Use of Corn Co-Products in Small Ruminant Diets

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Over the past ten years the availability of corn co-products for feeding ruminants has increased steadily. In 1999, U.S. ethanol bio refineries produced 2.3 million metric tons of distillers grains. In 2010, that production was at 32.5 million metric tons (source: Renewable Fuels Association) and includes distillers grains, corn gluten feed, and corn gluten meal. This represents a large increase in usage of high value livestock feed over the past decade. In 2010, the dairy and beef industries utilized 80% of the corn co-products produced. In addition, the use of corn co-products in the diets of goats and sheep has also increased. Feeding corn co-products to small ruminants does require special considerations.

Based on the typical analyses shown in Table 1 on the next page, these corn co-products are intermediate in protein (exception is corn gluten meal), relatively high in rumen undegradable protein, high in methionine, and high in energy. These characteristics, coupled with economic prices, at times, may make these products very attractive feed ingredients for use in sheep and goat rations.

One challenge facing those who feed corn co-products to sheep and goats is the low calcium/high phosphorus levels that are characteristic of corn co-products. With rations containing corn co-products, care should be taken to ensure a 2:1 calcium to phosphorus ratio in the diet to help maintain urinary tract health, particularly in male sheep and goats. The ratio of calcium to phosphorus in goat and sheep diets can range from 2:1 to 7:1 (Schauer and Held, 2008). From field experience it has been found that it is best to avoid exceeding 0.6% phosphorus in grain rations for male goats or sheep. For added protection against urinary tract problems (urinary calculi), ammonium chloride should be added to the grain mix (0.5 -1.0% per ton).

Corn co-products, except corn germ meal, can contain high levels of sulfur. For sheep and goats, ingestion of high levels of sulfur (from feed and/or water) can interfere with thiamine synthesis in the rumen, which could predispose the animal to polioencephalomalacia. In addition, high sulfur levels can cause decreased feed intake and tie-up copper and molybdenum. Schauer and Held (2008) point out that in the total diet (forages and grain mix) of small ruminants, the total sulfur should not exceed 0.4%. In high-forage diets, the maximum sulfur should not exceed 0.5%. In the grain mix, sulfur should be limited to no more than 0.3%. Thiamine can be added to small ruminant diets to provide added protection against the effects of high sulfur levels. Added levels of thiamine have varied between 35-100 mg/lb in a complete grain mix or pellets. Exact levels of added thiamine needed for effective protection against polioencephalomalacia are not well established for small ruminants.

For distillers dried grains with solubles, fat levels can vary widely depending on the source (distillery). The amount of fat in corn distillers can range from 4% to 16%, although there are fewer sources of the high fat distillers available. Most ethanol producers are standardizing the amount of fat in their distillers products. If a producer is going to utilize corn co-products, the fat percentage of the product should be determined. Vegetable fat, an energy source, can help increase palatability; however, high levels of fat (over 5-6% of the ration) may over time lower utilization of fiber in the rumen, destroy needed rumen bacteria, and cause acidosis.

ADM sets high standards for grain utilized for ethanol production and the subsequent corn co-products produced. However, it is possible that corn co-products may contain appreciable levels of mycotoxins. If the grain source contained substantial levels of mycotoxins, then the fermentation process can actually concentrate those levels of mycotoxins. Caution should be used when purchasing corn co-products, particularly when grain is sourced from areas known to produce crops high in mycotoxins.

Research on the Use of Corn Co-products in Small Ruminant Diets

Schauer et al., 2008, (North Dakota State University) fed 240 western white-faced Rambouillet wether and ewe lambs (69.8 lb initial average weight) that were assigned to one of four diets where barley (control ration) was replaced by 20%, 40%, and 60% distillers dried grains. Lambs were fed these finishing diets for 111 days. All diets supplied each animal with an average of 142 mg/hd/day (DM basis) of thiamine or an average of 35 mg of thiamine per lb of feed (DM basis). The calcium: phosphorus ratios were at least 2:1 for each ration. Ammonium chloride was supplied at 0.5% of the grain mixes. With a few exceptions, the effects of level of distillers on feedlot performance and carcass traits did not differ ($P \geq 0.15$) from the barley-based ration. Intake increased in a linear manner as level of distillers increased ($P<0.001$). The authors speculated that the increased intake as distillers increased was possibly due to increased palatability (maybe due to increased fat content).

At South Dakota State University, Zelinsky et al. (2009) fed 80 white-faced and brockle-faced wether and ewe lambs (78.1 lb initial average weight, 79-105 initial days of age) one of two rations. The

Table 1 Typical Chemical Characteristics of Corn Co-products†

Nutrient*	Co-Product			
	Corn Gluten Meal	Corn Gluten Feed	Corn Germ Meal	Distillers Dried Grains with Solubles
Dry Matter, %	90.0	90.0	90.0	91.0
Crude Protein, %	60.2	21.5	24.0	26.5
Rumen Undegradable Protein (RUP), %	55.0	30.0	–	56.0
Fat, %	2.0	3.0	2.7	8.4
Fiber, %	2.5	10.0	9.5	8.5
Neutral Detergent Fiber (NDF), %	5.0	33.3	62.0	34.0
Acid Detergent Fiber (ADF), %	6.0	10.7	17.7	16.3
Calcium, %	0.05	0.16	0.01	0.20
Phosphorus, %	0.44	0.83	0.43	0.77
Potassium, %	0.20	0.98	0.38	0.84
Magnesium, %	0.08	0.30	0.21	0.19
Sulfur, %	0.80	0.70	0.28	0.60
Total Digestible Nutrients, %**	89.0	80.0	74.0	85.0
Net Energy Lactation, mcal/lb**	0.94	0.87	0.77	0.90
Net Energy Gain, mcal/lb**	0.69	0.59	0.51	0.64
Net Energy Maintenance, mcal/lb**	1.00	0.88	0.80	0.33
Lysine, %	1.02	0.63	0.94	0.62
Methionine, %	1.43	0.35	0.46	0.52

*As-fed basis; **Dry matter basis; †ADM Feed Ingredient Catalog

rations were either corn or soybean hull-based (76% corn or 76% soy hulls) using dried distillers grains with solubles (DDGS) as the protein supplement (each ration contained approximately 17% DDGS). Both rations provided 14% protein, 0.5% ammonium chloride, and at least a 2:1 calcium-phosphorus ratio. Lambs were fed for 60 days. No differences were observed in lamb growth rates for the entire period. Lambs fed the corn diet gained 0.77 lb per head per day, and lambs fed the soybean hull diet gained 0.79 lb per head per day. Diet intake (P = 0.0021) and feed to gain ratios (F/G) (P = .0039) were greater for the soybean hull-based ration versus the corn-based ration. Feed refusals were less for the soy hull-based ration (P = .0056) than for the corn-based ration. Carcass measurements for back fat, loin eye area, hot carcass weight, and USDA Quality and Yield Grades did not differ between rations. These results are similar to what McEachern et al. (2009) found when cottonseed meal was replaced with distillers in feeding Rambouillet lambs. Replacing all of the cottonseed meal with distillers (approximately 20% of the ration) had no negative effects on growth, efficiency of gain, or wool characteristics.

Work at the University of Kentucky (Hutchens et al., 2006) compared goat performance utilizing three different rations:

- Commercial ration (17.8% protein, 15.2% ADF)
- Farm-mixed ration containing 20% DDGS, 40% soybean hulls, and 40% whole shelled corn
- Farm-mixed ration containing 30% DDGS, 30% soybean hulls, and 40% whole shelled corn

These feeds were fed at the rate of 3% of the group average body weight. Hay (10.3% protein, 44.9% ADF) was fed free-choice. A total of 60 weanlings (Boer X Kiko; 104 to 120 days old) were assigned to one of these three rations and fed for 56 days. Initial weight averaged 40.1 to 41.2 lb for these 35 intact males and 25 females. There was no significant difference (P< .05) in total pounds of gain and ADG with these three rations. ADG was 0.44 lb for the commercial feed group and the 20% DDGS group. Average daily gain for the 30% DDGS group was 0.41 lb. Age of animals had no effect on (P< .10) on overall weight gain or ADG.

Practical Small Ruminant Feeding Scenarios Utilizing Corn Co-products

Under most circumstances, because of the possibility of high phosphorus, sulfur, and fat levels in many corn co-products, inclusion of corn co-products in small ruminant grain rations should be limited to 20 to 25% of the grain ration. More precisely, grain rations should have total sulfur limited to 0.3% or less of the grain ration, and phosphorus should be limited to 0.6% or less of the grain ration. Total fat in a grain ration for small ruminants should not exceed 5-6%.

From the limited research conducted, DDGS and possibly other corn co-products work very well as a energy source (replacing grain) and as a protein source (replacing oil meals) in small ruminant diets. It has been found that DDGS can replace the oil meals as the sole protein source in small ruminant feedlot rations (up to 20% of the ration). There are strong indications that corn co-products (particularly DDGS) can be used in conjunction with soybean hull pellets to partially or completely replace corn in lamb feedlot diets without jeopardizing overall gain and performance.

ADM Alliance Nutrition® Possesses the Knowledge and Programs Needed to Help Small Ruminant Livestock Producers be Successful in Feeding Corn Co-products

ADM Alliance Nutrition's small ruminant concentrates can be utilized very successfully when a moderate level of corn co-products are to be fed (5-10% of the ration). These products include Meat Goat 36% Concentrate (80867AAA), Dairy Goat 36% Concentrate (80863AAA, which should not to be used for male goats), and 36% Sheep Concentrate (80915AAA). These products are designed to deliver a 2:1 calcium-phosphorus ratio

in the final mix, appreciable levels of added thiamine, along with high-quality protein, vitamins, and minerals.

When a higher amount of corn co-product is to be fed (20-30%), where the corn co-product is the main protein source in the ration, ADM Alliance Nutrition offers two corn co-product mixer pellets that can be utilized. These include Sheep By-Product Mixer Pellet (81095AAA) and Meat Goat By-Product Mixer Pellet (81511AAA). These products are used at 175 to 200 lb per ton of complete grain mix to supply a 2:1 calcium phosphorus ratio, appropriate ammonium chloride levels, added thiamine, and optimum levels of vitamins and minerals.

Under most circumstances utilizing ADM Alliance Nutrition's small ruminant concentrates or by-product mixer pellets in sheep or goat rations that contain appreciable amounts of corn co-product can result in optimum performance with a minimum of nutritional problems.

References:

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