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The pricing of corn is based upon a number of factors including moisture content, test weight, level of contaminants, and deterioration of quality. It is understood that high moisture content dilutes the concentration of energy and nutrients. Poor quality because of deterioration during storage and the presence of contaminants lowers the palatability of the ingredient and may have negative health ramifications. With less logical reasoning it has been assumed that the feeding value of corn for pigs is related to corn's bulk density. Low-test weight corn is sold at a discount even if moisture content and quality factors are desirable. Corn harvested in the fall of 1992 with a density of either 20.9 kg/bu (46 lb/bu; LO) or 25.5 kg/bu (56 lb/bu; HI) was used in a growth trial and a digestibility study to further evaluate the effect of test weight of corn on its feeding value for growing pigs.

(Key words: Growing swine, Corn density, Digestibility.)

## Experimental Procedure

Ninety-six crossbred pigs (30.9 kg) were allotted four pigs per pen within sex to two weight blocks with six treatments consisting of diets with six corn densities (20.9, 21.9, 22.8, 23.7, 24.6, and 25.5 kg/bu). The growth study was a complete block design with dietary treatments, gender (barrow or gilts), and weight blocks included in the model. A basal diet was formulated to contain 16% crude protein and fortified with vitamin and minerals using HI corn and soybean meal (Table 1). Six dietary treatments were made by substituting LO corn for all or a portion of the HI corn in the basal diet in 20% increments (Table 2). Pigs were weighed and feed disappearance recorded weekly. Average final weight of pigs was 70.9 kg.

A digestibility trial was conducted with diets containing corn with bulk densities of 20.9 kg/bu (LO), 23.2 kg/bu (MED), or 25.5 kg/bu (HI) corn. The three dietary treatments were obtained by substituting the LO corn diet for 100%, 50%, or 0% of the basal HI corn diet (Table 2). Three littermate barrows (40 kg) from each of three litters were used in a 3 x 3 Latin square design. An indigestible indicator (.5% $Cr_2O_3$) was added to the diets. Pigs were housed in individual collection pens and allowed ad libitum access to feed and water. A 3-day fecal collection period followed a 4-day dietary adjustment period. Diet and fecal samples were analyzed for dry matter (DM), crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), gross energy (GE), and $Cr_2O_3$ indicator to obtain digestibility values. Pigs were weighed at the beginning and end of each collection period and feed disappearance was also recorded during each collection period.

TABLE 1. COMPOSITION OF BASAL DIET

| Ingredient | Percent |
|---|---|
| Corn | 75.65 |
| Soybean meal | 21.67 |
| Dicalcium phosphate | 1.07 |
| Limestone | .86 |
| White salt | .25 |
| Vitamin/mineral premix | .50 |
| Total | 100.0 |

TABLE 2. BLENDS OF LO AND HI CORN TO PRODUCE CORN DENSITIES

| Densities | 20.9 kg/bu, LO | 25.5 kg/bu, HI |
|---|---|---|
| | Growth Trial | |
| 20.9 kg/bu | 100 | 0 |
| 21.9 kg/bu | 80 | 20 |
| 22.8 kg/bu | 60 | 40 |
| 23.7 kg/bu | 40 | 60 |
| 24.6 kg/bu | 20 | 80 |
| 25.5 kg/bu | 0 | 100 |
| | Digestibility Trial | |
| 20.9 kg/bu; LO | 100 | 0 |
| 23.2 kg/bu; MED | 50 | 50 |
| 25.5 kg/bu; HI | 0 | 100 |

## Results

Growth performance data are presented in Table 3. Pigs had similar (P>.10) ADG (.81 vs .80 kg/day), ADFI (2.46 vs 2.41 kg/day), and gain/feed (.33 vs .33) when fed diets consisting solely of HI or LO corn, indicating no difference in feeding value for the low and high bulk density corn. There was a linear change (P<.05) in ADFI as percentage of HI corn increased in the diet. This occurred, not as a result of a difference in ADFI between pigs receiving diets consisting of 100% HI and 100% LO corn (P>.10), but because pigs consuming HI corn in blends of 60 or 80% consumed more feed than pigs receiving blends of 60 or 80% LO corn (P<.01). However, this did not result in differences in ADG (P>.10). Gain/feed was similar for pigs fed all diets (P .10). Gender performance means confirmed that barrows gain faster (P<.05) and eat more feed (P<.10) than gilts with no difference in gain/feed (P>.10) at this stage of production.

Table 4 provides the analyzed nutrient composition of the three diets fed in the digestion trial. The digestibility coefficients for these nutrients are presented in Table 5. Dietary CP, ADF, and NDF on a DM basis and DM decreased as corn density increased. Digestibility coefficients increased linearly for CP (P=.001) and for DM (P<.10) as corn density decreased. Density did not affect ADF or NDF digestibility. Gross energy and GE digestibility of the diets were not affected by corn density. Calculated DE (GE x digestibility coefficient) for the diets from low to high density were 3.47, 3.47, and 3.50 Mcal/kg.

## Summary

Ninety-six pigs were used in a growth performance trial to determine the effects of six corn test weights in diets of growing swine. No differences in ADG, ADFI, and gain/feed resulted when comparing the diets consisting of either 100% LO or 100% HI corn. When considering all six diets, corn bulk density affected ADFI in a linear manner but did not affect ADG or gain/feed. Higher feed consumption was observed when diets contained 60 or 80% HI corn compared to 60 or 80% LO corn. However, the increased consumption did not result in increased gain.

Nine barrows, three each from three litters, were used to determine the nutrient digestibility of diets containing corn of three test weights. Protein and DM contents were higher in LO corn than in HI corn. Protein and DM digestibility decreased as test weight increased. The combination of similar energy and higher nutrient density and nutrient digestion coefficients for LO corn resulted in similar growth performance for growing pigs regardless of corn bulk density.

## Implications

These growth and digestion trials with growing pigs (40 kg) demonstrate that corn of a wide range of test weights is satisfactory for swine diets. Fiber components of LO corn was slightly higher than in HI corn. However, DE values were similar for diets with corn of extreme test weights. Crude protein content may actually be higher in LO corn than HI corn. Low-test weight corn, purchased at a reduced price, can result in feed cost savings without risking pig performance. Feeding home produced, low-test weight corn will result in value added to the discounted price which would be obtained with normal sale. It must be emphasized that low bulk density corn requires more space in storage bins and in feeders and that corn additions to the mixer must be based upon weight and not volume to ensure proper nutrient levels in the complete feed.

TABLE 3. THE EFFECT OF CORN DENSITY ON PIG PERFORMANCE FROM 30 TO 70 KG

| Corn (25.5 kg/bu)<br>Corn (20.9 kg/bu)<br>Test wt, kg/bu | 0% HI<br>100% LO<br>20.9 | 20% HI<br>80% LO<br>21.9 | 40% HI<br>60% LO<br>22.8 | 60% HI<br>40% LO<br>23.7 | 80% HI<br>20% LO<br>24.6 | 100% HI<br>0% LO<br>25.5 |
|---|---|---|---|---|---|---|
| Initial wt, kg[ab] | 31.1 | 31.0 | 31.0 | 30.9 | 30.9 | 30.8 |
| Final wt, kg | 71.0 | 70.5 | 68.6 | 73.0 | 72.8 | 69.9 |
| ADG, kg/day | .81 | .80 | .77 | .86 | .85 | .80 |
| ADFI, kg/day[ac] | 2.46 | 2.29 | 2.36 | 2.55 | 2.59 | 2.41 |
| Gain/feed | .33 | .35 | .33 | .34 | .33 | .33 |

Statistical contrasts:

| | |
|---|---|
| Linear | [a]P<.05 |
| Quadratic | |
| 100% LO vs 100% HI | [b]P<.01 |
| 100% LO and 100% HI vs blends | |
| 60 and 80% LO vs 60 and 80% HI | [c]P<.01 |

TABLE 4. ANALYZED NUTRIENT COMPOSITION (DM BASIS) OF THREE DIETS UTILIZED IN THE DIGESTION TRIAL

| | Corn density, kg/bu | | |
|---|---|---|---|
| Item | 20.9 | 23.2 | 25.5 |
| Crude protein, % | 20.6 | 20.3 | 19.7 |
| Dry matter, % | 88.4 | 88.1 | 87.8 |
| Acid detergent fiber, % | 5.2 | 5.2 | 5.1 |
| Neutral detergent fiber, % | 14.3 | 14.2 | 13.1 |
| Gross energy, Mcal/kg | 4.30 | 4.38 | 4.40 |
| Digestible energy, Mcal/kg | 3.47 | 3.47 | 3.50 |

TABLE 5. DIGESTIBILITY COEFFICIENTS (%) AS AFFECTED BY CORN DENSITY (40 TO 50 KG GROWING SWINE)

| | Corn density, kg/bu | | |
|---|---|---|---|
| Item | 20.9 | 23.2 | 25.5 |
| Crude protein[a] | 78.3 | 75.8 | 73.7 |
| Dry matter[b] | 81.2 | 79.8 | 79.9 |
| Acid detergent fiber | 52.8 | 50.7 | 52.2 |
| Neutral detergent fiber | 57.4 | 55.1 | 55.6 |
| Gross energy | 80.7 | 79.3 | 79.6 |

Linear effect [a]P=.001, [b]P<.10.