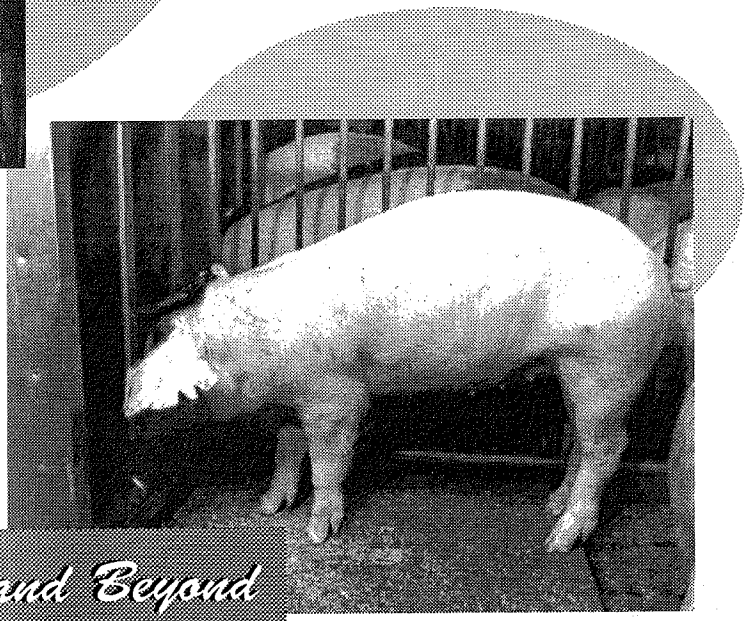
1995 Illinois Swine Research Reports

Department of Animal Sciences



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The Nutritional Value of High–Oil Corn

Corn is the major grain crop in livestock feed in the United States, and it is generally the major energy containing feedstuff in swine feed. The major energy contributing nutrient in corn is starch. The protein fraction makes up only 8.5% and the fat content only 3.7%. Hence, corn is usually not considered an oilseed crop.

Through genetic selection over many years, certain varieties of corn with a higher content of oil have been bred. The efforts in this area started nearly 100 years ago, when a classical breeding experiment at the University of Illinois was initiated by Dr. Hopkins. By selecting for oil content over 70 generations it was possible to increase the oil content to a level of 17 %, and after 82 generations, the oil content was 19%. Since these lines were only selected for their oil content, the yield was only about 30 % of the yield of commercial hybrids, - for this reason these lines have not been introduced commercially. However using modern breeding schemes, it has been possible to produce hybrids with 6-8% oil and with yields similarly to those of commercial hybrids. For this reason, interest in the use of high oil corn in livestock feeding has increased.

The chemical composition of three different lines of high-oil corn as well as a normal corn are shown in table 1.

Little research has been conducted to establish the nutritional value of high-oil corn. In the early 70's, an experiment was conducted to test the energy content in high-oil corn. In this experiment growing pigs from 20 to 100 kg were fed either high-oil corn or normal corn. No differences in growth rates between pigs receiving high-oil corn or normal corn were obtained, but a significant improvement in feed efficiency was observed with high oil corn, indicating a higher energy content in high-oil corn. In addition, a higher deposition of linoleic acid was found in carcasses from pigs fed high-oil corn, and the carcasses from these pigs were softer.

In a European study protein quality of 11 different varieties of high-oil corn grown in the former Yugoslavia, was evaluated and compared to normal corn. From this study, it was concluded that the protein quality of high-oil corn is better than that of normal corn, mainly due to a greater content of indispensable amino acids.

Other experiments conducted in the 80's by Dr. Al Jensen and his graduate student Keith Adams at

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[1]*Prepared by Hans H. Stein, Dr.Robert A.Easter,Scott N.Carr, and Kevin Soltwedel, Department of Animal Sciences, University of Illinois.*

the University of Illinois evaluated the quality of the fat portion of high-oil corn. In these experiments, the fat digestibility in high-oil corn was compared to that of normal corn and of corn oil. The conclusion was that the digestibility of fat in high-oil corn is considerably lower than that found with pure corn oil (75% and 90% respectively). This was explained by the fact that the fats in corn oil are free and easy to digest, whereas the intact fats in high-oil corns might be bound within fiber structures and, hence, more difficult for the digestive enzymes to reach. However, it was also concluded that the energy value of high-oil corn is higher than that of normal corn.

In a series of experiments completed in 1994 at the University of Illinois by Dr. Bob Easter and one of his graduate students, Scott N. Carr, the nutritional value of three different lines of high oil corns was evaluated. The objective of these experiments was to determine how the extra oil content in high-oil corn effected the metabolizable energy content of the corns, and to evaluate the digestibility of the amino acids in high-oil corn as well as in normal corn. The chemical composition of these three varieties of high-oil corns are shown in table 1. Also shown in table 1 is the expected energy values in the high oil corns as well as in normal corn, when calculated from their chemical composition. A 2-5% increase in metabolizable energy was expected.

Diets were formulated with the four test corns and fed to growing pigs in a traditional metabolism study that involved total collection of urine and feces.

The results from this study are shown in table 2. The metabolizable energy content of all the corns were somewhat lower than expected. However the ME values for two of the high oil corns increased as expected compared to normal corn. This means that the pigs were able to utilize the extra oil efficiently for growth. However, it also appears from table 2 that one of the high-oil corns did not show the increase in energy value that was expected given the difference in oil content. The reason for this is unknown, but the key implication is that there are differences in the energy values from different varieties of high-oil corns, and that the energy value in high-oil corn can not be calculated directly from the oil content of that corn.

Evaluating the amino acid digestibilities in normal corn and a high oil corn using cannulated pigs, the investigators found that the amino acids in high-oil corn are digested at least as efficiently as those in normal corn. Thus, it is safe to use the same digestibility coefficients as in normal corn when calculating the amount of digestible amino acids in high-oil corn. However, in agreement with the earlier European studies, it was also found that the concentration of lysine along with other indispensable amino acids tended to be higher in high-oil corn than in normal corn. Consequently, the total amount of digestible amino acids is also higher.

The conclusion from these studies is that some lines of high-oil corn will contribute more energy to swine feeds, and by this, the overall feed utilization will be increased. The digestibility of amino acids in high oil corn is, at least, comparable to normal corn so no corrections are needed in this regard. Differences do seem to exist between different strains of high-oil corns. Therefore, it is important to know the genetic background of a specific strain of high-oil corn in order to calculate the nutritional value of this corn before feeding it.

Table 1. Chemical composition of normal corn (NC) and three different varieties of high-oil corn (HOC).

Nutrient	NC	HOC 1	HOC 2	HOC 3
Dry matter,%	87.0	87.0	87.0	87.0
Crude fat,%	3.71	5.89	8.26	8.83
Crude protein,%	7.31	9.05	7.48	8.26
Crude fiber,%	1.83	1.91	2.52	2.35
Ash,%	1.13	1.22	1.39	1.39
Expected ME, kcal/kg.	3420	3496	3573	3593
Expected ME, NC=0	100	102	104.5	105

Table 2. Energy values in normal corn (NC) and high-oil corn (HOC).

	NC	HOC 1	HOC 2	HOC 3
ME expected, kcal/kg	3420	3496	3573	3593
ME obtained kcal/kg	3269	3394	3326	3451
ME obtained, NC=100.	100	103.8	101.7	105.6