Effect of High-moisture Grain on Availability of Phosphorus for Swine

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Summary

A feeding trial and two phosphorus balance studies were conducted to compare the availabilities of phosphorus from high-moisture sorghum grain treated with propionic acid (1.2% acid, 23% moisture), grain stored in an oxygen limiting structure (27% moisture), and field-dried sorghum grain (13% moisture). Bone and phosphorus retention data indicated that the phosphorus in high-moisture sorghum grain is more available than phosphorus in field-dried sorghum grain.

Introduction

Practical swine diets composed predominantly of cereal grains and vegetable proteins provide a large portion of the phosphorus in organic form (phytate phosphorus is the principal organic form) which is largely unavailable to pigs. Several attempts have been made to increase phytate phosphorus through various methods of feed processing. The most marked changes have been between high-moisture and dry corn.

We compared the effects of high-moisture sorghum grain, either treated with porpionic acid or stored in an oxygen limiting structure, with field-dried sorghum grain on availability of phosphorus.

Procedures

We used 87 crossbred finishing pigs in a feeding trial and two phosphorus balance studies. The basal diet (dry grain with no supplemental phosphorus) contained 79.50% sorghum grain, 17.85% soybean meal, 1.35% limestone, .5% salt, .8% of a vitamin, trace mineral, antibiotic premix. All grains were ground before mixing and incorporated into 16% protein diets formulated on an equal dry matter basis. Phosphorus levels used with each grain type were: no supplemental phosphorus, 0.07% added phosphorus, and 0.14% added phosphorus.

In the feeding trial, pigs averaging 43.35 kg (95.4 lbs.) were group fed (3 pigs/pen, 9 pigs/trt.) in 4' x 16' pens with solid concrete floors. Pigs were slaughtered at the end of the 66-day trial and the right front legs were removed for bone breaking strength and bone ash, calcium, and phosphorus determinations.

In the balance studies, pigs were housed in metal metabolism cages allowing for separate collection of feces and urine. Daily feed intake, fed in two equal portions was constant. Fresh water was supplied at each feeding.

A five-day pre-trial period preceded a five-day collection period. Feces and urine were analyzed for phosphorus.

Results and Discussion

Results of the feeding trial are presented in table 25 with bone data in table 26. Average daily gains and feed:gain were similar for all nine treatments. Bone breaking strengths of the ulna were significantly greater ($P<.05$) for pigs receiving high-moisture treatments, as were bone phosphorus values; however, the differences were not significant. Adding 0.07% phosphorus to the field dried sorghum grain significantly increased ($P<.05$) bone data (breaking strength, bone ash, bone calcium, and bone phosphorus) over similar data from pigs receiving no supplemental phosphorus, and equal to those from the high-moisture sorghum grain with no supplemental phosphorus. More than 0.07% phosphorus did not increase bone data.

Results of the phosphorus retention studies were similar to bone data. Pigs receiving either of the high-moisture sorghum grain treatments with no supplemental phosphorus retained significiantly more phosphorus than pigs receiving the field dried sorghum grain with no phosphorus added. When 0.07% phosphorus was added to each sorghum grain ration, no significant differences were observed.

These studies indicate that the feeding high-moisture sorghum grain (treated with propionic acid or stored in an oxygen limiting structure) increases the availability of phosphorus over feeding field-dried sorghum grain.

Table 25. Pig Performance as Influenced by Sorghum Grain Type and Phosphorus Level.[a]

Diet	ADG (lbs)	Daily intake[b] (lbs)	F/G[b]
Dry + 0.00% P	1.94	6.20	3.21
Dry + 0.07% P	1.98	6.27	3.16
Dry + 0.14% P	1.87	5.94	3.16
HMPA + 0.00% P	1.91	5.76	3.01
HMPA + 0.07% P	1.89	6.09	3.23
HMPA + 0.14% P	1.89	6.03	3.19
HMO_2L + 0.00% P	1.96	6.01	3.09
HMO_2L + 0.07% P	1.96	6.36	3.24
HMO_2L + 0.14% P	1.96	6.18	3.15

[a]Initial weight 95.4 lbs - 66 day trial - 3 pigs/pen - 9 pigs/treatment.

[b]Reported on a 100% dry-matter basis.

Table 26. Bone Development as Influenced by Sorghum Grain Type and Phosphorus Level.

Treatment	Breaking strength[d] (kg/cm^2)	Bone ash[e] (%)	Bone calcium[e] (%)	Bone phosphorus[e] (%)
Dry + 0.00% P	598.6[a]	60.95[a]	21.05[a]	11.16[a]
Dry + 0.07% P	777.0[b]	62.14[abc]	22.51[b]	11.67[ab]
Dry + 0.14% P	773.4[b]	63.44[bc]	22.43[b]	11.93[ab]
HMPA + 0.00% P	725.9[b]	62.85[bc]	22.52[b]	11.55[ab]
HMPA + 0.07% P	786.6[b]	63.83[bc]	22.31[b]	12.37[b]
HMPA + 0.14% P	743.6[b]	61.64[ab]	21.86[ab]	11.71[ab]
HMO_2L + 0.00% P	725.7[b]	63.67[bc]	22.43[b]	11.60[ab]
HMO_2L + 0.07% P	756.7[b]	63.67[bc]	22.60[b]	11.52[ab]
HMO_2L + 0.14% P	738.3[b]	63.28[bc]	22.47[b]	11.75[ab]

[a,b,c]Means in same column with different superscripts differ statistically.

[d]Breaking strength values obtained on right ulna.

[e]Bone ash, Ca and P values obtained on right radius and reported on dry, fat-free basis.