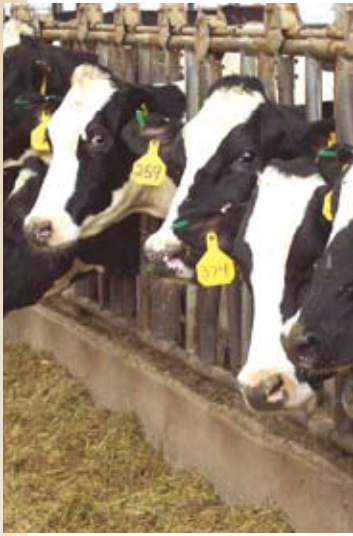


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Value of Distillers' Grains for Lactating Dairy Cows

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Introduction

Co-products from grain and oilseed processing are attractive low-cost feed alternatives for many Indiana dairy producers. The expanding bioenergy production capabilities of Indiana and surrounding states will provide even further opportunities to use these co-products as a feedstock for lactating dairy cows.

While there are several attractive features of these biofuel co-products, there is a lack of experience among Indiana's dairy producers and consulting nutritionists with regard to their handling, storage, and feeding. This publication outlines some of the important factors when considering co-products of corn ethanol production as feeds for lactating dairy cows.

Forms of Distillers' Grains for Dairy Cattle

The fermentation of corn to ethanol results in two basic co-products: coarse unfermented distillers' grain (DG) residue and a liquid fraction containing yeast, fine grain particles, and soluble nutrients. The liquid fraction from the fermentation is condensed to form condensed distillers' solubles (CDS), which contain about 30 to 40% dry matter. Further processing and dehydration of unfermented grain residue results in distillers' dried grains (DDG). Addition of a portion of CDS to DG followed by drying yields DDG plus solubles (DDGS). Alternatively, distillers' co-products are also available as wet distillers' grains (WDG), which may or may not contain added CDS as wet distillers' grains with solubles (WDGS).

Feed Value of Distillers' Grains

As a general rule of thumb, all of the components found in dry corn, with the exception of starch, are also present in DDG and DDGS but at approximately three times greater concentrations. For example, the profile of crude protein, neutral detergent fiber (NDF), fat (ether extract), and phosphorus in corn are 8.4, 9.5, 4.2, and 0.30%, compared with 30, 39, 10, and 0.83% in DDGS (NRC, 2001). However, deviations in grain processing and co-product handling can alter these values, and laboratory analysis is recommended before incorporating DDGS into any feeding program.

Anti-nutritional factors, such as mycotoxins, can also be concentrated in DDGS. Because of the concentration of P in DDGS is three times greater than in corn grain, special attention needs to be given to levels of inorganic P in the diet in order to avoid overfeeding and potential environmental concerns from excessive P in manure.

Feeding DDGS supplies both crude protein (CP) and energy for lactating dairy cattle.



Because the protein needs of dairy cattle are met through a combination of rumen undegradable protein (RUP) in the feed and the protein synthesized by rumen bacteria, it is critical to feed both “the rumen” and “the cow.”

Feeding DDGS is good source of RUP, but its sole inclusion in the diet may limit microbial protein synthesis and milk production because of a lack of N availability to the rumen bacteria. Therefore, the balance of RDP and RUP needs special attention when DDGS comprise the bulk of protein for lactating dairy cattle. Computer programs such as the Cornell Penn Miner and NRC model are excellent tools to assist feed managers and consulting nutritionists in balancing RDP, RUP, and energy sources that optimize protein nutrition.

Formulating balanced diets using corn is a challenge for all classes of livestock because of the inherently low lysine content of corn protein. Dietary amino acid imbalances can reduce voluntary feed intake, milk protein production, and efficiency of protein metabolism; the latter leads to increased N losses in urine. Limitations in lysine supplied in corn can usually be overcome by the amino acids supplied other proteins in the diet.

This issue is often highlighted when DDG or DDGS replaces SBM as the main source of added protein. It is critical that special attention be given to the amino acid profile of the diet in order to avoid imbalances and studies indicate increased milk yield and milk protein yield when supplemental lysine, in rumen protected form, are added diets containing DDGS (Nichols et al., 1998).

The crude protein content of corn DDGS is approximately 30% on a dry matter basis; however, the rumen RUP content of corn grain and DWG is approximately 47% of CP. The application of heat in the production of DDGS (or DDG) can increase RUP content to as much as 50 to 60% of CP. Excessively “toasted” DDGS result in heat-damaged protein that is indigestible by the cow. Differences in dry times, temperatures, and drying equipment may contribute to differences in the nutritional quality of DDGS among plants and between batches.

The fibrous portion of DDGS is highly digestible and supplies rumen bacteria with energy. The energy value of DDGS is currently a topic of research, and there are some indications that the energy value of DDGS may be closer to 1.03 Mcal NE_l/lb (Birelo et al., 2004) rather than 0.89 Mcal NE_l/lb, as previously indicated by the NRC (NRC, 2001). Corn DDG and DGGS contain approximately 44 % highly digestible NDF but lack effectiveness of fiber to stimulate cud-chewing activity.

Therefore, providing enough “effective fiber” in the forage portion of the ration is essential. The Penn State particle separator box is an excellent tool for evaluating the physical form of the TMR. Adequate “effective fiber” is necessary for maintaining rumen health and normal milk fat profiles.

Energy is also derived from the oil portion of DDG and DDGS. When #2 yellow corn is fermented to ethanol, the oil content of DDGS is 10 to 12% of DM. Therefore, approximately 1/3 to 1/2 of the energy in DDG and DDGS is in the form of oil. Because corn oil is subject to oxidation, special attention needs to be given to the storage and handling of corn ethanol co-products to avoid rancidity. There are some concerns with the effect of increased fat level in the ration when DDGS are fed but recent studies at Wisconsin and South Dakota indicate no reduction in milk fat yield or other detrimental effects when DDGS was contained at 15 to 20% of the ration DM (Cyriac et al., 2005; Leonardi et al., 2005). A handful of studies indicate more healthful fatty acids in milk, such as greater CLA levels, when DDGS are fed.

Quality Concerns in Feeding DDGS

The main challenge in using DDG and DDGS in rations for dairy cattle is the ability to recognize when these feeds have been heat damaged during drying. There is potentially a wide variability in nutrient content and digestibility, especially for CP and neutral detergent fiber. Reduced digestibility devalues DDGS, as does inconsistency in nutrient profile.

Subjective measures such as color and smell are indicators of quality; golden yellow DDGS is associated with higher digestibility and palatability. Analysis of DDGS should include CP, fat (as ether extract), NDF, and ash to determine energy values and acid detergent insoluble nitrogen (ADIN) as an indicator of heat damage. Feed color and ADIN are not perfectly linked but can be used as relative indicators of DDGS digestibility and quality. High quality DDGS should have a honey to caramel color, whereas DDGS that is the color of coffee grounds is high in ADIN and has reduced digestibility. When high quality DDGS are fed, the efficiency of production (i.e., lbs of feed per lb of milk produced) is often greater than control diets based on soybean meal.

The primary quality concern when feeding WDDGS is the limited storage and shelf life of the WDDGS as is discussed in ID-332-W, “Value of Distillers’ Grain Ethanol Co-Products to Dairy Replacements” (Lemenager et al., 2006).

Pricing Considerations for WDG, DDG, and DDGS

Alternative feeds for livestock are often priced using the energy in corn and protein in soybean meal as points of reference. This simple value comparison does not consider the value of nutrients such as RUP or the current prices for other alternatives co-product feeds and their nutritional attributes. Computer programs such as SESAME, developed at The Ohio State University, uses nutrient composition and prices of all available feedstuffs to estimate unit costs of nutrients and break-even prices for feeds including DDGS.

Conclusion

Corn ethanol co-products are an excellent feed for dairy cattle but must be handled properly at the ethanol plant and at the farm in order to avoid problems. When properly handled, WDGS and DDGS can be easily included at 20% of the ration DM. Greater inclusion levels of DDGS are possible using the considerations describe above.

Additional research is needed to more precisely define the maximum inclusion levels, economic value, and the best processing and handling practices for co-products from Indiana's corn ethanol plants. Currently available information suggests a high potential value of these co-products to Indiana's dairy industry.

To capture the maximal feeding value from corn ethanol co-products:

- Obtain laboratory analysis of co-products.
- Base inclusion levels on nutrient profiles determined by laboratory analysis.
- Include DDGS up to 30% of diet DM.
- Limit WDGS to approximately 20% of diet DM.
- Check the particle size of the final ration to ensure adequate effective fiber.
- Pay attention to nutritional quality and consistency in quality of co-products.

- Balance for RUP and RDP, and check amino acid profiles of the ration.
- Determine fat, P and mycotoxin levels in the purchased distillers' products.

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