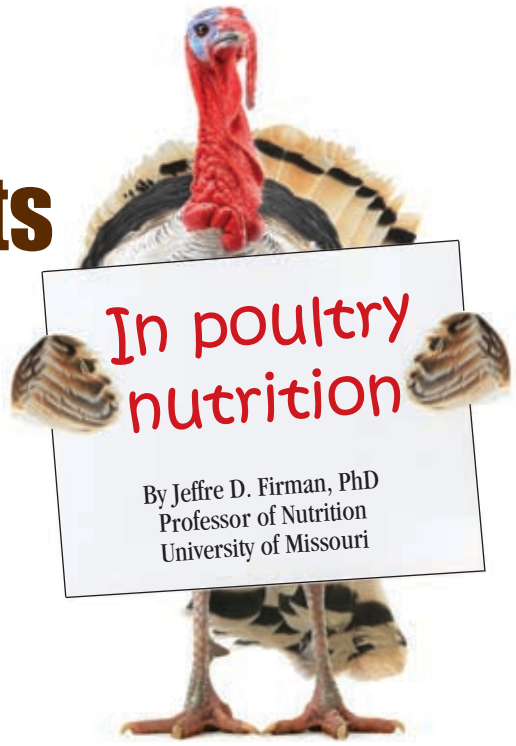
Benefits of Rendered Products



The poultry industry in the United States and worldwide has seen major changes in the past 50 years. Consumption of poultry and poultry products has increased dramatically over this time period and the evolution of the industry has resulted in advances in diet formulation as new ingredients and technology have become available. As this evolution took place, formulations became more sophisticated, moving from hand to computer, from a total protein basis to a digestible amino acid basis, and incorporation of a variety of micronutrient sources. All of this has led to reduced cost and maximum bird performance for the poultry industry.

The availability of a variety of rendered by-products has been of great benefit to the modern poultry industry, but due to changes in consumer preference and welfare standards, challenges to the poultry industry's use of rendered products need to be addressed so that these beneficial commodities can continue to be used.

Use of Rendered Products in Poultry Feed

There has been a long history worldwide of using animal proteins and a variety of rendered fats in poultry feed. Essentially all sources of proteins and fats have been and continue to be used in significant quantities in the United States with the primary issue being relative values compared to other protein sources such as soybean meal. Products currently being utilized include meat meals from ruminant, swine, and poultry as well as the blood products from these proteins, rendered fat from each of these sources, and feather meal. Additionally, there is now some limited production of whole hen meal made from spent laying hens. Each of these products has been used successfully at various levels in the rations of poultry of all types with the higher levels going into broilers and turkeys due to their higher relative protein needs in comparison to layers.

Animal proteins and fats provide nutrients needed by poultry at reasonable prices relative to competing commodities. There has also been some interest in replacement of a portion of the soybean meal in poultry rations with animal protein meals to improve performance. The oligosaccharide portion of soybean meal has been shown to produce some detrimental effects to poultry. This is thought to be due to a substance in the undigested portion of the product that irritates the footpad. The addition of animal proteins may improve performance over standard vegetarian diets. While these results may be due to high levels of limiting amino acids, it may also be explained by the reduction of poorly digested carbohydrates in the soybean meal. Previous work in the University of Missouri lab suggested that up to half of the protein source can be provided with mixed by-products if one formulates correctly. While each product has different nutrient contents and potential values, most are excellent sources of energy or high quality protein, highly available phosphorus, and other minerals.

Practical Use of Fat in Poultry Rations

The practical use of fat in poultry rations is straightforward, and the effects of fat addition are well understood. A minimum level of fat (usually one percent) is usually fixed into the diet for several reasons, but is typically done to assure sufficient quantities of linoleic acid. It also helps reduce dust levels of feed, lubricates equipment, and improves palatability of feed. This addition level is generally done regardless of cost. Levels beyond one percent of the diet are mostly used to improve growth rate and feed efficiency and are far more related to cost of the total diet relative to performance gains achieved

A number of different fat sources are available for poultry from the rendering industry. The primary sources are poultry fat, tallow, yellow grease, lard, and blends. In other countries, there is considerable use of vegetable fats such as sunflower oil, soybean oil, or palm oil. Generally these fats are relatively expensive when compared to rendered products, resulting in lower fat utilization and thus lower metabolizable energy (ME) diets than in the United States.

Inclusion of rendered fats in poultry feed has many advantages, such as:

- concentrated source of energy and the main method of increasing the energy content of diets;
- increased growth rates, feed efficiency, and palatability of feeds;
- decreased feed intake and dustiness of feeds;
- good source of linoleic acid;
- lubrication for equipment in feed mills;
- increased rate of gain that could decrease age at market and increase throughput of housing systems;
- lower heat increment useful during heat stress to keep caloric intake up;
- possible slow gut transit of other feeds resulting in increased digestibility;
- possible "extra-caloric" effect that may be more cost-effective than other energy sources;

- concentrated feeds that decrease transportation costs for feed delivery; and
- use of higher levels of fat that could negate the effects of pelleting.

However, there are some concerns that should be noted with fat utilization, including:

- measurement of ME content can be somewhat difficult;
- potential for rancidity;
- equipment needs relative to fat additions must be adequate; and
- poor digestibility of saturated fats by the young bird.

One of the major concerns relative to fat usage is the actual ME value that should be assigned to each fat source. This number is often difficult to determine in a practical sense and may have little value in diet formulation (see tables 1 and 2). When analyzing energy content of fat, it is generally done indirectly by substitution of a portion of the ration fed in the ME determination. Additionally, fat may have an extra-caloric effect, whereby it affects the nutrient availability of other ingredients. This was noted in the University of Missouri lab where it was found that fat additions resulted in digestibility of meat and bone meal (MBM) being increased. This would explain why some ME values reported are greater than the gross energy values possible for fat as well.

Early work on use of fat in poultry rations generally indicated a higher ME value for unsaturated vegetable oils when compared to rendered fats or products with high free fatty acid content. However, when fed as a portion of a complete ration, most experiments have indicated no difference in performance parameters when different fat sources were fed (tables 1, 2). Several reasons may be postulated why the differences seen in energy value in an ME analysis do not translate into differences in actual performance when added to complete diets. One of these is that the improvement in utilization of other dietary components is equally enhanced by different sources regardless of ME content.

A more obvious answer may be the relatively small difference in ME content of a total ration at typical fat inclusion levels. In other words, if two fats of 7,000 and 8,000 kilocalories per kilogram (kcal/kg) ME are fed at three percent of the diet, the difference in ME content of the complete ration is only 30 kcal/kg, or less than one percent of the total dietary energy. This type of difference is very small and would be extremely difficult to pick up experimentally. In a study from the University of Georgia, a variety of fat sources were fed and differences of more than 4,000 kcal/kg were seen. However, when these same fats were fed to birds in a floor pen trial, no differences in gain, or feed:gain, were observed, indicating that the net energy available to the bird was comparable. Similar results were found in a more recent study from the University of Missouri lab and are shown in tables 1 and 2.

Increasing dietary fat improves feed efficiency but also may result in increased fat deposition. When turkeys were fed energy from 88 to 112 percent of the National Research Council suggested levels, birds showed increased growth rate (25.3 to 29.4 pounds) and dramatic changes in feed efficiency (3.41 versus 2.41 pounds feed:pound gain). While birds decreased feed intake in response to the higher energy diets in these studies, overall energy was higher with additional energy coming from fat additions.

Table 1. Average broiler growth for birds fed a variety of fat sources

Fat source	0-3 week*	0-5 week*	0-7 week*
Soybean oil	0.77	1.92	2.85
Yellow grease	0.76	1.96	2.95
Poultry fat	0.76	1.93	2.92
Tallow	0.75	1.92	2.99
Animal-veg blend	0.74	1.89	2.96
Lard	0.75	1.88	2.97
Palm oil	0.75	1.95	2.94

*kg per bird per phase
No statistical differences between treatments.

Use of Animal Proteins in Poultry Rations

Animal proteins available from the non-edible portion of cattle/pig/poultry processing include meat meal, MBM, poultry by-product meal, feather meal, and blood meal. The products may vary based on input materials and the proportion of bone. Meat-based meals range from 50 percent to as high as 65 percent protein and may have as much as 5 percent available phosphorus as well as a variety of other nutrients. Feather and blood meals can have 80 percent crude protein, though the protein is not a well-balanced amino acid profile.

Protein from many of these products is highly digestible and cost-effective. Phosphorus is generally thought to be highly available although phosphorus from bone meal sources has been shown to be slightly less available than from dicalcium phosphate. However, more recent data indicate no differences in utilization of phosphorus from animal protein meals or dicalcium phosphate. Most nutritionists today assume 90 to 100 percent availability of phosphorus from rendered by-products.

Use of rendered proteins in poultry feed has many advantages. Some of the benefits of their addition are:

- competitive cost-wise relative to vegetable protein sources thus reducing total diet costs in most cases;
- source of high-quality protein that is highly digestible in most cases;
- may help balance out amino acid needs;
- provides a small increase in growth rates over vegetable protein-only diets in many cases; and

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Table 2. Adjusted feed:gain ratios for broilers fed a variety of fat sources

Fat source	0-3 week*	0-5 week*	0-7 week*
Soybean oil	1.38	1.60	1.87
Yellow grease	1.38	1.56	1.85
Poultry fat	1.38	1.58	1.85
Tallow	1.40	1.61	1.83
Animal-veg blend	1.42	1.63	1.86
Lard	1.40	1.52	1.77
Palm oil	1.42	1.56	1.88

*kg:kg

- excellent source of highly available phosphorus and other minerals.

Some concerns that should be noted with utilization of rendered proteins include:

- poor quality control could result in decreased amino acid digestibility;
- proper formulation methods must be used for most effective use; and
- variation of product due to material mix and/or processing methodology.

Use of rendered proteins has been limited in the past for a variety of reasons. Older research indicates a growth depression if use exceeded certain limits, such as 7.5 percent of the diet. This occurred primarily due to the reduced digestibility of many products relative to soybean meal. Older data from the University of Missouri lab indicates almost 10 percent less digestible lysine in MBM than in soybean meal. Thus as the levels of MBM increased in the diet, the level of lysine available for use by the bird decreased. While the routine safety factor covered this deficit to a point, an amino acid deficiency eventually developed and growth rate was depressed. Formulation on a digestible basis eliminates this problem and inclusion rate has become less of an issue. Additionally, more recently tested product has approached soybean meal in terms of amino acid digestibility.

Table 3. Cost of broiler starter at different levels of MBM and poultry by-product meal (PBM)

MBM level	PBM level	Relative price of product	Price of broiler starter per ton
0%	0%	N/A	$258.18
5.0%	0%	100%	$255.12
5.0%	5%	100%	$251.02
3.8%	10%	100%	$247.13
5.0%	5%	110%	$254.22
3.8%	10%	110%	$251.56
5.0%	5%	90%	$242.32
3.8%	10%	90%	$235.72

Rendered proteins are heavily used in most rations for broilers and turkeys in the United States. While they may be utilized individually, in most cases the most cost-effective additions result from allowing the computer to select from a variety of available animal protein meals. Including multiple protein sources reduces cost, improves nutrient balance, and decreases nitrogen excretion.

MBM of porcine/ruminant origin is generally the most cost-effective source, followed by feed grade poultry by-product meals. MBM and poultry by-product meal are added as protein and phosphorus sources, with the latter generally being higher in protein/energy and thus commanding a higher value. When formulated on a digestible basis, the upper limit of these additions can easily exceed 10 percent from a growth standpoint, but are generally more based on cost-efficiency. If not formulating on a digestible amino acid basis, one should still look at digestibility of the product and set a maximum inclusion rate if there are substantial differences in digestibility from soybean meal. Given the quantity of data available, all poultry diets should be formulated on a digestible basis in the future. Table 3 shows the effect of additions of MBM and poultry by-product meal on diet cost in various scenarios.

In summary, rendered products provide valuable sources of highly available energy, protein, and minerals that should continue to be utilized by all aspects of the poultry industry. **R**

Putting All-veggie Broiler Diets to the Test

In 2006, a large poultry and pork producer in Australia switched to an all-vegetable diet for their birds due to a contract feed manufacturer wanting to remove meat by-products from their mill. The result of this change was that as soon as the birds started on these diets, their droppings became very wet. The company had no choice but to continue with the diets, yet as time went on and the birds gained weight, the wet litter became a major issue.

The main effects were:

- Due to the wet litter, the shed floors became extremely slippery, the litter stuck to the birds' legs, and ultimately the birds suffered extreme ammonia burns to their legs and breasts.
- Feed conversions blew out dramatically causing the birds to remain in the sheds longer, subjecting them to unsuitable conditions and increasing costs to the company.
- Respiratory problems caused by high ammonia levels from the wet litter caused bird mortalities to increase dramatically.

The conditions in the sheds were so bad that work crews entering the sheds to pick up the birds complained about the slippery conditions on the floors and the high levels of ammonia. Their pay was increased as an incentive to continue picking up the birds but eventually they refused due to the poor conditions. Management staff ultimately had to perform the final bird collections.

The company then organized a trial to see if the all-veggie diet was the cause of the wet litter and weight conversion problems. It was arranged so several sheds of birds were fed vegetable diets and several were fed diets with meat and bone meal (MBM) inclusion. The MBM diets were supplied by the company's feed mill.

The results were immediate. The birds fed the MBM diets had no wet litter issues, mortalities decreased, and feed conversions returned to very low levels. The birds fed the vegetable diets continued to have wet litter problems, high mortalities, and poor feed conversions.

The company repeated these trials on two occasions with the same results leading the poultry producer to go back to feed rations with MBM inclusion that was supplied by its own feed mill.

The Australian Renderers Association has published a white paper on MBM in broiler feed written by Dr. Kenneth Bruerton, Protea Park Nutrition Services. Contact Dennis King at dennis.king@ausrenderers.com.au. **R**