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Understanding Milling Feed Byproducts For Dairy Cattle

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This NebGuide discusses nutritional composition of ethanol byproducts.

Accurate understanding of the chemical composition of feedstuffs is the key in properly identifying cost effective feed ingredients and in delivering a ration that maximizes milk production. Assembling this knowledge not only requires understanding of the feeds typically grown on the farm, but also usually involves understanding of other complementary industries that may be supplying feedstuffs to the dairy industry. One such industry is ethanol production. Ethanol production from corn grain has been demonstrated to be an effective strategy to produce high quality and clean liquid transportation fuels. More specifically, the growth of the U.S. ethanol industry has provided an economic stimulus for U.S.-based agriculture. The feed industry plays an integral role in this industry. For example, the primary product of the dry milling production process is ethanol but approximately one-third of the total dry matter is recovered in the form of byproducts. These byproducts are becoming an increasingly available feedstuff and, as a result, both producers and nutritionists should be sure to consider capturing any valuable opportunities. Distiller's grains or corn gluten feed may serve as excellent feedstuffs, but application of further understanding of these feeds also may lead to a more cost effective ration. Dairy producers may find the estimated nutrient content of these and other common feeds listed in Table I useful. The following is a listing of 10 points a dairy manager should understand when considering or using these feeds in a dairy ration.

1. The Terminology

Two distinct milling industries produce two different feed byproducts. In dry milling either corn or sorghum is cleaned, ground dry and the whole kernel used in the fermentation process to produce ethanol and carbon dioxide. In this case there are basically two products of interest. The first product is the solid, unfermented grain portion called wet distillers grains (WDG). The second is the thin stillage fraction that contains water, small particles, yeast and all other soluble nutrients. If not sold as WDG, material may

Table I. Chemical composition of corn gluten feed, distillers grains, corn silage, alfalfa haylage and soybean meal

	Dry Corn Gluten Feed	Dry Distillers Grains	Corn Silage	Alfalfa Silage	Ground Corn	Soybean Meal
Dry Matter, %	89	88	34	40	88	90
Crude Protein, % DM	25	31	8	21	9	50
Rumen Undegradable Protein, %CP	30	50	35	20	43	43
Fat, %DM	3	13	3	4	4	4
Acid Detergent Fiber, % DM	12	17	26	35	3	8
Neutral Detergent Fiber, % DM	37	34	44	44	10	13
Lignin, % DM	1.6	5	3.5	8	1	1
Starch, % DM	15	5	31	2.5	69	1.7
Calcium, % DM	0.13	0.09	0.27	1.4	0.04	0.43
Phosphorus, %DM	1.1	0.91	0.24	0.33	0.30	0.74
Sulfur, %DM	0.50	0.63	0.10	0.25	0.10	0.39

be further dried, yielding dried distillers grains (DDG); in some cases the thin stillage is added back to yield dried distillers plus solubles (DDGS). In wet milling water is added to the grain and the steeping process aids in starch removal. This process is more complex than dry milling and separates the corn kernel into numerous fractions. The starch may be dried and sold or it may be used to produce products such as corn syrups and high fructose sweeteners, and may even be further processed to produce fuel ethanol. Subsequently during this process, oil is extracted from the corn germ and the remaining fractions are bran and steep liquor, the major components of corn gluten feed (CGF).

2. Wet Versus Dry ... Practical Considerations

As mentioned above, distiller's grains (DG) or CGF may be available in either a wet or dry form, and the nutrient content when expressed on a dry matter basis is similar for both. Although it is generally believed that there is little difference in milk production when animals are fed either form, beef feedlot studies have demonstrated that rations containing wet distillers grains are consumed in lower amounts and result in greater feed efficiencies than those containing dried distillers grains. When deciding which form may fit best, producers should evaluate several factors including distance from plant of origin, the anticipated feeding rate, on-farm storage facilities and handling equipment. Because a wet product may not be stored as long and is usually associated with high shipping charges, dried forms may be more feasible if a plant is not located near the farm (this also increases the price of the feedstuff). If the farm is located near a plant, wet forms may serve as being cost effective — but remember the rate of spoiling also is dependent upon feeding rate and environmental temperature. Generally, wet loads should arrive at least weekly to ensure the pile is "fresh." There continues to be interest in ensiling feeds such as wet distillers grains as a method that may eliminate oxygen exposure and as a result reduce feed spoiling and loss. In addition a number of commercial direct application preservative products may be useful in extending shelf life of these feeds, but producers should be mindful of these added costs.

3. Valuable Protein Content

Protein contained in the feed can be utilized by rumen microbes or the rumen undegradable protein (RUP) portion may bypass the rumen and supply the small intestine with protein where it is digested and absorbed. On a dry matter basis, distiller's grains contain approximately 30 percent crude protein but may range between 25 percent and 35 percent. Distiller's grains are a good source of rumen undegradable protein (approximately 50 percent) with wet being slightly higher than dry. On a dry matter basis corn gluten feed contains approximately 25 percent crude protein but may range between 20 percent and 30 percent and the RUP fraction is slightly lower than distiller's grains at approximately 30 percent.

4. Digestible Fiber and Energy

Although field nutritionists often view DDGS as a useful protein or nitrogen source, this feedstuff contains more than simply nitrogen. Beef nutritionists have documented that feeding distillers grains in place of corn grain is useful in providing energy and also preventing acidosis in feedlot cattle. Distiller's grains typically contain 34 percent neutral detergent fiber (NDF) and 13 percent fat on a dry matter basis. Nutritionists also can position CGF as a good source of digestible NDF as it contains approximately 37 percent NDF, of which 42 percent is believed to be digested over a 24-hour period; this is similar to corn silage or alfalfa haylage. The proportion of fat contained in CGF is lower than that of distillers grains (3 percent versus 13 percent DM) and in part explains why the energy content of distillers grains is higher the CGF.

5. Low Physically Effective Fiber

Effective fiber is the portion of the diet that is believed to stimulate rumination, chewing activity and saliva secretion, which may help to maintain healthy rumen function and normal pH levels. When DG or CGF are used to substitute forage in the TMR, chewing activity is believed to be reduced due to finer particle size. Although other factors such as the amount of grain fed also may influence rumen pH, it is generally recommended that the diet should contain other roughage sources to ensure normal rumination activity. Using the Penn State Particle Separator, at least 5 percent to 10 percent of the particles should be at least three quarters of an inch long and the diet should contain 26 percent to 30 percent NDF.

6. High Phosphorus and Sulfur Content

The mineral content of feeds and associated levels in livestock manure has received considerable attention. When including either DG or CGF into dairy diets, producers should understand that these feeds may contain high levels of phosphorus and sulfur as well as many valuable nutrients. Although it is unlikely that these levels would contribute to the loss of any milk production or health problems, producers should be mindful of the importance of dealing with these minerals. Recently the land application of dairy manure has risen to national attention and continues to face growing scrutiny because this practice may accumulate nutrients and has the potential to contaminate surface and groundwater. To avoid these problems producers should ensure that their waste management plan attempts to account for accumulating nutrients and allows for maximum crop use of the nutrients contained in the manure. Nutritionists also should be aware of the mineral levels of these feeds and be sure that they are not over supplementing.

7. Nutrient Variation

Recent investigations conducted by the University of Minnesota have demonstrated that there may be a high degree of variation in the nutrient content of byproducts such as distillers grains both within and across production plants. For example, these investigators demonstrated that the crude protein level in distillers grains may range from 25 percent to 35 percent, with variation also observed in fat (10 percent to 12 percent), NDF (8 percent to 10 percent) and phosphorus (0.8 percent to 1 percent). These investigators note that one of the greatest sources of nutrient variation for DDGS was a function of the amount of solubles that were added to the grains. Along with concentration of CP, the availability of these nutrients may also vary. How should the variation in feed composition be dealt with? Investigators at The Ohio State University suggest that routine feed sampling is essential. Because it may be difficult and time consuming to sample and formulate rations based on lab results on individual loads, numerous load samples should be collected and analyzed over time. This allows estimates of the mean values to be obtained and to see how much these values may vary. Consequently the producer and nutritionists may protect against underfeeding a nutrient such as protein by feeding an anticipated mean value of the feed.

8. Some Economic Considerations

Recent work by beef nutritionists has evaluated the economics of wet distillers grains in ruminant feed systems. Generally the price of wet distillers grains is 90 percent to 95 percent of the current price of corn at the ethanol plant. In addition other factors that may influence the price of this feedstuff may include:

- Proximity of the production plant to feeding location
- Shrink, or feed volume loss that was purchased
- Potential increased handling and delivering costs
- Inclusion rate

9. How Much is Too Much?

It is impossible to recommend an optimal inclusion level, as it depends upon many factors, including price and the nutrient content of all available feedstuffs. A number of investigators have evaluated the effects of increasing levels of distillers grains in replacing both forages and concentrates. Conservative estimates from these studies suggest that 20 percent of the ration DM may be included in a properly formulated ration for a lactating cow. Some research has even indicated that CGF may be effectively included in diets at 35 percent of the dry matter, provided that starch levels are not excessive. Research has indicated that when DG replaced corn in beef feedlot diets, weight gain and energy use is improved, possibly from the reduction of rumen acidosis. Clearly, research into this area is needed to make use of the increased supply.

10. What Will the Cows Think?

A ration change and inclusion of these feeds should proceed at a logical and measured pace. Producers should first discuss potential availability of these feedstuffs with their nutritionists. As mentioned, generally the closer to a plant, the lower the cost. Proper evaluation of any ration change should allow the cows to consume the diets for at least three weeks so that cows and their rumen microbes can adapt to the change. Once adapted, milling products will be very palatable and may even result in increased dry matter intake. If intakes appear to increase, be sure that enough feed is mixed up each day to allow for approximately 5 percent refusal. Final evaluation of the change should include observations of intake, milk production, composition and ultimately consideration of income over feed costs.

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