Feeding Grain Sorghum to Swine[1]

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Traditionally, corn has been the mainstay of most swine feeding programs used in Florida and the southeastern United States. Increases in grain sorghum production in the southeast have increased its availability, making it an attractive alternative to corn for use in swine diets, especially with the increased cost of corn.

Types of Grain Sorghum

Grain sorghum varieties can be grouped into two general categories: non-bird-resistant (or yellow grain sorghum), and bird-resistant (brown grain sorghum). Yellow and brown refer to seed coat color; however non-bird-resistant grain can have seed coat colors ranging from white to brown, with variations of yellow, tan and brown; bird-resistant grain usually has seed coat colors between tan and dark red-brown. Thus, seed coat color is not a completely accurate method of differentiating between the two types of grain sorghum.

The primary difference between the two grain sorghum types is the presence of tannins in the bird-resistant grain. Tannins have a bitter taste that birds do not like; hence the term bird-resistant. However, tannins decrease the feeding value of grain sorghum for swine. Tannins interfere with the utilization of some of the nutrients, particularly protein, in grain sorghum, thus decreasing its nutritional value for swine. Fortunately, not much bird-resistant grain sorghum is grown in the US.

Nutrient Composition

Comparative nutritional compositions of grain sorghum and corn, as well as other feed ingredients, are shown in Table 1. The crude protein content of grain sorghum is usually slightly higher than that found in corn. However, the lysine content of grain sorghum is similar to, or slightly lower than, that of corn. Lysine content is important because swine, like most non-ruminant animals, require specific levels of amino acids that make up protein. Some of these amino acids are essential and must be present in the diet for pigs to grow and perform well. A few essential amino acids tend to be limiting in typical swine diets. One essential amino acid, lysine, is usually the most limiting, or first limiting. This means that if a diet is formulated to supply the correct amount of lysine, then generally the levels of other essential amino acids will be adequate. Therefore, lysine is an important consideration when comparing cereal grains.

Grain sorghum contains about as much phosphorus as corn but contains less fat than corn, and the metabolized energy (or calorie) content for swine is about 95% that of corn.

Results of Feeding Trials

Extensive research was conducted by the University of Florida during the 70s and 80s to evaluate non-bird-resistant and bird-resistant grain sorghums grown locally for use in growing-finishing swine rations. A summary of the research is given in Table 2. In each trial, pigs were self-fed mixed diets containing either ground grain sorghum

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or ground corn as the grain source; levels of other dietary ingredients, such as protein supplement, were similar. Results of these trials show that pigs fed diets containing non-bird-resistant grain sorghum had rates of daily weight gain similar to those of pigs fed corn diets. With regard to feed efficiency, however, slightly more feed was required to obtain a pound of weight gain with grain sorghum diets than with corn diets.

Pigs fed diets containing bird-resistant grain sorghum also were found to have an average daily rate of weight gain similar to that of pigs fed corn diets. This similarity in rate of gain indicates that bird-resistant grain sorghum is highly acceptable for the growing-finishing pig. However, inclusion of bird-resistant grain sorghum in the diet had a detrimental effect on feed efficiency, as indicated by the relatively high overall feed-to-gain ratio as compared to that of pigs fed corn diets (Table 2). This detrimental effect on feed efficiency is probably due to decreased nutrient digestibility because of the tannins contained in the bird-resistant grain sorghum.

Use of Grain Sorghum in Swine Diets

Grain sorghum, like corn, is an energy feedstuff. Also like corn, grain sorghum contains some protein, essential amino acids, vitamins and minerals. However, grain sorghum alone is inadequate to meet the pigs' nutrient requirements and therefore it must be supplemented.

Even though grain sorghum many times contains more protein than does corn, diets still should be formulated to meet essential amino acid (especially lysine) requirements, rather than the crude protein requirements of the pig. The analyzed crude protein content of grain-sorghum-based diets often will be higher than that of corn-based diets when both diets contain equal levels of lysine. If diets containing grain sorghum are formulated based on crude protein alone, lysine levels could be inadequate and animal performance could suffer.

Because of the similarity of essential amino acid, calcium, phosphorous and energy contents of grain sorghum and corn, grain sorghum should be used much like corn in swine rations. However, for maximum utilization, grain sorghum should be fed in a complete, mixed diet and should not be fed alone (separate feeding of whole grain and supplement), as can be done with corn.

Due to its reduced feeding value, bird-resistant grain sorghum should be avoided for use in diets for lactating sows and for young pigs under 50 pounds. Young pigs and lactating sows have high nutrient requirements. If bird-resistant grain sorghum is to be used in swine diets, it should be mixed with other grains. If fed at 75 to 100% of the grain portion of the diet, the protein content of the diet should be increased by 1 to 2% by adding another 50 pounds of soybean meal per ton of mixed diet. The additional protein is needed to overcome the detrimental effect of tannins on protein digestibility.

Processing of Grain Sorghum

Grain sorghum should be processed if it is to be used efficiently in swine diets. Best results in university-sponsored feeding trials were obtained when grain sorghum was finely ground through a 1/8-inch screen or dry-rolled. However, fine grinding of grains can produce excessive dust and a greater chance of the grain absorbing moisture from the atmosphere, which could lead to spoilage. Moisture absorption and subsequent feed spoilage is a particular problem in areas such as the southeastern US. Additionally, diets with finely ground grain sorghum could bridge and not flow well in self-feeders. Therefore, grain sorghum should be ground just finely enough so that there are no, or very few, whole kernels.

Low-Test-Weight, Sprout-Damaged, and Contaminated Grain Sorghum

Low test-weight (low weight per bushel) in grain sorghum usually is due to shrunken and shriveled kernels, extensive weather damage to the grain before harvest, and/or sprouting damage in the kernels. In most instances, low-test-weight grain sorghum can be included in swine diets much like grain sorghum of high test-weight without affecting performance. Low-test-weight grain sorghum should be purchased and used in the diet on a weight, rather than a volume, basis.

Sprout-damaged grain sorghum is that which has sprouted in the head before harvest. It usually has a decreased test-weight. Experiments conducted in Nebraska have shown that sprout damage has little effect on the feeding value of grain sorghum. Because of the possibility of associated mold contamination, sprout-damaged grain sorghum should be used in growing and finishing diets only, not in diets fed to young, growing pigs under 50 pounds or for the breeding herd. If doubt exists about the acceptability of sprout-damaged grain sorghum, it should be test-fed to a small group of pigs before purchasing large quantities.

Sprout-damaged grain sorghum should be mixed with undamaged grain sorghum or corn if there are acceptability problems.

Grain sorghum contaminated with trash (seed husks, stem pieces, etc.) is quite common, and usually poses no problem when included in swine diets; however this trash will dilute the feeding value. Grain sorghum contaminated with various weed seed can be fed to swine with few problems. However, grain sorghum extremely contaminated with coffeeweed seed (*Cassia* sp., 0.5% or more by weight) should not be used in swine diets because coffeeweed seed is known to be toxic to livestock. Inclusion of coffeeweed seed in swine diets has been reported to result in decreased performance, and may cause various reproductive problems in sows. Again, if doubt exists about the acceptability of contaminated grain sorghum, it should be test-fed to a small group of pigs before purchasing large quantities. Contaminated grain sorghum should be mixed with "clear" (uncontaminated) grain sorghum or corn if there are acceptability problems.

High-Moisture Grain Sorghum

Various university studies, including studies conducted in Florida, have shown that ensiling high-moisture grain sorghum (22 to 28% moisture) in an air-tight silo does not improve its nutritional value for swine. Therefore, the decision to feed high-moisture grain sorghum must be based on whether this type of harvesting and storage is the most efficient handling method on a particular farm. Unlike dry grain sorghum, high-moisture grain sorghum can effectively be fed whole.

Feeding high-moisture grain sorghum can be a problem. Because it is usually very palatable, pigs fed free-choice will often over-eat on grain and under-eat on protein-mineral-vitamin supplement. This situation can be prevented by grinding or rolling the quantity of high-moisture grain sorghum needed each day in order to mix it with the supplement.

High-moisture grain sorghum should be fed fresh daily to prevent spoilage and caking in feeders. Spoilage can be prevented by treating the high-moisture grain sorghum at the time of harvest with up to 1% of propionic acid or a mixture of propionic and acetic acids. The exact amount of acid preservative required depends upon grain moisture level and length of grain storage. Acid treatment also eliminates the need for frequent grinding and mixing because mixed feeds made from acid-preserved, high-moisture grain sorghum will store well for several days.

Summary

- Grain sorghum (non-bird-resistant) can be used as a partial or sole grain source in diets for all classes of swine.
- Swine diets containing grain sorghum should be balanced to meet essential amino acid, especially lysine, requirements instead of crude protein requirements. A grain-sorghum/soybean-meal-based diet will many times be higher in crude protein than will a comparable corn/soybean-meal-based diet.
- Grain sorghum can be used, and should be thought of, as a corn replacement in swine diets.
- Grain sorghum for use in swine diets should be ground fine (through a 3/16-inch or finer screen) or rolled so that there are no or very few whole kernels present.
- Grain sorghum (non-bird-resistant) is worth up to 95% of the purchase price of corn on an equal weight basis.
- Based on results from feeding trials in Florida and elsewhere and due to the similarity in nutrient composition to corn, grain sorghum is valued up to 95% of the purchase price of corn.

Table 1. Typical analyses of grain sorghum and other feedstuffs.[a]

	Metabolizable Energy (kcal/lb)	Crude Protein (%)	Lysine	Calcium (%)	Phosphorous (%)
Grain sorghum, non-bird-resistant	1425[b]	9.5	.22	.03	.25
Grain sorghum, bird-resistant	1250[c]	9.5	.22	.03	.25
Corn, yellow	1500	8.5	.24	.02	.25
Wheat, soft red	1500[b]	10.0	.30	.05	.30
Oats (36 lb/bu)	1200[b]	11.0	.40	.05	.30
Soybean meal (48%CP)	1500	48.5	3.05	.30	.60

[a] Values given are typical for feedstuffs used in the Southeast (expressed on an as-fed basis).
[b] Relative energy (feeding) value compared with corn = 100; grain sorghum (non-bird-resistant) = 95; wheat = 100; oats = 80.
[c] Estimate.

Table 2. Summary of grain sorghum swine feeding experiments in Florida.

Trial number and year (location)[a]	No. of pigs	Initial and final weight (lb)	Avg. daily weight gain (lb)		Feed/unit gain		Relative feeding value of grain sorghum[b]
			Corn	Sorghum	Corn	Sorghum	
Non-bird-resistant:							
1. 1976 (Live Oak)	36	29–211	1.51	1.50	3.31	3.61	89
2. 1979 (Gainesville)	36	15–216	1.48	1.39	2.93	3.03	96
3. 1979 (Marianna)	48	15–213	1.55	1.61	2.89	2.93	98
4. 1980 (Gainesville)	36	22–187	1.67	1.62	2.71	2.77	97
5. 1980 (Marianna)	36	77–220	1.75	1.80	2.91	3.04	95
6. 1981 (Marianna)	36	56–215	1.77	1.76	2.99	3.05	98
7. 1982 (Gainesville)	54	75–195	1.76	1.80	3.04	3.04	100
8. 1982 (Marianna)	48	68–211	1.94	2.05	3.07	3.22	94
Average Total	**330**	36–208	1.69	1.71	2.98	3.08	96
Bird-resistant:							
1. 1975 (Live Oak)	36	35–207	1.79	1.72	2.73	3.16	80
2. 1976 (Live Oak)	36	29–211	1.51	1.52	3.31	3.66	87
3. 1976 (Live Oak)	36	29–211	1.51	1.53	3.31	3.70	86
4. 1979 (Marianna)	48	55–216	1.89	1.87	3.14	3.38	90
5. 1979 (Gainesville)	32	55–220	1.69	1.62	3.15	3.43	89
Average Total	**180**	41–213	1.68	1.67	3.13	3.46	87

[a] Varieties used: Non-bird-resistant: (1) Funk G522 (2 through 5) Ring Around 811A; (6) 1:1 mix of Funk G522 DR and Ring Around 811A; (7 and 8) 1:1:1 mix of Funk G522 DR, Dekalb DK61 and DK64, and Gold Kist GSA 1290. Bird-resistant: (1) Funk BR 79; (2 and 5) Dekalb BR 54; (3 and 4) Funk 516
[b] Compared to corn at 100. Obtained by calculation using feed/gain figures and corrected to the level of grain in the ration.