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Acid-treated high-moisture sorghum for swine

G L. Allee

R Nelson

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Summary

Three trials involving 166 growing pigs (initial weight 20.5 pounds) and 96 finishing pigs (initial weight 108.7 pounds) were conducted to investigate effects of feeding high-moisture, acid-treated sorghum to swine. Sorghum harvested at 23% moisture was treated with 1.2% propionic acid. Method of processing (whole or ground) and method of feeding (complete or free-choice) were also evaluated. Pigs fed high-moisture, acid-treated sorghum in a complete ration gained at the same rate and just as efficiently as pigs fed the dry, complete ration. Feeding of supplement free-choice tended to reduce daily gain but not feed efficiency. Finishing pigs fed whole, high-moisture, acid-treated sorghum required significantly ($P < .05$) more feed per unit of gain than pigs fed the ground high-moisture, acid-treated sorghum.

Acid-treated, high-moisture sorghum in a ground complete ration is equal to dry sorghum in feeding value for swine.

Introduction

The oxygen limiting structure has been the conventional method of storing high-moisture grain. Recently interest has developed in using organic acids to preserve high-moisture grain. Acid-

treatment is an alternative to oxygen-limiting structures for the preservation of high-moisture grain. The acid lowers the pH of the grain which inhibits microbial growth.

The objectives of these studies were to evaluate the effects of treating high-moisture sorghum with propionic acid on acceptance and utilization in swine rations. Method of processing (whole vs. ground) and method of feeding (complete vs. free-choice) were also evaluated.

Experimental Procedures

Sorghum for the trials was harvested at 23% moisture, treated with 1.2% propionic acid on a weight basis, and stored in a metal bin. The control (dry sorghum) was harvested at 14% moisture. Trials were conducted in the fall of 1975.

Growing pigs were housed in an environmentally-controlled nursery. Each pen (1.5m x 3.4m) had totally slatted floors and contained a two-hole feeder with an automatic watering cup. The finishing trials were conducted in a modified, open-front building with concrete, slatted floors. Each pen (1.8m x 3.4m) contained a two-hole feeder with an automatic water cup. Compositions of the protein supplements and the dry control rations for growing and finishing are shown in tables 16 and 17, respectively. All complete rations pro-

vided the same amount of sorghum on a dry matter basis. The protein supplement was fed as a 3/16 inch pellet in a separate two-hole feeder when the supplement was offered free-choice.

Table 16. Compositions of protein supplement and control ration for growing pigs.

| Ingredient, % | Dry-control ^a | Supplement |
|--------------------------------|--------------------------|---------------|
| Sorghum | 69.4 | |
| Soybean meal (44 %) | 26.6 | 86.94 |
| Dicalcium phosphate | 1.4 | 4.57 |
| Limestone | 1.2 | 3.92 |
| Salt | 0.5 | 1.63 |
| Trace-mineral ^b | 0.1 | 0.33 |
| Vitamin premix ^c | 0.5 | 1.63 |
| Antibiotic premix ^d | 0.3 | 0.98 |
| | <u>100.0</u> | <u>100.00</u> |

^aAll complete rations provided the same amount of dry matter from sorghum.

^bProvided in the complete diet (ppm): zinc, 100; iron, 100; manganese, 100; copper, 10.0; iodine, 1.0.

^cProvided per ton of complete diet: vitamin A, 4,000,000 IU; vitamin D₃, 300,000 IU; vitamin E, 20,000 IU; riboflavin, 45 g; niacin, 25 g; pantothenic acid, 12 g; vitamin B₁₂, 22 milligrams.

^dProvided 100 g chlortetracycline, 100 g sulfamethazine, and 50 g procaine penicillin per ton of complete diet.

Table 17. Compositions of protein supplement and control ration for finishing pigs.

| Ingredient, % | Dry-control ^a | Supplement |
|--------------------------------|--------------------------|---------------|
| Sorghum | 81.55 | |
| Soybean meal (44 %) | 15.30 | 82.99 |
| Dicalcium phosphate | 1.00 | 5.40 |
| Limestone | 1.00 | 5.40 |
| Salt | 0.50 | 2.70 |
| Trace-mineral mix ^b | 0.05 | 0.27 |
| Vitamin premix ^c | 0.50 | 2.70 |
| Antibiotic premix ^d | 0.10 | 0.54 |
| | <u>100.00</u> | <u>100.00</u> |

^aAll complete rations provided the same amount of dry matter from sorghum.

^bProvided in the complete diet (ppm): zinc, 50; iron, 50; manganese, 50; copper, 5.0; iodine, 0.5.

^cProvided per ton of complete diet: Vitamin A, 4,000,000 IU; vitamin D₃, 300,000 IU; vitamin E, 20,000 IU; riboflavin, 45 g; niacin, 25 g; pantothenic acid, 12 g; vitamin B₁₂, 22 milligrams.

^dProvided 20 grams Tylosin.

Trial I. One hundred forty-four pigs averaging 10.7 kg (23.5 lbs.) were randomly assigned to dietary treatments by weight and sex. The treatments were: 1) dry, ground, complete, 2) high-moisture, propionic acid, ground complete, 3) high-moisture, propionic acid, ground, free-choice supplement, 4) high-moisture, propionic

acid, whole, free-choice supplement. The trial lasted 35 days.

Trial II. Ninety-six Yorkshire finishing pigs weighing 49.4 kg (108.7 lbs.) were randomly assigned to the same dietary treatments as in trial I by weight and sex. When pigs in each pen averaged approximately 100 kg (220 lbs.) the trial was terminated.

Trial III. Trial III was to determine if growing pigs prefer high-moisture, acid-treated sorghum to dry sorghum. Two feeders, one containing the dry, ground, complete diet and the other the high-moisture, propionic acid treated, complete diet, were placed in a pen of 22 growing pigs averaging 6.8 kg (15 lbs.). The trial lasted 35 days.

Results and Discussion

Performances of growing pigs fed high-moisture, acid-treated or dry sorghum are shown in table 18. Pigs fed ground, high-moisture, acid-treated sorghum as a complete ration gained at the same rate and as efficiently as pigs fed the dry complete ration. Pigs fed high-moisture, acid-treated sorghum and supplement free-choice gained significantly ($P < .05$) slower than pigs fed the complete rations. The reduced performance of pigs fed free-choice probably resulted from reduced consumption of the supplement. Even though the only protein source was soybean meal, which is highly palatable to pigs, they consumed less than when the ration was fed complete. There were no differences in feed efficiency of growing pigs fed high-moisture ground sorghum or high-moisture whole sorghum when supplement was offered free-choice.

In the preference trial with growing pigs, acid treatment did not adversely effect feed consumption (table 19). With a choice between the dry control ration and the high-moisture, acid-treated sorghum ration, pigs ate 7% more of the acid-treated grain. Therefore, feed intake should not be a problem with growing pigs fed high-moisture, acid-treated sorghum.

Finishing pigs fed high-moisture, acid-treated sorghum as a ground, complete ration gained at the same rate and were just as efficient in feed utilization as pigs fed the dry ground complete ration (table 20). When pigs were offered high-moisture, acid-treated sorghum and supplement free-choice, they ate less supplement than those on a complete ration. Finishing pigs fed whole high-moisture, acid-treated sorghum required significantly ($P < .05$) more feed per unit of gain than pigs fed ground sorghum. Numerous whole kernels of the high-moisture sorghum were observed in the feces.

Table 18. Performance of growing pigs fed high-moisture or dry sorghum (trial I).^{abc}

| Treatment | Daily Intake, lbs. | | | | |
|------------------------------|--------------------|---------|------------|-------|---------------------|
| | Daily gain, lbs. | Sorghum | Supplement | Total | Feed/Gain |
| Dry, ground, complete | 1.29 ^d | 1.58 | .70 | 2.28 | 1.77 ^d |
| H-M P.A. ground, complete | 1.32 ^d | 1.65 | .75 | 2.40 | 1.79 ^{d,e} |
| H-M P.A. ground, free-choice | 1.08 ^e | 1.50 | .55 | 2.05 | 1.89 ^e |
| H-M P.A. whole, free-choice | 1.14 ^e | 1.69 | .59 | 2.28 | 2.00 ^e |

^aAll feed data expressed on a dry matter basis.

^bEach value is the mean of 36 pigs with an initial weight of 10.7 kg (23.5 lbs.).

^cThe trial lasted 35 days.

^{d,e}Means with different superscripts differ significantly ($P < .05$).

Table 20. Performances of finishing pigs fed high-moisture or dry sorghum (trial II).^{abc}

| Treatment | Daily Intake, lbs. | | | | |
|------------------------------|---------------------|---------|------------|-------|-------------------|
| | Daily gain, lbs. | Sorghum | Supplement | Total | Feed/Gain |
| Dry, ground, complete | 1.52 ^d | 4.05 | .95 | 5.00 | 3.30 ^d |
| H-M P.A. ground, complete | 1.52 ^d | 4.11 | .97 | 5.08 | 3.36 ^d |
| H-M P.A. ground, free-choice | 1.43 ^{d,e} | 4.07 | .77 | 4.84 | 3.38 ^d |
| H-M P.A. whole, free-choice | 1.39 ^e | 4.86 | .75 | 5.61 | 4.04 ^e |

^aAll feed data expressed on a dry matter basis.

^bEach value is the mean of 24 pigs with an initial weight of 49.4 kg (108.7 lbs.).

^cThe trial was terminated when each pig in each pen averaged approximately 100 kg (220 lbs.).

^dMeans with different superscripts differ significantly ($P < .05$).

Table 19. Consumption of feed by growing pigs in preference trial (trial III).^{bc}

| | High-moisture acid-treated (lbs.) | Dry control (lbs.) |
|----------------------------|-----------------------------------|--------------------|
| Feed consumed ^a | 830 | 777 |

^aExpressed on a dry matter basis.

^bThe trial lasted 35 days.

^cTrial with 22 growing pigs 6.8 kg (15 lbs.).