Optimizing the Use of Distillers Grains in Rations

Roger Epley[1]
Epley Nutrition, Ltd.

Five considerations in the decision to feed or not to feed distillers grains **(DG)** are:

- Moisture level of the ration that includes wet distiller's grains **(WDG)**,
- Nitrogen, sulfur, and phosphorus levels regarding the environment,
- Mycotoxin and sulfur level of DG,
- Free corn oil regarding milk fat production, and
- Economics of feeding DG.

Feeding DG to lactating cattle is not new news. The large volume of DG available is the new news. We've seen thousands of dollars poured into research on the topic of feeding DG. Most dairy nutritionists have read research reports, popular press articles, and listened to and many have even given presentations on feeding DG.

This paper relates some of my personal experiences and thoughts about feeding DG.. And, I'll present my insight on how I'm planning to evaluate feeding DG in the future. As a free enterprising, independent, dairy nutritionist, I've had the opportunity to observe, lose sleep over, and rejoice in the "good", "bad", and "ugly" of feeding DG. In my business, there is never enough milk produced, and the feed cost is always too high. Besides the production and cost issues, there are always issues of cow performance, cow health, and environmental concerns.

Moisture Level of Rations with WDG

In my practice, ration moisture levels up to 60% are currently being fed with no apparent dry matter **(DM)** intake problems. One of my client's rations contains 60% water and our DM intake is right on track with the NRC (2001) suggested intakes for the corresponding ambient temperature, milk production, etc. Intake doesn't seem to be effected if the ration is over 50% moisture. This seems true as long as the excess water is associated with correctly fermented forages and/or fresh water in WDG, wet gluten feed, wet brewer's grains, etc.

Environmental Concerns Associated with Feedimg DG

My environmental concerns about feeding DG include two nutrients: nitrogen and phosphorus. Regarding nitrogen, ration optimizing software that allows me to set minimums for rumen degradable protein, metabolizable protein, metabolizable lysine, and metabolizable methionine is helpful to avoid over feeding crude protein. However, with current ingredient prices and by using the ration optimizer with minimum restraints for metabolizable protein and rumen degradable protein and no lysine restraint, 30 lb WDG comes into the ration (Table 1). I suspect this is more than the typical amount of WDG that is fed, but at the Tri-State Dairy Nutrition Conference last year, this level of feeding DG was discussed as a possibility (Schingoethe, 2006). The high DG ration, no lysine restraint, contains 0.5 %

[1]Contact at: 1327 Eagle Feather Trail, Neenah, WI 54956, (920) 722-1850, FAX: (920) 722-1896, Email: chewcud@tds.net

extra crude protein and 11 gram/day of excess phosphorus per cow compared to the ration with a minimum lysine restraint (Table 2). These excesses shouldn't be a problem when they are included in a nutrient management plan.

Potential Health Problems Associated with Feeding DG

Two potential health problems related to feeding distiller's grain includes the possibility of too much sulfur and mycotoxicosis.

Sulfur analysis of DG in 2006 (Dairyland Laboratory, Arcadia, WI) revealed high-end concentrations of sulfur in DG between 1 and 2%. I suspect the high sulfur concentration in DG is coming from a wet corn milling procedure used prior to fermentation to produce ethanol. Total sulfur intake could be a problem with high sulfur DG. The ration balancing software I use has a book value of 0.46% sulfur in DG. Using this book value of 0.46% sulfur and with 10% of the ration DM from DG, the ration would include about 0.24% sulfur. The 0.24% sulfur is coming from corn silage, haycrop silage, corn, soybean meal, DG, gluten feed, etc. If I replace the book value (0.46%) with DG containing 1.25% S, this brings the sulfur concentration in the ration DM to 0.32% of DM. In addition to sulfur from feed ingredients, well water in the area I work can often contain 1000 ppm of sulfate S (Lynn Davis, Ph.D., personal communication). This can provide an additional 0.11% sulfur added to the ration for a total of 0.43% sulfur. According to the NRC (2001), maximum tolerable sulfur concentration in a diet should be 0.4%. Too much sulfur intake can precipitate polioencephalomalacia. Currently, in the area I work, the WDG is coming from dry milling of corn. But in the near future, one of the local ethanol production facilities is switching to wet milling of corn. Henceforth, we'll want to be judicious about monitoring sulfur level in DG.

Mycotoxins produced in Wisconsin corn are most likely vomitoxin, T-2, or zearalenone. Production of ethanol effectively triples the concentration of the toxin found in corn before it was fermented. Here is an example of a potential vomitoxin problem in a dairy herd. Dairyland Laboratories, Inc. reported 6 to 20 ppm of vomitoxin in about 7% of 1500 shelled corn samples submitted in 2006. If we triple this level, we end up with 18 to 60 ppm vomitoxin. According to Whitlow and Hagler (2005), a dietary concentration of 2.5 ppm of vomitoxin may cause problems when fed to dairy cattle. Keep in mind this was 7% of the 1500 samples submitted and one might assume that samples submitted were suspect toxin samples. Considering this, the incidence of actionable vomitoxin in Wisconsin corn is probably low.

However, in addition to the possibility of vomitoxin from DG, I have experienced levels of 0.5 to 2.5 ppm vomitoxin in corn silage and high moisture corn. Even without vomitoxin coming from DG, a ration with this corn silage and high moisture corn could contain an actionable level of vomitoxin. In addition to these levels of vomitoxin, we also measured actionable levels of T-2 and Zearalenone. I don't know which mycotoxin caused variable manure consistency and low milk production, but inconsistent manure and suboptimal milk production was obvious. Feeding a toxin binder is giving us results of normal manure and about 8 lb/day of more milk per cow. To ameliorate future mycotoxin problems, we're planning to plant Bt corn for corn silage and high moisture corn. We also plan to pack corn silage in the bunker near 70% moisture. I suspect we'll also continue to feed a toxin binder for insurance against the presence of on-farm toxins and purchased toxins.

Milk Fat Depression Associated with Feeding DG

Here is a personal account of milk fat depression. Several years ago, a new ethanol production facility started selling WDG in the area I work. The price at the time was very competitive compared with other ingredients. At the time, milk prices were low, so feeding more DG was a good deal. The more DG fed, the more the feed bill went down. This scenario had the trappings of my heroism! But alas, with more and more DG in the ration, not only did the feed bill go down, but milk fat production also went down. We experienced less than 3% milk fat. At the time, we did not have a good understanding about why fat percentage would go down.

Now, we know more about the rest of the story. The relatively free corn oil in DG can really raise havoc with milk fat production. Dhiman et. al. (2000) looked at soybean oil added as either free soybean oil or oil added from roasted soybeans to a lactation ration that included high moisture corn. Added free oil resulted in about 2.8% milk fat, whereas adding the same level of oil from roasted beans produced a little over 3.3% milk fat. Given the right circumstances in the rumen, linoleic acid may be transformed into trans-10, cis-12 C18:2 and trans-10 C18:1. Bauman et.al. (2006) demonstrated that as little as several grams of these fatty acids will inhibit milk fat production in the mammary gland.

Can we use ration specifications to formulate our way out of the milk fat depression problem associated with feeding a lot of DG? According to Schingoethe (2006), feeding a ration with 20% of the DM as DG should be cost effective.

Dr. Elvin Thomas (Elanco Animal Health, Indianapolis, IN, personal communication), has provided a list of risk factors to consider before feeding high levels of DG. The risk factors include too much starch in the ration (21 to 23% starch), short particles of forage, low effective fiber (19 to 23%), and the addition of other sources of unsaturated and fish oils. We can formulate a ration to deal with these risk factors associated with feeding a high level of DG, assuming we can get adequate particle length from the forage: The high DG ration in Table 1 contains less than 2% added corn oil, contains about 22% starch (NFC about 37%), and contains 34% NDF. According to Dr. Thomas, this ration should result in normal milk fat production.

Current Economics of Feeding DG

At current ingredient prices, does DG fit in eastern Wisconsin rations? The answer is “yes”, if we set a ration minimum for metabolizable or crude protein. Distiller’s grain is a relatively good buy of metabolizable protein in the current market. However, if we want to improve the quality of the metabolizable protein in the ration by setting a minimum metabolizable lysine, DG is not a good choice of ingredients. The reason for wanting to improve the quality of metabolizable protein in the ration is to produce more milk protein. Schwab et al. (2003) demonstrated that we can produce more milk protein by increasing the quality metabolizable protein.

By using Formulate2 Dairy Ration Optimizer (Central Valley Nutrition Associates, Visalia, CA; www.formulate2.com, Version 5.0, based on the NRC (2001), we can demonstrate decreased utilization of DG by increasing the minimum level of metabolizable lysine. In this exercise, metabolizable protein, rumen degradable protein, and net energy for milk is set according to NRC (2001) requirements. The DM intake is the NRC estimate. Table 3 shows the specifications used for these optimizations. These rations are formulated for a mixed group of first-calf heifers and mature cows that are between 20 and 140 days in milk and producing 100 lb/day of milk. Milk components from this group are 3.1% true protein and 3.75% milk fat. Ingredients and prices for this optimization are listed on Table 1. The prices for these ingredients are quoted from a local feed mill. The WDG and wet corn gluten feed prices are the current local prices.

Two optimized rations are included for this discussion. The only specification change is the concentration of lysine as a percentage of metabolizable protein, (Table 4). The ratio of lysine to methionine is kept at 3:1. Ration ingredients resulting from optimization are listed in Table 1. As the metabolizable lysine specification minimum moves up, the amount of DG included goes down. Distiller's grain simply doesn't make the grade as an economical lysine source in the current market. Although, DG is an excellent buy as a source of metabolizable protein.

Using equations developed by Schwab et al. (2006), to estimate milk and milk protein yields, we see more milk and milk protein production as the result of improving the quality of metabolizable proteind (Table 4). Milk yield was estimated using the equation where lysine was the most limiting amino acid. Milk protein yield was estimated using the equation where methionine was the most limiting amino acid. Table 4 also shows increased daily feed costs and more daily income by improving the quality of metabolizable protein. Even though the feed costs are lower for the ration without a lysine minimum, the net income was greater for the ration with a minimum lysine restraint. Although rumen protected lysine is not available commercially, when rumen protected lysine is offered as an ingredient, DG does come into the ration with a minimum lysine constraint. In the current ingredient market, protected WDG lysine has to be about the same prize and protected methionine.

In summary, the amount of moisture in WDG does not appear to be an issue for my clients. The small amount of excess nitrogen and phosphorus from feeding high levels of DG should easily fit into a correct nutrient management plan. To deal with the potential health issues, we need to be aware of the cow's total sulfur intake, and we need to use a toxin binder in some cases. We can probably avoid milk fat depression associated with feeding high DG rations through ration formulation and management. But, by using ration optimizing software that allows a minimum restraint for metabolizable lysine, we may feed less DG because of economics.

References

Bauman, D.E., T. Hinrichsen, C. Tyburcxy, K.J. Harvatine, and A.L. Lock. 2006. Cornell Nutrition Conference, 68th meeting. Cornell University, Ithaca, NY. Pages 58-65.

Dairyland Laboratory, Inc. Arcadia, Wisconsin, www.dairylandlabs.com

Dhiman, T.R., L.D. Satter, M.W. Pariza, M.P. Gall, K. Albright, and M.X. Tolosa. 2000. Conjugated linoleic acid (CLA) content of milk from cows offered diets rich in linoleic and linolemic acid. J. Dairy Sci. 83:1016-1027.

National Research Council. 2001. Nutrient requirements of dairy cattle. 7th rev. ed. Natl. Acad. Sci., Washington, DC.

Schingoethe, D.J. 2006. Can we feed more distillers grains? Proceedings Tri-State Dairy Nutrition Conference. Pages 71-78.

Schwab, C.G., R.S. Ordway, and N.L. Whitehouse. 2003. Amino acid balancing in the context of MP and RUP requirements. Pages 23-23 in Proc. Four-State Applied Nutrition and Management Conf. Bafaboo, WI.

Whitlow, L.W., and W.M. Hagler, Jr. 2005. Mycotoxins: A review of dairy concerns. Proceedings Mid-South Ruminant Nutrition Conference, Texas A & M University, Dallas. Pages 47-58.

Table 1. Optimized rations with/without minimum lysine restraints.

Ingredient	No Minimum Lysine	Minimum Lysine at 6.3% of Metabolizable Protein
	---------- (lb/day) -----------	
Corn silage, $40/ton	55	59
Hay crop silage, $58/ton	45	30.5
High moisture corn, 70% DM, $123.53/ton	11.7	18.3
Wet distiller's grains, 33% DM, $41/ton	30	0
Soybean hulls, $148/ton	1.5	3.3
Wet corn gluten feed, 50% DM $54/ton	0	6
48% Soybean meal, $239/ton	0	6.4
Expeller processed soybean meal, $284/ton	2.5	1.6
Roasted soybeans, $315/ton	0.7	0.5
Rumen Protected Methionine, $9,820/ton	0.014	0.044
Urea, $402/ton	0	0.031
Tallow, $460/ton	0	0.8
Dicalcium phosphate, $300/ton	0	0.072

Table 2. Ration protein, lysine, methionine, and phosphorus concentrations resulting from with/without minimum lysine restraint.

Nutrient Results	No Minimum Lysine	Minimum Lysine at 6.3% of Metabolizable Protein
Crude protein, %	18.0	17.5
Metabolizable protein, g/day	3033	3033
Metabolizable lysine, g/day	175	191
Metabolizable methionine, g/day	58	64
Excess phosphorus, g/day	11	0

Table 3. Ration restraints used to demonstrate the effect of a minimum lysine restraint on the amount of distiller's grain in a ration.

Restraint[1]	No Minimum Lysine	Minimum Lysine at 6.3% of Metabolizable Protein
Dry matter intake, % of DM	59	59
Effective NDF, % of DM	27	24
NFC, of DM	37	42
Metabolizable protein, g/day	3033	3033
Rumen degradable protein, % of DM	11 to12	11 to 12
Lysine, % of metabolizable protein	None	6.3
Methionine, % of metabolizable protein	1.92	2.1
Phosphorus, % of DM	0.392	0.392

[1]DM = Dry matter, NDF = neutral detergent fiber, and NFC = nonfiber carbohydrates.

Table 4. Pounds of product, dollar value of product, and feed cost with/without minimum lysine restraints.

Item	No Minimum Lysine	Minimum Lysine at 6.3% of Metabolizable Protein
Milk per cow, lb/day	94	99
Milk protein, lb/day	2.91	3.07
Milk fat, lb/day	3.52	3.71
Other solids, lb/day	5.42	5.71
Milk protein, $/day	7.04	7.44
Milk fat, $/day	4.57	4.84
Other solids, $/day	1.41	1.48
Total protein, fat and other solids, $/day	13.02	13.76
Total feed cost, $/day	4.51	5.10
Net after feed cost, $/day	8.51	8.66