Using Distillers' Grains in Alternative Cow-Calf Production Systems

by ***Iowa Beef Center staff***

The ethanol industry in the United States — and especially Iowa — has increased dramatically, resulting in the production of millions of tons of distillers' grains coproducts each year. For every one bushel of corn processed, there is a yield of about 2.8 gallons (gal.) of ethanol and 17 to 18 pounds (lb.) of distillers' grains on a dry basis. Although one cannot be certain of future markets, it appears that large quantities of distillers' grains will be available to the livestock industry for years to come.

How distillers' grains are formed

Corn is comprised of nearly two-thirds starch, which is the primary substrate for alcohol fermentation. At the dry-milling plants, the corn is ground up, then enzymes convert the starch to sugar, which is then fermented to produce ethanol and carbon dioxide. The ethanol is collected and then a centrifuge separates the distillers' grains from the solubles. The solubles may then be condensed to about 30% dry matter (DM), or what's referred to as condensed distillers' solubles. These wet coproducts can then be used locally or dried down to distillers' dried grains (DDGs) or distillers' dried grains with solubles (DDGS). While the DDGs can be transported for longer distances, drying is expensive and some feeding value may be lost in the drying process.

Using distillers' grains in some cow-calf operations can be advantageous, especially when it comes to enhancing low-quality feeds like harvested cornstalks or poor-quality grass hay. With such low-quality forages, the energy level falls below nutritional requirements and, in the case of cornstalks, supplementing a diet with protein is necessary. However, before one analyzes the specifics for cow and calf rations, it is important to understand the basic nutrient value of ethanol coproducts.

Distillers' grains as a coproduct

DDGs, wet distillers' grains (WDGs) and distillers' grains with solubles (WDGS or DDGS) contain the remaining nutrients after the corn starch is fermented to alcohol.

Therefore, the original nutrients in the corn are concentrated by about three times. Wet and dried distillers' grains are higher in both protein and energy than corn gluten feed (CGF) because gluten and oil remain in distillers' grains. Like CGF, dried distillers' grains are a good bypass protein source for cattle.

Distillers' solubles can be added to the distillers' grains, or they can be condensed and used as a liquid feed supplement. Many ethanol plants and producers refer to these condensed distillers' solubles (CDS) as "syrup." Condensed distillers' solubles appear to be slightly higher in energy and sometimes lower in protein than wet distillers' grains when adjusted for moisture content. Because CDS are 70% moisture, cattle producers should use heated or underground storage tanks to prevent freezing.

Nutrient value and considerations

DDG, DDGS, WDG and WDGS will normally analyze with 28%-35% crude protein (CP) and 85%-95% total digestible nutrients (TDN, dry-matter basis) or more, depending upon the fat level. Typically, CDS on a 100% DM basis will have from 15% to 23% CP and 85% to 90% TDN or more, again depending on the fat level in the product. Feeding trials at feedlots have shown that distillers' grains contain higher energy values than corn grain, but that is dependent upon the ration inclusion rate. When lower rates were fed (5%-10% of the ration DM), the energy value was close to 140% of the value of corn, whereas when higher rates were fed (more than 35% DM), the energy value was about the same as corn. Typically, when using distillers' grains in a cow herd, it is assumed they will have 110%-125% of the energy value of corn.

Like CGF, distillers' grains are high in soluble fiber and rumen-undegradable protein, which makes it an excellent supplement for forage-based diets. The soluble fiber in distillers' grains, which is high in energy, does not interfere with the digestibility of the fiber components in forages and hays. Be aware that distillers' grains get their high energy value in part due to the corn oil that remains in the product after ethanol production. It is normal for the fat content to be 8%-14%, and total fat concentration in a beef cow ration should probably not exceed 5% fat of the total ration dry matter.

Challenges

In some instances, when distillers' grains are fed at moderate to high levels, they can provide more phosphorous (P) — and especially sulfur (S) — than required in the ration. Recent feed analysis results from Midwest ethanol plants found that phosphorous ranged from 0.4% to 1.6%, and sulfur ranged from 0.3% to 1.4%; therefore, it is key to evaluate the minerals in one's rations to achieve successful ration nutrition.

The phosphorus needs for British-type cows (as prescribed in the 2000 edition of the *Nutrient Requirements of Beef Cattle*) is 13-24 grams (g) per day, depending upon the stage of production. If 5 lb. of DDG containing 0.9% phosphorous are fed daily, nearly the entire phosphorous requirement is met during the lactation period and definitely during the dry, pregnant stage. Additional calcium (Ca) may be required to maintain a 1.4-to-1.0 calcium-to-phosphorous ratio. Therefore, it is important to realize that mineral supplementation programs for rations using distillers' grains can be formulated with little to no phosphorous in them.

Sulfur content was previously mentioned as a risk factor in using distillers' grains. According to the *Nutrient Requirements of Beef Cattle,* the maximum tolerable concentration for beef cow rations is 0.40%. When beef cow rations are evaluated using distillers' grains, sulfur concentration should be evaluated.

For instance, mid- to late-bloom alfalfa and fescue hays have between 0.25% to 0.30% and 0.15% to 0.20% sulfur, respectively. For this type of alfalfa or fescue

hay, it only takes 7 or 10 lb. daily of DDG to reach the maximum daily sulfur intake when the distillers' grains have 0.8% sulfur.

Keep in mind, these percentages are only sulfur intakes from feed. Some water supplies are high in sulfates, which will add to the total sulfur intake. In most nutritional management situations, protein and energy requirements are met well before these feeding levels are utilized. However, some producers, because of low-priced distillers' grains, may push to higher feeding levels.

Table 1 shows acceptable sulfur levels vs. warning and excess levels of sulfur. They are based on a ration of average Iowa hay containing 0.2% sulfur when fed with varying levels of distillers' grains, which can contain sulfur levels ranging from 0.4% to 1.4%.

Table 1: Sulfur content in rations with distillers' grains (DG) and hay*

	Distillers' grains as a percent or as pounds fed in a ration on a dry-matter basis				
% Sulfur	10%	20%	30%	40%	50%
in DG	3 lb.	6 lb.	9 lb.	12 lb.	15 lb.
0.4%	0.22%	0.24%	0.26%	0.28%	0.30%
0.6%	0.24%	0.28%	0.32%	0.36%	0.40%
0.8%	0.26%	0.32%	0.38%	0.44%	0.50%
1.0%	0.28%	0.36%	0.44%	0.52%	0.60%
1.2%	0.30%	0.40%	0.50%	0.60%	0.70%
1.4%	0.32%	0.44%	0.56%	0.68%	0.80%

*Average hay analysis is 0.2% sulfur, 1994-95 summary.

Total ration of sulfur does not include water intake.

Color code: Orange=acceptable sulfur levels, yellow=warning levels, Dark orange=excess levels.

Types of rations

The type and number of rations with distillers' grains are nearly endless; therefore, it is not possible to effectively discuss them in this publication. However, it is possible to show and briefly discuss some examples of rations. Because producers are interested in weaning calves earlier and maintaining cows in more confined or limited pasture situations, rations meeting these objectives have been formulated and presented in Table 2.

These rations range from limited hay feeding situations using harvested cornstalks and distillers' grains to corn silage combinations to strictly harvested cornstalks and distillers' combinations.

Management considerations

Beef cattle readily consume distillers' grains and will compete aggressively at the feedbunk for their share. Like any high-energy or protein supplement fed in limited quantities, producers must think about how it is distributed to ensure that all animals get their required allotment. If distillers' grains are supplemented as a single feedstuff, then one must be sure to allow sufficient bunk or feeding space to ensure consumption by timid cattle. On the other hand, if distillers' grains are mixed with other feed, be sure that ingredient separation does not occur, causing ration "hot spots."

Table 2 rations address the various stages of production, from the first trimester of pregnancy with no calf nursing to cows in mid-lactation, which would be in the early stages of pregnancy. This flexibility was built into the table so producers could see how the rations change due to wide variations in how they might manage their cows from a calf-weaning standpoint.

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Table 2: Rations formulated for a 1,350-lb. British, higher-milk beef cow in maintenance condition score to begin calving March 20[a,b]

	Dates				
	8/31 to 10/15	10/16 to 1/15	1/16 to 3/20	3/21 to 5/31	6/1 to 8/31
Ration type	1st trimester gestation	2nd trimester gestation	Precalving	Early lactation	Mid-lactation
Limit-fed hay; cornstalks; WDG	Hay: 2 lb. Stalks: 20 lb. WDG: 8 lb.	Hay: 3 lb. Stalks: 20 lb. WDG: 12 lb.	Hay: 5 lb. Stalks: 20 lb. WDG: 20 lb.	Hay: 7.5 lb. Stalks: 20 lb. WDG: 30 lb.	Hay: 5.5 lb. Stalks: 20 lb. WDG: 22 lb.
Corn silage; cornstalks; WDG	Corn silage: 8.5 lb. Stalks: 20 lb. WDG: 5.5 lb.	Corn silage: 10 lb. Stalks: 20 lb. WDG: 6.5 lb.	Corn silage: 18 lb. Stalks: 20 lb. WDG: 11.5 lb.	Corn silage: 26 lb. Stalks: 20 lb. WDG: 17 lb.	Corn silage: 20 lb. Stalks: 20 lb. WDG: 13 lb.
Cornstalks or poor-quality grass hay; WDG	Stalks/hay: 25 lb. WDG: 6 lb.	Stalks/hay: 25 lb. WDG: 10 lb.	Stalks/hay: 25 lb. WDG: 21 lb.	Stalks/hay: 25 lb. WDG: 34 lb.	Stalks/hay: 25 lb. WDG: 24 lb.
Cornstalks or poor-quality grass hay; CDS (corn needed in lactation)	Stalks/hay: 20 lb. CDS: 13 lb.	Stalks/hay: 24 lb. CDS: 13 lb.	Stalks/hay: 25 lb. CDS: 25 lb.	Stalks/hay: 25 lb. CDS: 33 lb. Corn: 4 lb.	Stalks/hay: 25 lb. CDS: 28 lb.
Good-quality hay; corn	Hay: 22 lb. Corn: 0 lb.	Hay: 25 lb. Corn: 0 lb.	Hay: 28 lb. Corn: 3 lb.	Hay: 28 lb. Corn: 8 lb.	Hay: 28 lb. Corn: 4 lb.

[a]These rations are intended for budgeting purposes and need mineral and vitamin supplementation balancing.

[b]CDS will substitute for WDGs at about 1.33-to-1. DDGs and dried CGF will substitute at about 0.4-to-1. For instance, if one is feeding 8 lb. of WDG, then 10.6 lb. of CDS would be needed, or 3.2 lb. of DDG or dried CGF.

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cow from a production standpoint (milk production and pregnancy), the greater the need for inclusion of distillers' grains. For instance, in the limited-hay ration examples, the amount of WDG or WDGS ranges from 8 lb. in early pregnancy and no lactation to 30 lb. in the first two months of lactation. Table 2 (see page 193) also addresses how one would substitute CDS, DDGS or CGF for the WDGS in those rations.

Feeding the earlier-weaned calf to normal market weight is another consideration in alternative cow management systems. If one is utilizing distillers' grains in cow feeding, then it should also be considered in the calf feeding systems. Obviously, depending on when the calves are weaned, the size of the calf can have a considerable effect on how one would formulate a ration. Table 3 presents example rations for calf weight ranges from 300 lb. to 600 lb., gaining 2-2.5 lb. daily. This weight gain goal would coincide with how the calves would gain if they were still nursing from their mothers.

Along with these weight ranges is a number of feed combinations that can potentially be used. It is imperative to realize these rations have not been balanced for minerals and vitamins, and close work with one's nutritionist or feed company is likely in order.

Storage challenges and considerations

Managing corn coproducts in a feeding system can be challenging because of storage problems. For example, rations that balance off cornstalks or poor-quality hay may only require 8-15 lb. of WDG per cow on a daily basis. For a herd of 50 cows, that is only 400-750 lb. daily, but most ethanol plants will only sell the products in 50,000-lb. truckloads. A truckload can last a producer for more than 60 days, but the dilemma lies in the shelf life. WDGs, without proper storage, will spoil more quickly than this — especially in warm weather. Higher storage losses result in higher feed costs per cow.

Another potential challenge is that WDGS can freeze, resulting in chunks that can range in size from a softball to a bowling ball. Experience has shown that cattle eventually consume these, but it certainly makes mixing a ration less than optimal.

Using DDGs does not present these types of problems, but one does need to store the dried product in an area where losses due to wind and rain are minimized. A feed-commodity shed would be preferable. Storage experimentation and demonstration projects to date have shown that straight modified distillers' grains (50% DM) can be stored in silo bags. But WDG (30%-35% DM) cannot be stored this way due to high moisture content. However, demonstration work in Nebraska has shown that mixing the wet product with forages allows successful storage in a bag. Reported forage optimums on a dry basis are as follows: grass hay, 15%; alfalfa hay, 22.5%; and wheat straw, 12.5%. Corn stover inclusion would likely be 12%-15%.

Tackling storage in a bunker silo is slightly different when compared to bagging. The University of Nebraska reported with larger-scale experimentation using WDGs with grass hay, 30% grass hay on a DM basis worked OK and required less storage space. However, Nebraska researchers went on to indicate that 40% worked even better with larger, heavier equipment. At lower levels of hay inclusion, the mixture was slick to operate an implement on for packing; thus, it is strongly suggested to use higher levels. Based on bagging results, the Nebraska researchers felt wheat straw would be optimal at the 25%-32% inclusion rate in a bunker.

Other researchers, when storing WDGs piled in a pyramid, have used plastic covers sealed to the ground with varying success rates. The product seems to store well; however, upon opening the plastic-covered pyramid, it is imperative to utilize the entire product in three to four weeks. AJ

Editor's Note: *Iowa State University's Iowa Beef Center (IBC) first published this series of fact sheets titled "Cows & Plows" in October 2007. The articles evaluated the management and economics of alternative feed and grazing systems in a time of skyrocketing land values and rental rates, soaring grain prices, and high feed and forage costs. While exact costs represented in the series may differ from today's even higher prices, the derived principles remain pertinent, if not more so.*

Table 3: Rations formulated for varying weight bull or implanted steer calves early weaned to gain 2-2.5 lb. daily[ab]

Ration type	Weight range 300-350 lb.	Weight range 350-400 lb.	Weight range 400-450 lb.	Weight range 450-500 lb.	Weight range 500-550 lb.	Weight range 550-600 lb.
Grass hay; corn; WDG	Hay: 4 lb. Corn: 5 lb. WDG: 5 lb.	Hay: 4 lb. Corn: 6.5 lb. WDG: 5 lb.	Hay: 4.5 lb. Corn: 6.5 lb. WDG: 5.5 lb.	Hay: 5 lb. Corn: 7 lb. WDG: 6 lb.	Hay: 5.5 lb. Corn: 7.5 lb. WDG: 6.5 lb.	Hay: 6 lb. Corn: 7.5 lb. WDG: 7 lb.
Grass hay; cornstalks; WDG	Hay: 3 lb. Stalks: 3 lb. WDG: 13 lb.	Hay: 3 lb. Stalks: 3 lb. WDG: 16 lb.	Hay: 3.5 lb. Stalks: 3.5 lb. WDG: 17 lb.	Hay: 4 lb. Stalks: 4 lb. WDG: 18 lb.	Hay: 4.5 lb. Stalks: 4.5 lb. WDG: 18 lb.	Hay: 5 lb. Stalks: 5 lb. WDG: 18 lb.
Grass hay; cornstalks; WDG; corn	Hay: 2 lb. Stalks: 2 lb. WDG: 6 lb. Corn: 5 lb.	Hay: 2 lb. Stalks: 2 lb. WDG: 6.5 lb. Corn: 5.5 lb.	Hay: 2 lb. Stalks: 2 lb. WDG: 7 lb. Corn: 6.5 lb.	Hay: 2 lb. Stalks: 2 lb. WDG: 7.5 lb. Corn: 7 lb.	Hay: 2 lb. Stalks: 2 lb. WDG: 8.5 lb. Corn: 8 lb.	Hay: 2 lb. Stalks: 2 lb. WDG: 9 lb. Corn: 8.5 lb.
Grass hay; soyhulls; WDG; corn	Hay: 3 lb. Soyhulls: 3 lb. WDG: 4 lb. Corn: 3 lb.	Hay: 3 lb. Soyhulls: 3 lb. WDG: 4 lb. Corn: 4 lb.	Hay: 3 lb. Soyhulls: 3 lb. WDG: 4 lb. Corn: 5 lb.	Hay: 3.5 lb. Soyhulls: 3.5 lb. WDG: 4 lb. Corn: 5.5 lb.	Hay: 3.5 lb. Soyhulls: 3.5 lb. WDG: 4 lb. Corn: 6.5 lb.	Hay: 3.5 lb. Soyhulls: 3.5 lb. WDG: 4 lb. Corn: 7.5 lb.
Good-quality hay; corn; 36% all-natural supplement	Hay: 3 lb. Corn: 6 lb. Supplement: 1.5 lb.	Hay: 4 lb. Corn: 6.5 lb. Supplement: 1.5 lb.	Hay: 4 lb. Corn: 7.5 lb. Supplement: 1.5 lb.	Hay: 5 lb. Corn: 8 lb. Supplement: 1 lb.	Hay: 5 lb. Corn: 9 lb. Supplement: 1 lb.	Hay: 5.5 lb. Corn: 9.5 lb. Supplement: 1 lb.

[a]These rations are intended for budgeting purposes and need mineral and vitamin supplementation balancing; expect heifers to gain 10% less.

[b]CDS will substitute for WDGs at about 1.33-to-1. DDGs and dried CGF will substitute at about 0.4-to-1. For instance, if one is feeding 8 lb. of WDG, then 10.6 lb. of CDS would be needed, or 3.2 lb. of DDG or dried CGF.