

Feeding Wheat to Swine ¹

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The primary sources of energy in swine diets are cereal grains. Traditionally, corn has been the mainstay of most swine feeding programs. When the price of corn is high and wheat is low, wheat can be an attractive alternative to corn for swine diets. Research indicates that wheat can be efficiently utilized by swine of all ages; however, when using wheat to replace corn or other cereal grains in swine diets, consideration must be given to its nutrient composition, method of processing, and quality as well as cost.

Nutrient Composition

There are several classes of wheat grown in the United States. These include soft white winter, hard red winter, hard red spring and soft red winter. The only type of wheat grown in the Southeast is soft red winter.

The comparative composition of soft red winter wheat and corn, as well as other common feed ingredients, is shown in Table 1. Wheat is higher than corn in crude protein but, more importantly, is higher in lysine. Lysine is an important essential amino acid which forms the building blocks of protein. The protein of corn, wheat or other cereal grains is deficient in certain of these essential amino acids and

must be fortified with a protein supplement such as a soybean meal. Lysine is especially important because it is the first limiting amino acid in a grain-soybean meal diet. This means that if a diet is formulated to supply the correct amount of lysine, then generally the levels of the other essential amino acids will be adequate. Therefore, lysine content is an important consideration when comparing cereal grains.

Wheat contains less fat than corn but is equivalent to corn in energy content (metabolizable energy). Phosphorus content of wheat is slightly higher than that usually found in corn, and research has suggested that the phosphorus in wheat may be more available (digestible) to the pig.

Results of Feeding Trials

Research designed to evaluate soft red winter wheat in swine diets has been conducted in Kentucky and Florida. A summary of this research indicates that a wheat-soybean meal diet is essentially equal in feeding value to a corn-soybean meal diet as measured by average daily gain or feed conversion of growing-finishing swine.

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Use of Wheat in Swine Diets

Even though wheat contains more protein than corn, diets should be formulated to meet the lysine requirement of the pig rather than crude protein requirement. The analyzed crude protein content of wheat-based diets will usually be higher than corn-based diets when both diets contain equal levels of lysine. If diets containing wheat were formulated to meet the crude protein requirement, lysine levels would be inadequate to support maximum performance in swine.

Producers who mix their own diets using a soybean meal-premix program may want to use the suggested diets in Table 2 and Table 3. These suggested diets were formulated to take advantage of the higher lysine level of wheat, resulting in a savings of 50 lb of soybean meal (44%) per ton of complete diet over comparable corn-based diets. The 50 lb figure is an easy number to remember and will work with all swine diets when wheat is substituted for corn.

Producers using a commercially available complete protein-vitamin-mineral supplement should consider wheat equal to corn and substitute wheat for corn on an equal weight basis when mixing swine diets. To decrease the amount of these complete supplements to take advantage of the higher lysine (protein) content of wheat would dilute out the essential minerals and vitamins that these supplements also provide in the diet. This dilution could lead to inadequate mineral and vitamin levels in the diet, resulting in poor swine performance. Many problems associated with feeding wheat can be the result of improper protein supplementation.

Processing of Wheat

Processing wheat for efficient use in swine diets is very important. Best results in university feeding trials were obtained when wheat was coarsely ground or lightly crushed (lightly rolled). Hammer mill screen size of 5/16 to 1/4 inch and perhaps reduced hammer mill rpms should provide an acceptable grind. However, the wheat should be ground such that there are no whole kernels. Finely ground wheat is not desirable because it easily absorbs moisture from the air and the pig's own saliva which can result in feed

spoilage and reduce feed intake. This absorption of moisture and subsequent feed spoilage is a particular problem in hot, humid areas such as Florida.

Additionally, feed with finely ground wheat could bridge and not flow well in self-feeders. These problems may still occur even with coarsely ground wheat in the diet. Under these conditions, mixing wheat with ground corn is advisable. Examples of diets using both wheat and corn are given in Table 2 and Table 3. Corn is a better grain to mix with wheat than grain sorghum as mixtures of wheat and grain sorghum act similar to wheat alone.

Wheat of low test weight (low weight per bushel) is usually discounted or "docked" when sold for human consumption and, if the test weight is too low, it cannot be sold for human consumption at any price. This low test weight is usually due to shrunken and shriveled kernels or sprouting damage in the kernels. In most instances, this wheat can be included in swine diets without affecting performance. In fact, wheat kernels that are shrunken and shriveled are usually higher in crude protein and lysine than normal wheat kernels. However, unless it can be analyzed for lysine content, it is suggested that this wheat be used in swine diets much like wheat of higher test weight. Wheat of low test weight should be purchased and used in the diet on a weight basis rather than on a volume basis.

Sprout-damaged wheat has sprouted in the head before harvest and usually has a decreased test weight. Feeding tests have shown that sprout damage had essentially no effect on the feeding value of soft white winter wheat for growing-finishing swine. Therefore, sprout-damaged wheat can be effectively used in swine diets the same as undamaged wheat, provided that the grain is dry and mold free. If in doubt about the acceptability of sprout damaged wheat, it should be test-fed to a small group of pigs before purchasing large quantities. Sprout-damaged wheat can be mixed with undamaged wheat or corn if there are acceptability problems. Be aware that wheat rained on before harvest can not only lead to sprouting but also to mold growth. Some of these molds can produce mycotoxins that result in reduced pig performance. One of these mycotoxins, deoxynivalenol (DON), is of particular concern in

pigs. Pigs are very sensitive to the ill effects of this mycotoxin.

Wheat contaminated with various foreign materials such as rye, mustard seed, wild garlic and/or wild onion can be fed to swine with few problems. Wheat with extreme contamination, especially with wild garlic and/or onion, may be unpalatable to the pig and may reduce feed intake. Contaminated wheat can be mixed with "clean" (uncontaminated) wheat or corn if there are acceptability problems.

Relative Value of Wheat

The relative value of wheat compared to corn at varying corn and soybean meal prices is shown in Table 4. Because of its higher lysine content than corn, the relative price of wheat is dependent upon the price of soybean meal or other protein sources. The higher the price of soybean meal, the higher the value of wheat relative to corn. As an example, when soybean meal is \$300/ton and corn is \$3.50/bu, wheat would have an equivalent value of \$3.69/bu. Therefore, wheat purchased for less than \$3.69/bu would result in more economical gains. On a bushel basis, wheat is always worth more than corn, since a bushel of wheat is heavier than a bushel of corn (58 to 60 vs 56 lb). However, for producers who mix their own diets using a complete protein-vitamin-mineral supplement, wheat would only be worth the same price as corn on an equal weight basis since wheat should only replace corn on a pound for pound basis when using complete supplements.

Summary

1. Wheat may be used as a partial or sole grain source in diets for all classes of swine.
2. Diets containing wheat should be balanced for lysine instead of crude protein. Wheat-soybean meal diets will be higher in crude protein content than comparable corn-soybean meal diets.
3. Wheat contains more lysine than corn, thus those producers who mix their own diets using a soybean meal-premix program can save 50 lb of soybean meal per ton of mixed diet. (Table 5)

4. Those producers who mix their own diets using a complete protein-vitamin-mineral supplement should replace corn with wheat on a pound for pound basis.
5. Wheat should be coarsely ground or rolled for use in swine diets.
6. Wheat is worth up to 5% more than corn on an equal weight basis for those who can take advantage of wheat's higher lysine content.

Table 1.

Table 1. Typical analysis of wheat and other feedstuffs. ¹							
	Metabolizable ² energy, kcal/lb	Crude protein, %	Lysine %	Calcium %	Phosphorus %		
Wheat	1500	12.0	.32	.05	.30		
Corn	1500	8.5	.24	.02	.25		
Grain sorghum	1425	9.5	.22	.03	.25		
Oats	1200	13.0	.45	.05	.30		
Soybean meal (47%)	1500	47.5	3.05	.30	.60		
Dicalcium phosphate	--	--	--	22.0	18.50		
Defluorinated phosphate	--	--	--	32.0	18.0		
Mono-dicalcium phosphate	--	--	--	18.0	21.0		
Limestone, ground (calcium carbonate)	--	--	--	38.0	.04		

¹ Values given are typical for feedstuffs used in the Southeastern U.S. (Expressed on an as-fed basis).

² Relative energy (feeding) value compared with corn = 100, wheat = 100, grain sorghum = 95, and oats = 80

Table 2.

Table 2. Suggested starter, grower, finisher and combination grower-finisher diets using wheat as the major or sole grain.						
Ingredient	Starter (20 to 50 lb)		Grower (50 to 125 lb)		Finisher (125 lb to mkt. Wt.)	
	Wheat	Wheat & corn	Wheat	Wheat & corn	Wheat	Wheat & corn
	-----lb/ton -----					
Wheat, soft red	1360	635	1600	800	1725	850
Corn	--	700	--	775	--	850
Soybean meal (44%) ¹	575	600	350	375	225	250
Dicalcium phosphate	30	30	20	20	20	20
Limestone, ground	20	20	20	20	20	20
Salt	10	10	7	7	7	7
Vitamin-trace mineral premix ²	5	5	3	3	3	3
Total	2000	2000	2000	2000	2000	2000
Calculated Composition (as fed basis):						
Crude protein, %	20.8	20.0	17.3	16.4	15.3	14.2
Lysine, %	1.08	1.08	.78	.78	.60	.60
Calcium, %	.82	.82	.69	.69	.67	.67
Phosphorus, %	.65	.65	.54	.53	.52	.50
¹ Can replace 10 lb of 44% soybean meal with 9 lb of 48% soybean meal and 1 lb of grain.						
² See Table 5.						

Table 3.

Table 3. Suggested gestation (and boar) and lactation diets using wheat as the major or sole grain.

Ingredient	Gestation		Lactation	
	Wheat	Wheat & corn	Wheat	Wheat & corn
	-----lb/ton-----			
Wheat	1700	850	1610	785
Corn	--	825	--	800
Soybean meal ¹	225	325	--	350
Base mix:				
Dicalcium phosphate	40	40	30	30
Limestone, ground	20	20	20	20
Salt	10	10	10	10
Vitamin-trace premix ²	5	5	5	5
Total	2000	2000	2000	2000
Calculated composition (air dry basis):				
Crude protein, %	15.5	14.5	17.4	16.4
Lysine, %	.60	.60	.75	.74
Calcium, %	.89	.89	.78	.78
Phosphorus, %	.70	.68	.62	.60

Table 3.

¹ 47% crude protein.
² See Table 5.

Table 4.

Table 4. Maximum price that can be paid for wheat to replace corn (\$/bu).¹										
Soybean meal (44%) \$/ton	Corn \$/bu									
	3.00	3.25	3.50	3.75	4.00	4.25	4.50			
220	3.15	3.39	3.65	3.90	4.15	4.40	4.66			
240	3.16	3.40	3.66	3.91	4.17	4.41	4.67			
260	3.16	3.41	3.67	3.92	4.18	4.42	4.68			
280	3.17	3.42	3.68	3.93	4.19	4.43	4.69			
300	3.18	3.43	3.69	3.94	4.20	4.44	4.70			
320	3.19	3.44	3.70	3.95	4.21	4.45	4.71			
340	3.20	3.45	3.71	3.96	4.22	4.46	4.72			

¹ Based on wheat having lysine content = 0.32%, relative energy = 99% of corn and bushel weight = 58 lbs.

Table 5.

Table 5. Suggested vitamin-trace mineral premix. ¹			
Ingredient	Amount per lb premix	Amounts supplied per lb of mixed feed when added at:	
		5 lb/ton	3 lb/ton
Vitamin A	8,000,000 I.U.	2,000 I.U.	1,200 I.U.
Vitamin D	80,000 I.U.	200 I.U.	120 I.U.
Vitamin E	3,400 I.U.	8.5 I.U.	5.1 I.U.
Vitamin K (menadione)	660 mg	1.6 mg	1.0 mg
Riboflavin	800 mg	2.0 mg	1.2 mg
Pantothenic acid	4,000 mg	10.0 mg	6.0 mg
Niacin	5,400 mg	13.5 mg	8.1 mg
Vitamin B ₁₂	4 mg	10.0 ug	6.0 ug
Choline chloride	50,000 mg	125 mg	75 mg
Copper	.4%	10 ppm	6 ppm
Iodine	.008%	.2 ppm	.12 ppm
Iron	3.0%	75 ppm	45 ppm
Manganese	.8%	20 ppm	12 ppm
Zinc	4.0%	100 ppm	60 ppm
Selenium	.010%	.25 ppm	.15 ppm

¹ Vitamin and trace mineral mixes may be purchased separately. This is advisable if a combination vitamin-trace mineral premix is to be stored longer than 2 to 3 months. Vitamins may lose their potency in the presence of trace minerals if stored for prolonged periods. Commercial vitamin-trace mineral premixes are usually formulated to be used in corn-based diets. The premixes are adequate for wheat-based diets. Follow manufacturer's guidelines in their use.