initially 19 d and 11.9 lb) was used in this 25 d growth trial. Pigs were blocked by weight and allotted to one of three dietary treatments for a total of 11 pigs/pen and six pens/treatment. The three treatments were a control diet without acid or diets containing 1.5% fumaric acid or 1.5% calcium formate.

The trial was divided into two phases. During phase I (d 0 to 14 postweaning), high nutrient density diets containing 20% dried whey, 7.5% porcine plasma, and 1.5% spray-dried blood meal were fed (Table 1). Diets were formulated to contain 1.5% lysine, .8% phosphorus, and at least .9% calcium. During phase II (d 14 to 25 postweaning), diets contained 10% dried whey and 2.5% spray-dried blood meal and were formulated to 1.25% lysine, .8% phosphorus, and at least .9% calcium. Fumaric acid and calcium formate replaced corn in the phase I and II diets to achieve the three

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experimental diets. The limestone was removed from the diets containing calcium formate to maintain calcium at less than 1.1% of the diet. Phase I diets were fed as pellets, whereas phase II diets were fed in meal form.

Pigs were housed in an environmentally controlled nursery in 5 x 7 ft pens. They had ad libitum access to feed and water.

Pigs were weighed and feed disappearance was determined at the end of phase I (d 14) and at the conclusion of the 25 d trial. Average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) were determined.

Results and Discussion

Including calcium formate in the phase I and II diet had no influence on ADG, ADFI, or F/G (Table 2). Fumaric acid improved ADG by 10.7% during phase I; however, this response was not statistical significant ($P=.18$). Adding fumaric acid to the diet improved ($P<.07$) feed efficiency by 7% during phase I. Pigs fed the diet containing fumaric acid had slightly lower feed intake during phase II ($P<.09$); however, this did not translate into differences in ADG or F/G. For the overall trial (d 0 to 25), adding fumaric acid to the diet had no influence on pig performance

The main theory behind the addition of acids to starter diets for the early-weaned pig is that the pig is unable secrete enough gastric acid to lower the pH of the stomach and small intestine. The lower pH is necessary to allow maximal activity of the enzymes needed to digest complex proteins and carbohydrates. Research from the University of Illinois has demonstrated that adding fumaric acid to a corn-soybean meal diet for the young pig will decrease pH in the stomach and small intestine, enhancing digestibility and performance. Under disease situations, decreasing the pH of the gut is especially important because bacterial growth is maximized at higher pH.

The reason for the relatively small response to acid inclusion in the diet in this experiment may have been the milk and blood product inclusion levels in the diet. As explained above, previous research indicated that adding acids to diets containing high levels (40%) of milk products did not influence pig performance. In this trial, the phase I and II diets contained only 20 and 10% milk products, respectively. However, because the diets also contained highly digestible spray-dried blood products, they may have been too digestible to detect any improvement from lowering the pH of the gastrointestinal contents.

Further research is needed to evaluate the effectiveness of calcium formate in less complex diets for the early-weaned pig. Additional research also is needed to determine the repeatability of the 5 to 7% improvement in feed efficiency seen in this trial when fumaric acid was added to the diet.

Table 1. Composition of Diets[a]

Ingredient, %	Phase I	Phase II
Corn[b]	44.59	58.92
Soybean meal (48% CP)	19.30	21.04
Dried whey	20.00	10.00
Porcine plasma	7.50	
Spray-dried blood meal	1.50	2.50
Soybean oil	3.00	3.00
Monocalcium phosphate (21% P)	1.83	1.98
Limestone	.69	.83
Apralan	1.00	
Mecadox		1.00
Copper sulfate	.08	.08
L-Lysine HCl		.15
DL-methionine	.06	.05
Vitamin premix	.25	.25
Trace mineral premix	.15	.15
Selenium premix	.05	.05
Total	100.00	100.00
Calculated Analysis, %		
Crude protein	22.5	18.9
Lysine	1.50	1.25
Methionine	.37	.35
Ca[c]	.90	.90
P	.80	.80

[a]Pigs were fed the phase I and II diets from d 0 to 14 and d 14 to 25, respectively.
[b]Calcium formate and fumaric acid (1.5%) and soybean meal (.13%) replaced corn (1.63%) to form the experimental diets. Limestone was replaced with corn in the calcium formate diet to account for the extra calcium.
[c]Phase I and II diets with calcium formate contained 1.04% calcium.

Table 2. Influence of Fumaric Acid and Calcium Formate on Starter Pig Performance[a]

Item	Control	Fumaric acid	Calcium formate	CV
D 0 to 14				
ADG, lb	.47	.52	.47	12.5
ADFI, lb	.58	.60	.58	8.3
F/G[b]	1.26	1.17	1.26	6.4
D 14 to 25				
ADG, lb	1.07	1.04	1.07	5.6
ADFI, lb[c]	1.65	1.55	1.61	5.0
F/G	1.54	1.49	1.53	9.6
D 0 to 25				
ADG, lb	.74	.76	.74	6.2
ADFI, lb	1.07	1.03	1.05	4.1
F/G	1.44	1.37	1.44	7.1

[a]Each value is the mean of six pens containing 11 pigs per pen. Pigs were weaned at 16 d of age and 11.9 lb.
[b]Contrast: control vs fumaric acid ($P < .07$); fumaric acid vs calcium formate ($P < .07$).
[c]Contrast: control vs fumaric acid ($P < .09$).