EFFECT OF ACIDIFICATION ON STARTER PIG PERFORMANCE

C. V. Maxwell[1], K.S. Sohn[2] and K.S. Brock[3]

Story in Brief

Acidification of feeds may result in improved digestibility of nutrients in young pigs and has been shown to reduce proliferation of coliform bacteria. The fact that organic acids are absorbed rapidly from the intestine may limit their effectiveness and require high inclusion levels to produce the acidification effect. A fatty acid coated acid product (containing 300g of acid/kg or 30% acids) was tested to determine the efficacy of a protected organic acid product in early-weaning pig diets. During the first two week period, feed intake and gain was similar between pigs fed the control diet and those fed either the protected or unprotected acid source. Pigs fed the unprotected acid source (.50% citric and .50% fumaric) had a higher intake and gain than those fed a lower level of protected acid source (.3% Triacid-300). During Phase 2, feed intake, gain and efficiency were similar among the three treatments. During Phase 3, however, when pigs were fed a simpler corn-soybean meal diet, feeding .3% Triacid-300 improved gain, feed intake and efficiency. This study demonstrates a better efficiency of a protected acid source at lower inclusion level (6.6 lb/ton) than more common organic acids fed at a higher level (20 lb/ton).

(Key Words: Early-weaned Pigs, Acidification, Protected Acids.)

Introduction

There has been considerable research on the use of organic acids to promote gastrointestinal tract acidification in young pigs. Acidification of feeds results in improved digestibility of nutrients in young pigs (Kirchgessner and Roth, 1982) and reduces proliferation of coliform bacteria (Scipioni et al., 1978). Organic acids are absorbed rapidly and the acidification effect may be reduced in the small intestine by the rapid digestion and absorption of acids.

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[1]Professor [2]Research Associate [3]Swine Herdsmen

A lipid coated acid source may reduce the rate of absorption and thereby prolong the acidification process in the small intestine. An additional advantage of protected acids may be to reduce the inclusion level required for dietary acidification. This study was conducted to determine the effect of organic acids on nursery pig performance and to compare an unprotected organic acid source with a lower inclusion level of a protected mixed acid source (Triacid-300).

Materials and Methods

Seventy-two pigs (Hampshire and/or Yorkshire) were group weaned (from one farrowing room) when the oldest pigs were approximately 26 days old, and the youngest pigs were approximately 20 days old. Pigs were blocked by age group (36 pigs in each of 2 groups) and stratified by litter, weight, and sex (boars and gilts) into 6 pens with 6 pigs per pen in each weight group. Pens from each weight group were randomly allotted to one of three treatments (4 pens/treatment) consisting of a basal prestarter diet (Table 1, Treatment 1), the basal prestarter diet + .5% citric acid and .5% fumaric acid (Treatment 2) or the basal prestarter diet + .3% Triacid 300 (Treatment 3). The prestarter diet was fed for a two week period (Period 1) when the diets were changed to a basal starter I diet (Table 1, Treatment 1), the basal starter I diet + .5% citric acid and .5% fumaric acid (Treatment 2) or the basal starter I diet + 0.3% Triacid 300 (Treatment 3). The starter I diets were continued for a two week period (Phase 2) when the diets were changed to a basal starter II diet (Table 1, Treatment 1), the starter II diet + .5% citric acid and 0.5% fumaric acid (Treatment 2) or the basal starter II diet + .3% Triacid 300 (Treatment 3). The starter II diet was fed for a two week period (Phase 3). The trial was conducted in an environmentally controlled nursery with temperatures initially maintained at 86°F and decreased 2°F weekly until the temperature reached 78°F. Both feed and water were available on an ad libitum basis. Interim gain and efficiency of gain estimates were obtained weekly.

Results and Discussion

Means are presented for each treatment and each treatment x age combination (Table 2). Both are presented because treatments had different effects for pigs of different ages ($P < .05$). During week 1, pigs fed .3% Triacid 300 (Treatment 3) grew slower ($P < .05$) than those fed the control diet (Treatment 1) or the .5% citric and .5% fumaric acid diet (Treatment 3). During week 2, pigs fed .5% citric and .5% fumaric acid (Treatment 2) or

Table 1. Composition of experimental diets.

	Diet								
	Prestarter 0-2 Weeks			Starter I 2 wk - 4 wk			Starter II 4 wk - 6 wk		
	Control 1	Cit+Fum 2	Triacid 300 3	Control 1	Cit+Fum 2	Triacid 300 3	Control 1	Cit+Fum 2	Triacid 300 3
Dried skim milk	10.0	10.0	10.0	-	-	-	-	-	-
Whey, dehy	20.0	20.0	20.0	5.0	5.0	5.0	-	-	-
Steam rolled oats	10.0	10.0	10.0	-	-	-	-	-	-
AP-820[a]	6.0	6.0	6.0	-	-	-	-	-	-
Soybean meal	-	-	-	23.40	23.40	23.40	28.60	28.60	28.60
Corn, ground	36.135	35.135	35.835	60.255	59.255	59.955	67.375	66.375	67.075
Soybean oil	4.0	4.0	4.0	3.0	3.0	3.0	-	-	-
Pro-88[b]	5.0	5.0	5.0	-	-	-	-	-	-
Fishmeal[c]	7.0	7.0	7.0	5.0	5.0	5.0	-	-	-
Citric acid	-	.50	-	-	.50	-	-	.50	-
Fumaric acid	-	.50	-	-	.50	-	-	.50	-
Triacid-300	-	-	.30	-	-	.30	-	-	.30
Lysine, HCl	.22	.22	.22	.28	.28	.28	.28	.28	.28
Ethoxyquin	.025	.025	.025	.025	.025	.025	-	-	-
Mecadox[d]	.25	.25	.25	.25	.25	.25	.25	.25	.25
Flavor	.1	.1	.1	.1	.1	.1	-	-	-
$CuSO_4$	.1	.1	.1	.075	.075	.075	-	-	-

Table 1. (Continued).

	Diet								
	Prestarter 0-2 Weeks			Starter I 2 wk - 4 wk			Starter II 4 wk - 6 wk		
	Control 1	Cit+Fum 2	Triacid 300 3	Control 1	Cit+Fum 2	Triacid 300 3	Control 1	Cit+Fum 2	Triacid 300 3
$CaCO_3$	-	-	-	.19	.19	.19	.66	.66	.66
Dical phosphate	.65	.65	.65	1.65	1.65	1.65	2.06	2.06	2.06
DL-Methionine	.02	.02	.02	-	-	-	-	-	-
Vit-Min-Mix	.50	.50	.50	.375	.375	.375	.375	.375	.375
Salt	-	-	-	.4	.4	.4	.4	.4	.4
Calculated composition									
Lysine	1.60	1.60	1.60	1.33	1.33	1.33	1.22	1.22	1.22
Ca	0.93	0.93	0.93	0.90	0.90	0.90	0.90	0.90	0.90
P	0.80	0.80	0.80	0.80	0.80	0.80	0.75	0.75	0.75

[a] Plasma protein - American Protein Corporation, Ames, Iowa
[b] Morgan Manufacturing Co., Inc. Paris, IL
[c] Select Grade
[d] Contains 22 g Carbadox per kg.
[e] JEFO Import Export, Inc., Quebec, Canada

Table 2. Effect of acidification on starter pig performance[a].

	Age x treatment subclass means						Treatment main effect means			SE
	Control		CIT+FUM		Triacid-300		Control	CIT+FUM	Triacid-300	
	Old	Young	Old	Young	Old	Young				
Initial age, d	28.4	22.9	28.5	23.2	28.2	23.0	25.7	25.9	25.6	
Initial wt, lb	17.40	14.63	17.29	15.26	17.38	15.55	16.01	16.28	16.88	
ADG, lb										
WK 1	1.08[b]	.75[cd]	1.03[b]	.77[cd]	.84[c]	.64[d]	.92[b]	.90[b]	.75[c]	.04
WK 2	.70[bcd]	.44[cd]	.86[b]	.64[bcd]	.81[bc]	.51[cd]	.57[g]	.75[f]	.66[fg]	.07
Phase 1(WK1-2)	.98[bc]	.59[e]	.94[b]	.70[cde]	.83[bcd]	.57[e]	.74[fg]	.84[f]	.70[g]	.04
WK 3[h]	1.14[cd]	1.06[cd]	.1.41[b]	.88[e]	1.21[c]	.90[e]	1.10	1.14	1.06	.04
WK 4	1.65[b]	1.39[bc]	1.58[bc]	1.30[c]	1.54[bc]	1.30[c]	1.52	1.47	1.43	.07
Phase 2(WK3-4)	1.41[bc]	1.23[de]	1.49[b]	1.08[e]	1.38[bcd]	1.10[e]	1.32	1.30	1.23	.04
WK 5	1.08[cd]	1.01[d]	1.32[bc]	1.12[cd]	1.45[b]	1.19[cd]	1.03[c]	1.21[b]	1.32[b]	.04
WK 6	1.30	1.25	1.28	1.16	1.47	1.41	1.28	1.23	1.45	1.1
Phase 3(WK5-6)	1.19[bc]	1.12	1.30[bc]	1.14[c]	1.47[b]	1.30[bc]	1.17[c]	1.21[bc]	1.39[b]	.07
ADFI, lb										
WK 1	.92[bc]	.70[c]	.99[b]	.75[bc]	.88[bc]	.66[cd]	.81	.80	.77	.07
WK 2	1.03[bc]	.68[e]	1.21[b]	.92[cd]	.97[cd]	.62[e]	.84[c]	1.08[b]	.77[c]	.04
Phase 1(WK1-2)	.99[bc]	.70[e]	1.10[b]	.84[cde]	.92[bcd]	.64[e]	.84[bc]	.97[b]	.77[c]	.04
WK 3	2.18	2.18	2.33	2.20	2.27	2.13	2.18	2.27	2.20	.07
WK 4	2.42	2.49	2.38	2.49	2.31	2.27	2.46	2.44	2.55	.15
Phase 2(WK3-4)	2.31	2.33	2.35	2.35	2.31	2.20	2.31	2.35	2.24	.07

Table 2. (Continued).

	Age x treatment subclass means						Treatment main effect means			SE
	Control		CIT+FUM		Triacid-300		Control	CIT+FUM	Triacid-300	
	Old	Young	Old	Young	Old	Young				
WK 5	2.44	2.55	2.77	2.55	2.60	2.51	2.49	2.66	2.55	.15
WK 6	2.51	2.40	2.62	2.64	2.75	2.57	2.44	2.62	2.66	.18
Phase 3(WK5-6)	2.48	2.49	2.71	2.60	2.68	2.55	2.49	2.64	2.62	.20
F:G(Feed/Gain)										
WK 1	.86	.92	.95	.97	1.04	1.04	.89	.96	1.04	.07
WK 2	1.50	1.66	1.41	1.48	1.24	1.26	1.58	1.44	1.25	.14
Phase 1(WK1-2)	1.18	1.29	1.18	1.22	1.14	1.15	1.24	1.20	1.15	.09
WK 3[i]	1.90^{bc}	2.05^{cd}	1.66^{b}	2.50^{e}	1.89^{bc}	2.37^{de}	1.97	2.08	2.13	.09
WK 4	1.47^{f}	1.79^{fg}	1.51^{f}	1.93^{g}	1.51^{f}	1.72^{fg}	1.63	1.72	1.62	.09
Phase 2(WK3-4)	1.68^{e}	1.92^{bcd}	1.59^{e}	2.22^{b}	1.71^{de}	2.05^{bc}	1.80	1.91	1.88	.06
WK 5	2.26^{bcd}	2.54^{b}	2.11^{cde}	2.27^{bc}	1.80^{e}	2.12^{cde}	2.40^{c}	2.19^{bc}	1.96^{b}	.08
WK 6	1.92	1.97	2.06	2.23	1.86	1.84	1.95	2.14	1.85	.11
Phase 3(WK5-6)	2.10^{bcd}	2.26^{b}	2.09^{bcd}	2.25^{bc}	1.83^{d}	1.98^{bcd}	2.18^{f}	2.17^{f}	1.90^{g}	.08

[a] Least squares means.
[b,c,d,e] Means in the same row with different superscripts differ (P<.05).
[f,g] Means in the same row with different superscripts differ (P<.1).
[h] Treatment x age interaction (P<.05).
[i] Treatment x age interaction (P<.1).

.3% Triacid 300 (Treatment 3) grew 31% (P< .10) and 15.4% faster, respectively than those fed the control diet without acid. Feed intake was higher (P<.05) in week 2 in pigs fed .5% citric acid and .5% fumaric acid (Treatment 2) when compared to those fed the control diet without acid (Treatment 1) or the .3% protected (Triacid-300) diet (Treatment 3). During the first two week period (Phase 1) pigs fed the Triacid 300 diet (Treatment 3) consumed less feed (P<.05) than those fed .5% citric acid and .5% fumaric acid (Treatment 2). Feed efficiency was similar among the treatments. During weeks 3 and 4 and for the two week Phase 2 period, overall performance (gain, feed intake and feed efficiency) was similar among the three treatments. During week 3, older pigs tended to respond to the acid diets with increased average daily gain, while the younger pigs tended to grow more slowly when compared to pigs fed the control diet. This resulted in a treatment x age interaction (P<.05). A similar response was observed for feed efficiency during week 3 (P<.1).

During the final two week period (Phase 3), when a simpler corn-soybean meal diet was fed, pigs fed .3% Triacid 300 (Treatment 3) grew 18.9% faster (P<.05) than those fed the acid free control diet (Treatment 1) and 14.5% faster than those fed .5% citric acid and fumaric acid (Treatment 2). This improvement in gain was achieved with a similar feed intake among the three treatments. Therefore, pigs fed .3% Triacid 300 (Treatment 3) were 12.8% more efficient (P<.1) than those fed the acid free Control diet (Treatment 2) and 12.4% (P<.1) more efficient than those fed the .5% citric acid and .5% fumaric acid diet (Treatment 2).

In this study, Triacid 300 was more effective in improving performance in Phase 3, (when pigs were fed a corn-soybean meal diet) than critic and fumaric acid. It should be noted that gain and efficiency were improved even though the inclusion level of Triacid 300 was only 6.6 lb/ton compared to 20 lb/ton in pigs fed citric and fumaric acid. This could reduce cost of producing the acidification effect in early-weaning pig diets.

Literature Cited

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