EFFECTS OF WATER-BASED CITRIC ACID ON GROWTH PERFORMANCE AND WATER DISAPPEARANCE OF WEANLING PIGS

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Summary

A total of 399 weanling pigs (initially 12.2 lb and 14 ± 3 d of age, PIC) were used to determine the effects of water-based citric acid on nursery pig growth performance and water disappearance. Pigs were given a common diet and one of two experimental water treatments: 1) negative control, water containing no additives; and 2) water containing 0.55 g per L citric acid. Overall (d 0 to 10 after weaning), there were no differences in growth performance between pigs provided water or water with added citric acid. In addition, water disappearance was similar between treatments for the overall period. These results suggest that adding 0.55 g/L of citric acid improves neither pig growth or water intake when offered immediately after weaning.

(Key Words: Citric Acid, Nursery Pig, Water, Growth.)

Introduction

The use of acidifiers in weanling pig nutrition has been shown to improve growth rate and feed efficiency for diets based on corn-soybean meal. Citric acid is a common organic acid included in some diets for this reason. Citric acid added to the drinking water supply is thought to improve water-based antibiotic solubility and improve water intake by the weanling pig. Recent experiments at Kansas State University have shown beneficial growth performance as a result of using water-based antibiotics in place of feed-grade antibiotics. In those experiments, there were difficulties experienced with solubility of the medication in water, and with plugged waterers. Because of the known solubility of citric acid, and its potential for growth promotion, it is of interest for use in water medication dosing systems. Therefore, the objective of this experiment was to determine the effects of water-based citric acid on the growth performance and water disappearance of weanling pigs. This is important to determine if positive results in previous studies evaluating water-based feed medication were due to the specific medication and/or the citric acid added to the water.

Procedures

A total of 399 weanling pigs (initially 12.2 lb and 14 ± 3 d of age, PIC) were blocked by initial weight and randomly allotted to one of two water treatments. Groups of ten pens were supplied by the same water line and served as one experimental unit. There were five pigs per pen and four experimental units (40 pens) per treatment. Pigs remained on the same treatments for 10 d after weaning.

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The two experimental treatments were negative control and water containing 0.55 g/L citric acid. When used, granular citric acid (Univar USA, LLC; Kirkland, WA) was provided as a concentrate of 55.0 g per L of water, and the concentrate was diluted to a concentrate:water ratio of 1:100. This provided 0.55 g of citric acid per L of drinking water. All pigs received a common diet containing an antibiotic.

Water disappearance data was collected and water treatments were administered through SelectDoser™ peristaltic pumps (Genesis Instruments; Elmwood, WI). This type of doser is powered by electricity; siphons a concentrated, pre-mixed stock solution through a tube; and doses the medication into the existing water supply. Concentrated stock solutions were made once every two days throughout the experiment. The acidified water solution consisted of 4 L of water and 220 g granular citric acid. These concentrated stock solutions were dosed into the existing water line at a ratio of 1:100 to achieve the desired level of acidification.

Phase 1 (d 0 to 5 after weaning) diets (Table 1) were fed in pellet form and were formulated to contain 1.51% true ileal digestible (TID) lysine, 0.79% Ca, and 0.55% available phosphorus. Phase 2 (d 5 to 10 after weaning) diets were formulated to contain 1.40% TID lysine, 0.85% Ca, and 0.48% available phosphorus. The trial was conducted in an environmentally controlled segregated early-weaning nursery facility at Kansas State University. Each pen was 5 × 5 ft and contained one self-feeder and one nipple waterer to provide *ad libitum* access to feed and water. Average daily gain, ADFI, and F/G were determined by weighing pigs and feeders on d 5 and 10 after weaning. In addition, water disappearance was measured. Growth performance data were analyzed as a randomized complete-block design, with pair of pens as the experimental unit. Analysis of variance was performed by using the MIXED procedure of SAS.

Results and Discussion

There were no differences in growth performance between pigs provided the two treatments during Phase 1 (d 0 to 5), Phase 2 (d 5 to 10) or the overall (d 0 to 10) treatment period (Table 2). In addition, water disappearance was similar between treatments for the overall period (Table 3). This indicates that citric acid in the water at 0.55 g/L does not affect pig growth, feed intake, feed efficiency, or water disappearance. Although citric acid is still a valuable water additive to influence antimicrobial solubility, citric acid addition in this experiment did not influence growth performance or water intake. Further research is encouraged with other organic acids to determine potential effects of acidified drinking water on the feed and water disappearance of weanling pigs.

Table 1. Diet Composition (As-fed Basis)

Ingredient, %	Phase 1[a]	Phase 2[b]
Corn	37.14	54.44
Soybean meal (46.5% CP)	20.06	24.51
Spray-dried animal plasma	2.50	---
Select menhaden fish meal	5.00	4.00
Spray-dried blood cells	1.25	---
Spray dried whey	25.00	10.00
Choice white grease	5.00	---
Soy oil	---	3.00
Monocalcium P (21% P)	0.70	1.10
Limestone	0.45	0.70
Salt	0.30	0.30
Zinc oxide	0.38	0.25
Vitamin premix with phytase	0.25	0.25
Trace mineral premix	0.15	0.15
Lysine HCl	0.26	0.30
DL-methionine	0.18	0.18
L-threonine	0.13	0.13
Neo-Terramycin®	1.00	0.70
Acidifier	0.20	---
Vitamin E, 20,000 IU	0.05	---
Total	100.00	100.00
Calculated analysis		
Total lysine, %	1.65	1.54
True ileal digestible lysine,%	1.51	1.40
ME, kcal/lb	1,575	1,534
CP, %	22.6	19.8
Ca, %	0.79	0.85
P, %	0.73	0.75
Available P, %	0.55	0.48

[a]Fed from d 0 to 5 after weaning.
[b]Fed from d 5 to 10 fter weaning.

Table 2. Growth Performance of Nursery Pigs Provided Citric Acid in Drinking Water[a]

Item	Control	Citric acid, 0.55 g/L Water	Probability, P< Treatment	SE
d 0 to 5				
ADG, lb	0.52	0.52	0.90	0.019
ADFI, lb	0.43	0.42	0.54	0.016
F/G	0.84	0.83	0.77	0.016
d 5 to 10				
ADG, lb	0.65	0.62	0.20	0.027
ADFI, lb	0.93	0.91	0.35	0.024
F/G	1.48	1.50	0.54	0.034
d 0 to 10				
ADG, lb	0.58	0.57	0.38	0.021
ADFI, lb	0.68	0.67	0.36	0.019
F/G	1.18	1.18	0.98	0.019

[a]A total of 399 weanling pigs, (PIC L337 × C22) initially 12.2 lb. Values are the mean of 40 replications (pens).

Table 3. Water Disappearance of Nursery Pigs Provided Citric Acid in Drinking Water[a]

	% of Body Weight		Liters per Day	
Item	Control	Citric /acid, 0.55 g/L	Control	Citric Acid, 0.55 g/L
d 0 to 5	23.85	23.16	1.64	1.59
d 5 to 10	19.04	18.82	1.60	1.56

[a]A total of 399 weanling pigs, (PIC L337 × C22) initially 12.2 lb. Values are the mean of 4 replications.