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EFFECTS OF MAGNESIUM SILICATE (TALC) ON FEED FLOW CHARACTERISTICS AND GROWTH PERFORMANCE, CARCASS CHARACTERISTICS, AND STOMACH MORPHOLOGY IN FINISHING PIGS[1]

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Summary

Talc did not affect growth performance, carcass characteristics, or stomach ulceration in finishing pigs. Feeder bridging scores and coefficients of static force (the force needed to result in particle movement) were increased with added talc, both of which indicate reduced feed flowability. In a second experiment, reducing particle size from 1,050 microns to 450 microns increased the coefficients of static force, dynamic force, and angle of repose. Adding talc to either particle size diet did not improve feed flow characteristics.

(Key Words: Talc, Ulcers, Bridging, Finishing Pigs.)

Introduction

Intense competition in the marketplace, resulting from narrow profit margins and consumers demanding leaner pork products, has caused a shift to leaner genetics. Increased building and equipment costs have forced swine producers to maximize use of facilities by increasing stocking densities, while high feed costs have stimulated interest in technologies such as fine grinding of ingredients and pelleting to increase efficiency of feed utilization. Unfortunately, reports indicate that higher lean gain genetics, increased stocking density, fine grinding, and pelleting can precipitate adverse changes in stomach morphology of finishing pigs. Magnesium silicate has been suggested as a feed additive that decreases the incidence of stomach ulceration (report from the France Serebia Center, 1975) and enhances flow characteristics of finely ground feed. Thus, the experiments reported herein were designed to determine the effects of magnesium silicate on growth performance, carcass characteristics, stomach morphology, and feed flowability.

Procedures

Experiment 1. A total of 210 pigs (PIC 326 × C15 with an average initial weight of 120 lb) was used in a 75-d growth assay. The pigs were housed in a modified, open front, finishing facility with half slatted and half solid concrete floors. The pigs were allotted to pens (6 ft × 16 ft) on the basis of weight, sex, and ancestry with 14 pigs per pen (6.4 ft^2/pig) and five pens per treatment. Each pen had a nipple waterer and two-hole self-feeder to allow ad libitum consumption of feed and water. The diets were corn (ground to 450 microns in a hammermill)-soybean meal-based with .90% lysine, .65% Ca, and .55% P (Table 1). Treatments were: 1) control; 2) 1.5% talc; and 3) 3% talc.

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, feed/gain, backfat thickness, dressing percentage, fat-free lean index,

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stomach keratinization, and stomach ulceration. Additionally, feeder bridging scores (scale of 0 = none, to 5 = severe) were taken (12 times) the days after all feeders were filled and leveled. Coefficients of static force (the force needed to result in particle movement) and dynamic force (the force needed to stop particle flow after movement has begun) and angle of repose (the maximum angle, in degrees, at which a pile of material retains its shape) also were determined for each batch of feed. Procedures were followed as outlined in Feed Manufacturing Technology IV (American Feed Industry Association, 1994, Arlington, VA). All data were analyzed as a randomized complete block design (initial weight as the blocking term) using the GLM procedure of SAS. Pen was the experimental unit for all analyses, and polynomial regression was used to describe the shape of the response curve.

Table 1. Diet Composition, %[a]

Ingredient	Control
Corn	80.34
Soybean meal	15.52
Soy oil	1.00
Vit, Min, Antibiotic[b]	2.77
Lysine HCl	.30
Threonine	.04
Methionine	.03
Talc[c]	- -

[a]Formulated to .90% lysine, .65% Ca, and .55% P.
[b]Supplied 100 g/tone tylosin.
[c]Talc treatments resulted from top-dressing the diet with none, 1.5%, or 3.0% magnesium silicate.

Experiment 2. The diets formulated for experiment 1 (0, 1.5, 3.0% talc) were manufactured with corn ground to three different particle sizes (1,050, 750, and 450 microns) to determine the effects of talc and particle size on feed flow characteristics for finishing pigs. Coefficients of static force, coefficients of dynamic force, and angles of repose were determined as in Exp. 1 on 12 samples of the experimental diets. Concentration of talc and particle size were evaluated as a 3×3 factorial using the GLM Procedure of SAS.

Results and Discussions

Experiment 1. Talc had no effect on ADG, ADFI, or feed/gain (P>.2). Similarly, dressing percentage, last rib backfat thickness, and fat-free lean index were unaffected by talc (P>.2). However, the 1.5 and 3.0% additions of talc resulted in numerical decreases of 1.3 and 2.9% in efficiency of growth. This close correlation (between talc inclusion and efficiency of growth) suggests that the talc was inert and not affecting nutrient digestion and(or) metabolism. Stomach ulceration and keratinization scores (on a scale of 0 = normal to 3 = severe) were not influenced by talc addition (P>.11). Also, even though the pigs were somewhat crowded (6.4 ft^2/pig) and fed very finely ground corn (450 microns), only one pig died from an ulcer, and that pig was in a pen given the 3.0% talc diet. This suggests that talc addition had no effect on preventing ulcers.

Diets with talc had greater feeder bridging scores (quadratic effect, P<.03). The force needed to cause the diet to flow (coefficient of static force) also increased with talc addition (P<.005). The force needed to stop the diet from flowing (coefficient of dynamic force) and angles of repose were not affected by talc addition (P>.5).

Experiment 2. Decreasing particle size from 1,050 tp 450 microns increased the coefficient of static force (quadratic effect, P<.001), the coefficient of dynamic force (liner effect, P<.001), and the angle of repose (liner effect, P<.001). Decreased feed flowability with decreased particle size is well documented. Furthermore, with very fine particle sizes (e.g., the 450 micron treatment used in our experiment), bridging can become severe. Our question was can talc, as

a flow agent, reduce these bridging problems?

The coefficients of static (linear effect, P<.001) and dynamic (quadratic effect, P<.01) forces and the angle of repose (linear effect, P<.001) were increased with talc addition. These bridging increases may have resulted from the fine nature of the talc (a powder) that would tend to increase problems with flowability. Finally, interactions (P<.03) occurred among particle size and talc concentration, with general trends for the negative effects of increasing talc to be greatest in the diets with the largest (1,050 microns) and smallest (450 microns) particle sizes.

In conclusion, our data suggest that addition of talc to diets for finishing pigs did not affect growth performance, carcass characteristics, or stomach morphology. Decreasing particle size from 1,050 to 450 microns did decrease feed flowability of diets for finishing pigs, but talc addition to those diets did not enhance their flow characteristics.

Table 2. Effects of Talc on Growth Performance, Carcass Characteristics, and Stomach Morphology in Finishing Pigs and Feed Flowability[a]

	Concentration of Talc				Contrasts	
Item	Control	1.5%	3.0%	SE	Linear	Quadratic
ADG, lb	1.85	1.80	1.82	.02	- -[b]	- -
ADFI, lb	5.64	5.57	5.71	.09	- -	- -
F/G	3.05	3.09	3.14	.04	- -	- -
Backfat, in	1.10	1.10	1.11	.02	- -	- -
HCW, lb	189.9	190.6	189.8	.38	- -	- -
Dressing, %	74.5	74.9	74.6	.16	- -	- -
FFLI, %	47.5	47.6	47.4	.20	- -	- -
Feeder bridging scores	4.05	4.31	4.32	.04	.001	.03
Coefficient of static force	.81	.86	.92	.12	.005	- -
Coefficient of dynamic force	.61	.61	.61	.06	- -	- -
Angle of repose	58.1	58.6	58.5	.8	- -	- -

[a]A total of 210 pigs (avg initial wt of 120 lb) was used. [b]Dashes indicate P>.15.

Table 3. Effects of Talc on Stomach Morphology[a]

	Concentration of Talc				Contrasts	
Item	Control	1.5%	3.0%	SE	Linear	Quadratic
Stomach keratinization						
No. of observations	67	69	67	- -	- -	- -
Normal	29	29	36	- -	- -	- -
Mild	17	9	7	- -	- -	- -
Moderate	9	14	12	- -	- -	- -
Severe	12	17	12	- -	- -	- -
Mean score[b]	1.06	1.28	1.00	.46	.95	.11
Stomach ulceration						
No. of observations	67	69	67	- -	- -	- -
Normal	24	28	20	- -	- -	- -
Erosions	10	8	16	- -	- -	- -
Ulcers	23	20	17	- -	- -	- -
Severe ulcers	10	16	14	- -	- -	- -
Mean score[c]	1.28	1.39	1.37	.41	.46	.56

[a]A total of 210 pigs (avg initial wt of 120 lb) was used and 203 stomachs were collected. [b]The scoring system was: 0 = normal; 1 = mild; 2 = moderate; 3 = severe keratosis. [c]The scoring system was: 0 = normal; 1 = erosion; 2 = ulcer; and 3 = severe ulcer.

Table 4. Effects of Particle Size and Talc on Flowability of Diets for Finishing Pigs

	1,050 Microns			750 Microns			450 Microns				Contrasts[a]							
Item	0[b]	1.5	3.0	0	1.5	3.0	0	1.5	3.0	SE	1	2	3	4	5	6	7	8
Coeff. of static force	.53	.56	.60	.64	.66	.67	.75	.82	.84	.01	.001	.001	.001	- -[c]	- -	.001	.03	- -
Coeff. of dynamic force	.48	.52	.52	.58	.58	.57	.58	.65	.66	.01	.001	- -	.001	.01	.02	.001	- -	- -
Angle of repose	48.6	50.4	51.8	52.5	54.0	54.8	58.5	57.2	58.8	.4	.001	- -	.001	- -	.001	- -	.03	- -

[a]Contrasts were: 1) particle size linear; 2) particle size quadratic; 3) talc linear; 4) talc quadratic; 5) particle size linear × talc linear; 6) particle size quadratic × talc linear; 7) particle size linear × talc quadratic; 8) particle size quadratic × talc quadratic.
[b]Percentage talc in the diet.
[c]Dashes indicate P>.15.