

Benefits of High Oil Corn for Swine

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In the last issue, we introduced the topic of the new "designer genes" that have resulted in genetically modified cereal grains. In that article, we discussed the characteristics and benefits of low phytate corn and indicated that it will be commercially available in about two years. This article describes the characteristics and benefits of another genetically modified cereal grain, high oil corn. This corn is already commercially available to grain and swine producers.

First, a bit of background. The major role that cereal grains play in livestock feeds is as a source of energy. We normally express the energy requirements of pigs and the energy contributions by feedstuffs as digestible energy (DE) or metabolizable energy (ME), and less frequently as net energy (NE). Energy is generally expressed in units of kilocalories (kcal). Corn is an excellent source of energy due to its high starch content (located mainly in the endosperm), its low fiber content (mainly in the hull) and a small amount of oil (mainly in the germ). Typically, corn is considered to contain approximately 1,550 kcal of ME/lb on an "as-fed" basis for the pig. Wheat is similar to corn in energy content (1,500 kcal of ME/lb), as is grain sorghum (1,525 kcal of ME/lb), whereas the ME contents in barley and oats are less (1,325 and 1,230 kcal of ME/kg, respectively) due to their higher fiber content.

High-oil corn is not new. Plant breeders first attempted to modify the oil content of corn in studies that date back to the turn of the century, nearly 100 years ago. After 50 years of selection, plant breeders at the University of Illinois were able to produce a major difference in the oil content of corn, from 15.4% in their high oil line to less than 1.0% in their low oil line. However, it was only a few years ago that high oil hybrid corn was released for commercial use.

Typically, the new high oil cultivars of corn are about twice as high in their oil content as normal hybrid corn (6-7% versus 3.5-4%), as shown in Table 1. The 2.25-fold higher energy content of oil, as compared with starch, results in approximately 60 to 70 more kcal of ME/lb in high oil corn than typically found in normal corn.

The higher oil content of high oil corn is basically due to a larger germ. Because the germ also is higher in protein than the endosperm, and the proportion of lysine and certain other amino acids is higher in germ than in endosperm, the larger germ in high oil corn results in slightly higher levels of crude protein and several of the important essential amino acids, particularly lysine, than found in normal corn (Table 1). Also, the fatty acid profile of the fat is changed slightly (including high oleic acid, considered a "healthy" fatty acid), and the vitamin E content is slightly higher. Calcium and phosphorus are essentially the same in the two corn types.

The feeding of high oil corn to growing and finishing pigs results in slightly faster gains, reduced feed intake (due to the greater energy density), and improved efficiency of feed utilization (Table 2). The improvement in growth performance is similar to that obtained as when corn oil (or other sources of feed-grade fat) is added to the diet to provide the same level of oil as contributed by the high oil corn.

What are the benefits of high oil corn to swine producers? As seen from Table 2, a diet with a greater energy density, whether it comes from using high oil corn or from adding supplemental fat to the diet, results in a slight improvement in growth rate and an even greater improvement in feed efficiency. This means that less total feed is needed to produce a given tonnage of pork. Naturally this benefit

needs to be weighed against the added cost of a higher energy diet.

Probably the greatest benefit associated with high oil corn is the positive effect on physical properties of feeds. The presence of additional fat, regardless of type of fat, in diets reduces feed dust, and it has been clearly documented that reduced feed dust in swine facilities results in healthier pigs with fewer lung lesions and associated respiratory problems. Furthermore, less dust in hog buildings results in a much healthier atmosphere for people working in those buildings. The additional oil in corn has further benefits in that (1) it increases the throughput of hammermills (more than 10% in one study), thus reducing the amount of electrical energy needed to grind the corn, (2) it results in better mixing efficiency, (3) it reduces segregation of particles in mixed feed, and (4) it results in improved pellet quality when diets are pelleted.

The "prepackaged oil" in high oil corn has an additional benefit to small producers who mix their own feed, and who may not have sufficient production volume to justify keeping a heated fat tank on the farm at their feed mixing facility.

A question that corn producers always ask is whether high oil corn produces yields that are equal to normal corn? The answer is in the affirmative, but only when approximately 10% more kernels than normal are planted per acre. The greater number of kernels is due to the fact that approximately 10% of the kernels in a bag of high oil seed corn produce high-oil pollinator plants (these are low yielding plants) and the remaining 90% of the kernels produce the high yielding lines that are male sterile (i.e. they produce sterile pollen). The cross pollination that occurs in the field between the pollen of the high oil pollinator plants and the silks of the high yielding, male sterile recipient plants produces the corn grain that is high in oil.

Table 1. Composition of Normal and High Oil Corn^{ab}

	Normal Corn	High Oil Corn
Crude fat, %	3.47	6.33
Crude protein, %	7.94	8.49
Crude fiber, %	1.95	2.06
Starch, %	61.4	58.4
Metabolizable energy, kcal/lb	1,528	1,598
Amino acids		
Lysine, %	.25	.29
Threonine, %	.28	.31
Tryptophan, %	.07	.07
Methionine, %	.18	.20
Cystine, %	.18	.19
Fatty acids, % of total		
Palmitic acid	10.5	11.2
Stearic acid	2.1	2.7
Oleic acid	28.0	34.8
Linoleic acid	56.4	48.9
Linolenic acid	1.5	1.0
Minerals		
Calcium	.01	.01
Phosphorus	.24	.26
Vitamin E, mg/lb	10.0	12.7

^aAnalyses from over 300 samples over a 3-year period; Optimum Quality Grains, L.L.C., Des Moines, IA, 1998.

^b86% dry matter basis.

Table 2. Performance of Growing-Finishing Pigs Fed Corn-Soybean Meal Diets with Normal or High Oil Corn and Corn-Soybean Meal Diets with Supplemental Fat^a

	Normal Corn + Soy	High Oil Corn + Soy	Normal Corn + Soy + Fat
Experiment 1^a			
Avg daily gain, lb	1.87	1.88	1.92
Avg daily feed, lb	5.10	4.85	4.95
Feed/gain	2.72	2.58	2.58
Backfat, in.	.71	.68	.74
Loin eye area in. ²	6.2	6.1	6.4
Experiment 2^b			
Avg daily gain, lb		1.89	1.86
Avg daily feed, lb		5.26	5.21
Feed/gain		2.77	2.80
Backfat, in.		1.02	.98
Loin eye area in. ²		6.9	6.9
Carcass lean, %		50.0	50.2

^aExperiment involved 184 pigs from 44 to 254 lb body weight; Continental Grain Co. and Du Pont Agricultural Products.

^bExperiment involved 96 pigs from 62 to 248 lb body weight; Optimum Quality Grains.

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