Wheat as a Replacement for Corn in Poultry Diets

Corn is the high-energy grain favoured by most poultry nutritionists and poultry producers. However, it is not always available at an economic price. Wheat may be a more economic and readily-available alternative. Broiler diets containing up to 80%wheat have given good results in trials at UBC. A number of factors need to be considered when using wheat in place of corn in poultry diets.

❶ The metabolizable energy (ME) level in wheat is generally lower than in corn and is more variable than in corn

According to the US National Research Council - National Academy of Sciences, the average ME value for corn is 3,350 kcal/kg, for soft white winter wheat 3,120 kcal/kg and for hard red winter wheat 2,900.

All major wheat-producing countries report considerable variability in energy content, particularly Australia (see Table 1). A main reason for the variability in the energy content is variation in the content of complex polysaccharides in the grain. These non-starch polysaccharides (NSP's) are poorly digested by poultry (about 12%), result in reduced energy utilization, and interfere with the digestibility of other feed components. The content of NSP's in wheat may be 1-10% or more, and the NSP content is negatively correlated with ME content- the higher the NSP content, the lower the ME content.

Table 1. ME Values of Wheat for Poultry

	kcal/kg
Canada	2945-3960
US	2880-3220
UK	3110-3640
Australia	2475-3800*
NAS/NRC 1994	2900-3120

*NSP varied

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Unfortunately there is currently no quick and easy test available to the feed manufacturer to measure the NSP content of wheat. Feed companies can use a feed enzyme that will break down the complex polysaccharides in the gut of the chicken resulting in improved energy utilization and a higher ME content in the wheat.

The increase in ME value may be 100 kcal/kg or more. An example of the type of enzyme mixture being used with wheat is one that contains xylanase, beta-glucanase and pectinase. This mixture is intended to deal with a range of complex polysaccharides that can occur in wheat. The value of using enzyme with wheat is shown in Table 2.

Table 2. Influence of Dietary Wheat and Enzyme on Growth of Broilers (27-34 days of age)

	Gain (g)	FCE	ME feed kcal/kg DM
Corn	438a	0.51a	3979a
Wheat (Low ME)	306b	0.40b	2873c
Plus enzyme	397ab	0.51a	3571b
Wheat (regular)	383a	0.49a	3470b
Plus enzyme	431a	0.52a	3544b

FCE is Feed Conversion Efficiency and represents the kg of body wt gain divided by the kg of feed consumed.
DM is Dry Matter. The results shown are from Australian studies. Different letters following the figures above indicate statistically significant differences.

❷ Wheat-based diets require less protein supplementation than corn-based diets

One of the benefits of wheat is that it contains 12-14% protein, compared with about 8.5% in corn. As a result, less soybean meal or canola has to be used in wheat-based diets to achieve a necessary protein level in the finished feed.

❸ Broiler mortality may be higher with wheat-based diets

Several researchers have reported increased mortality, especially mortality from Sudden Death Syndrome (SDS). Some results from UBC are shown in Table 3. Two actions can be taken to minimize this effect. One is to supplement the diet with meat-meal and with the vitamin biotin, which is present in wheat but is in an unavailable form. The second is to alter the lighting program so that the growth of the birds is slowed during the first 3 weeks and then to increase it over the next 3 weeks. Benefits of the increasing lighting program are shown in Table 4.

Table 3. Diet and Mortality in Growing Broilers			
		Total Deaths %	**SDS Deaths %**
Grain Type	Corn	3.4b	2.4b
	Wheat	5.2a	3.3a
Protein Type	SBM	4.4	3.2a
	SBM + Meat meal	4.2	2.5b

SDS is Sudden Death Syndrome. SBM is Soybean Meal.
Different letters following the figures above indicate statistically significant differences.

Table 4. Lighting Patterns and Growth of Broilers				
		Weight* (g)	**Total Deaths %**	**SDS Deaths %**
Lighting	Constant	2398	11.5a	9.7a
	Increasing	2400	9.5b	7.8b

* Weight of broilers at 6 weeks of age.
Different letters following the figures above indicate statistically significant differences.

❹ Wheat generally gives a firmer pellet during feed manufacture

Broilers are usually fed textured diets, i.e. the feed mixture is compressed into crumbles for the starter (0-3 wks) phase and into pellets for the grower/finisher phase (4-6 wks). Diets containing at least 10% wheat bind better during feed manufacture, resulting in firmer pellets. A pellet binder, such as benotonite or lignosulfonate, may have to be used with corn-based diets.

❺ Wheat should be coarse-ground for use in mash diets

In some cases mash diets, i.e. mixtures of ground grains, proteins, etc. are fed in non-textured form. The wheat should not be finely ground for use in mash diets. Wheat fractures into very fine particles when subjected to fine grinding. Poultry do not like powdery diets as they clog the nostrils and eyes during feeding. The powdery diets also stick to their beaks. Prolonged feeding of such diets can result in beak abnormality, feed refusal and poor growth.

❻ Wheat contains a low level of pigmenting agents for yolk and skin colour

North American consumers generally prefer yellow-fleshed chickens and bright yellow yolks. This coloration can be achieved readily with corn-based diets, since these diets contain ample amounts of xanthophyll pigments. Wheat, however, contains a low level of pigmenting agents. As a result chickens and the yolks of eggs from birds fed wheat-based diets are pale yellow, sometimes almost white. To the uninformed consumer the chickens and eggs fed wheat based diets may appear to be anemic and sick. Other consumers actually prefer such eggs and chickens. This can vary based upon the background and experience of the consumers.

We can cope with different preferences! Where consumers prefer light-coloured eggs and chickens, poultry producers should avoid feeding ingredients such as corn and alfalfa that contain high amounts of natural pigments. Wheat and barley should be utilized as much as possible. Corn and alfalfa should be utilized in feeds in areas where consumers prefer deep yellow coloured yolks in their eggs and yellow skinned chickens. If these ingredients are unavailable or too costly, the wheat and barley-based diets should be supplemented with chemical pigments which are available for feed use. Some feed manufacturers also use natural pigmenting agents such as marigold petals.

❼ The body fat in broilers fed wheat-based diets is firmer

Broiler carcass fat appears more oily when the birds are raised on corn-based diets. The body fat is firmer when the diets are wheat-based. Part of the reason for this is that corn contains a higher level of fat than wheat. The processor and the consumer may prefer chickens with a firmer body fat. Where this is the case, wheat-based diets should be used.

SUMMARY

There are pros and cons in using wheat in poultry diets in place of corn. The various factors that should be taken into account, in addition to availability and cost, are as follows:

1. The energy (ME) value is generally lower for wheat. Use a feed enzyme to improve the ME value of the diet when using wheat.
2. Wheat-based diets have the advantage of requiring less protein supplementation.
3. Broiler mortality may be higher with wheat-based diets. Use a modified lighting program and dietary supplementation with meat meal and biotin to minimize this problem.
4. Inclusion of wheat in a feed generally results in a firmer pellet, which is an advantage.
5. Wheat should be ground to a coarse grist for use in mash (non-pelleted diets) to avoid feed refusals and beak deformations.
6. Wheat contains a low level of pigmenting agents for yolk and skin colour. Incorporate feeds such as alfalfa into the feed mixture to correct this problem.
7. The body fat in broilers fed wheat-based diets is firmer than in broilers fed corn-based diets, a possible advantage for the processor and consumer.

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