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## Effects of fat and sodium bicarbonate on growth performance and stomach morphology in finishing pigs

### Abstract

Pigs fed diets with soybean oil consumed less feed; grew more efficiently; and had greater last-rib backfat thickness, keratosis, and ulceration in their stomachs than pigs fed diets without soybean oil. Pigs fed diets with NaHCO<sub>3</sub> tended to eat more feed and had numerically greater ADG, but feed/gain and carcass measurements were not affected. NaHCO<sub>3</sub> decreased ulceration scores only for pigs fed diets without added fat.; Swine Day, Manhattan, KS, November 21, 1996

### Keywords

Swine day, 1996; Kansas Agricultural Experiment Station contribution; no. 97-142-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 772; Swine; Finishing pigs; Fat; Sodium bicarbonate; Ulcers

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**EFFECTS OF FAT AND SODIUM BICARBONATE  
ON GROWTH PERFORMANCE AND STOMACH  
MORPHOLOGY IN FINISHING PIGS**

*S. P. Sorrell, J. D. Hancock, I. H. Kim,  
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**Summary**

Pigs fed diets with soybean oil consumed less feed; grew more efficiently; and had greater last-rib backfat thickness, keratosis, and ulceration in their stomachs than pigs fed diets without soybean oil. Pigs fed diets with NaHCO<sub>3</sub> tended to eat more feed and had numerically greater ADG, but feed/gain and carcass measurements were not affected. NaHCO<sub>3</sub> decreased ulceration scores only for pigs fed diets without added fat.

(Key Words: Finishing Pigs, Fat, Sodium Bicarbonate, Ulcers.)

**Introduction**

Swine production in the United States has become very intensive. With this intensive production have come major changes in genetics; sometimes crowded pens; advanced feed processing procedures (e.g., fine grinding, pelleting, extruding, and expanding); and diet modifications (e.g., high fat) to maximize efficiency of gain. All of these factors have been implicated as contributors to the development of stomach lesions in finishing pigs. The resulting loss in growth performance and even death of afflicted pigs has prompted widespread investigation of methods to decrease the incidence and severity of stomach lesions.

Especially in the southeastern United States, anecdotal reports link crowded pens and high-fat diets with increased incidence of stomach lesions in pigs. In previous research here at KSU (1993 Swine Day Report), we observed that inclusion of 1% NaHCO<sub>3</sub> in simple corn-soy-based diets tended to reduce severity of gastric lesions in finishing pigs.

Thus, the objective of the experiment reported herein was to determine the effects of fat on growth performance and stomach lesions in finishing pigs and to evaluate NaHCO<sub>3</sub> as a modifying influence in development of stomach lesions for pigs fed diets with added fat.

**Procedures**

Two hundred and forty crossbred pigs were allotted to 16 pens with 15 pigs per pen (6 ft<sup>2</sup>/pig). Each pens was equipped with a self-feeder and nipple waterer to allowed ad libitum consumption of feed and water. The experiment was conducted as a 2 × 2 factorial with main effects of fat (none vs 6% added) and NaHCO<sub>3</sub> (none vs 1% added).

All pigs (Hampshire × Yorkshire × Duroc × Chester White crossbreds) were fed a corn-soybean meal-based diet formulated to .65% calcium and .55% phosphorus (Table 1). Lysine concentrations were .65% for the diets without added fat and .70% for the diets with added fat. The pigs were allotted to treatments on the basis of initial weight (avg of 100 lb), sex (eight barrows and seven gilts in each pen), and ancestry. The pigs were housed in a modified open-front building with half slatted and half solid, concrete floors.

The pigs were slaughtered when the average weight in the heaviest pen of a weight block reached 250 lb. At slaughter, carcass data were obtained, and the esophageal regions of the stomachs were scored for keratosis and ulceration. Response criteria were ADG, ADFI, G/F, backfat thickness, dressing percentage, FFLI, and scores for keratosis and ulceration in the stomach.

All data were analyzed as a randomized complete block design (initial weight as the blocking term) using the GLM procedure of SAS and with a 2 × 2 factorial arrangement of treatments. Pen was the experimental unit for all analyses.

### Results and Discussions

No interactions ( $P > .15$ ) occurred among the main effects of fat and  $\text{NaHCO}_3$  for any of the growth or carcass data (Table 2). However, pigs fed diets with soybean oil consumed less feed and were more efficient than pigs fed diets without soybean oil ( $P < .001$ ). These data are in agreement with numerous other reports that adding fat increases energy density of diets, reduces voluntary feed intake, and improves efficiency of growth. Pigs fed the fat-added diet had 1% greater dressing percentage ( $P < .002$ ), but also had .08 in. more last rib fat thickness ( $P < .006$ ).

The pigs ate more of the diets with 1%  $\text{NaHCO}_3$  ( $P < .06$ ), but rate and efficiency of gain were not affected ( $P > .12$ ). Adding

$\text{NaHCO}_3$  to the diets did not affect carcass characteristics ( $P > .15$ ).

Pigs fed soybean oil had greater keratinization ( $P < .07$ ) and ulceration ( $P < .05$ ) scores than pigs fed no soybean oil. Adding  $\text{NaHCO}_3$  decreased ulceration scores, but only for pigs fed diets without added fat (fat ×  $\text{NaHCO}_3$  interaction,  $P < .01$ ). This response was actually the opposite of what was expected, i.e., that fat additions might aggravate stomach tissues and that  $\text{NaHCO}_3$  could be of greatest benefit in those situations. To the contrary, lesion scores were actually slightly greater for pigs fed  $\text{NaHCO}_3$  in the fat-added diets.

In conclusion, our data suggested that soybean oil enhanced growth performance but increased stomach keratosis and ulceration. Feeding  $\text{NaHCO}_3$  did not affect growth performance (with only a trend for greater feed consumption) or carcass characteristics and prevented adverse changes in stomach morphology only for pigs fed diets without soybean oil.

**Table 1. Diet Composition<sup>a</sup>**

Ingredient, %	No Soy Oil and No $\text{NaHCO}_3$	1% $\text{NaHCO}_3$	6% Soy Oil	1% $\text{NaHCO}_3$ & 6% Soy Oil
Corn	82.8	81.6	77.0	75.9
Soybean meal	14.6	14.8	14.2	14.3
Soy oil	-	-	6.0	6.0
$\text{NaHCO}_3$	-	1.0	-	1.0
Vit, Min, Antibio <sup>b</sup>	2.6	2.6	2.7	2.7
Lysine HCl	-	-	.1	.1
<u>Calculated analysis</u>				
Lys, %	.65	.65	.70	.70
ME, kcal/lb	1,508	1,492	1,611	1,595

<sup>a</sup>Formulated to .65% Ca and .55% P.

<sup>b</sup>Supplied 40 g/ton tylosin.

**Table 2. Effects of Fat and Sodium Bicarbonate on Growth Performance, Carcass Characteristics, and Stomach Morphology in Finishing Pigs<sup>a</sup>**

Item	No Soy Oil & No NaHCO <sub>3</sub>	1% NaHCO <sub>3</sub>	6% Soy Oil	1% NaHCO <sub>3</sub> & 6% Soy Oil	CV	Contrasts		
						1	2	3
ADG, lb	1.85	1.93	1.87	1.91	3.7	-. <sup>e</sup>	.12	-
ADFI, lb	5.86	6.10	5.54	5.64	2.7	.001	.06	-
F/G	3.18	3.17	2.96	2.96	3.0	.001	-	-
Backfat, in	1.14	1.15	1.24	1.20	3.7	.006	-	-
HCW, lb	186	186	189	189	.74	.002	-	-
Dressing, %	74.8	74.6	75.9	76.0	.8	.002	-	-
FFLI, %	47.1	46.9	46.2	46.6	.8	.01	-	-
Keratosisc	1.39	1.45	1.62	1.54	43	.07	-	-
Ulceration <sup>d</sup>	.72	.33	.66	.88	139	.05	-	.01

<sup>a</sup>A total of 240 pigs (avg initial wt of 100 lb) were used.

<sup>b</sup>Contrasts were: 1) fat vs no fat; 2) NaHCO<sub>3</sub> vs no NaHCO<sub>3</sub>; and 3) fat × NaHCO<sub>3</sub> interaction.

<sup>c</sup>The scoring system was: 0 = normal; 1 = mild; 2 = moderate; and 3 = severe keratosis.

<sup>d</sup>The scoring system was: 0 = normal; 1 = mild; 2 = moderate; and 3 = severe ulceration.

<sup>e</sup>Dashes indicate  $P > .15$ .



**Swine Nutrition Graduate Students: Back row (L to R) Jim Smith, In-Ho Kim, Brandon Senne, Ioannis Mavromichalis, Robert Musser, Joe Loughmiller, LeAnn Johnston, Perry Sorrell; Front row (L to R) Carla Johnson, Jon Berstrom, Kittiporn Hongtrakul, Patrick O'Quinn, and Cao Hong. Not pictured, Chad Kerr and Ben Nessmith.**