



Using Distillers Grains in Alternative Cow-Calf Production Systems

The ethanol industry in the United States and especially in Iowa has increased dramatically resulting in millions of tons of the distillers grains co-products produced annually. For every one bushel of corn processed there's a yield of about 2.8 gallons of ethanol and about 17 to 18 pounds 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 many years into the future.

How Distillers Grains are Formed

Corn is nearly two-thirds starch and starch is the primary substrate for alcohol fermentation. At dry milling plants, corn is ground, then the starch is converted to sugar by enzymes before the yeast can ferment the sugar to produce ethanol and carbon dioxide. Ethanol is collected, followed by a centrifuge separation of the distillers grains from the solubles. The solubles can then be condensed to about 30% dry matter (condensed distillers solubles).

These wet co-products can then be used locally or dried down to distillers dried grains or distillers dried grains with solubles. Although the dried distillers grains can be transported longer distances, some feeding value may be lost in the drying process and drying is expensive.

Use of distillers grains in some cow-calf operations can be an advantage, especially in enhancing low quality feeds like harvested corn stalks or poor quality grass hay. In these situations, energy level of the forages is below nutritional requirements and in the case of corn-stalks, protein supplementation is a necessity. Before looking at specifics of cow and calf rations it's important to understand the basic nutrient value of these ethanol co-products.

Distillers Grains Co-products

Dried distillers grains (DDG), wet distillers grains (WDG) 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 about three times. Wet and dried distillers grains are higher in both protein and energy than corn gluten feed because gluten and oil remain in distillers grains. Like corn gluten feed, dried distillers grains are a good bypass protein source for cattle.

Distillers solubles can be added to the distillers grains, or condensed and used as a liquid cattle feed supplement. Many ethanol plants and producers call these condensed distillers solubles (CDS) "syrup." CDS appear to be slightly higher in energy and some lower in protein in comparison to wet distillers grains when adjusted for moisture content. Because CDS are 70% in 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 to 35% crude protein and 85 to 95% total digestible nutrients (dry matter basis) or more depending upon fat level. Typically CDS on a 100% dry matter basis will have from 15 to 23% crude protein and 85 to 90% total digestible nutrients or more, again depending upon fat level in the product.

Feedlot research feeding trials have shown that distillers grains feed with higher energy values than corn grain, but this is dependent upon the ration inclusion rate. When lower rates were fed (5 to 10% of the ration dry matter), the energy value was close to 140% the value of corn. Compare that to when higher rates were fed (over 35% dry matter), and the energy value was about the same as corn. Typically when we think about it for the cow herd it's assumed to be 110-125% the energy value of corn.

Like corn gluten feed, distillers grains are high in soluble fiber and rumen-undegradable protein, which makes it an excellent supplement for forage based situations. The soluble fiber in distillers grains, which is high in energy, does not interfere with the digestibility of the fiber components of forages and hays.

Be aware, however, that distillers grains get their high energy value in part due to the corn oil remaining in the product after the ethanol production. It's normal for fat content to be 8% to 14%, and total fat concentration in a beef cow ration should probably not exceed 5% fat of the total ration dry matter.

Distillers Grains Challenges

On the negative side in some situations, when fed at moderate to high levels distillers grains can provide more phosphorous and sulfur in the ration than required.

Recent feed analysis survey work of Midwest ethanol plants found that phosphorous ranged from .4 to 1.6% and sulfur ranged from .3 to 1.4%. Therefore, mineral evaluation of rations is a key factor in successful nutrition.

Phosphorous needs for British type cows as prescribed in the 2000 edition of the Nutrient Requirements of Beef Cattle (NRC) is 13 to 24 grams per day depending upon stage of production.

If 5 lbs of DDG containing .9% phosphorous are fed daily, nearly all of the requirement is met during the calf nursing period and most certainly during the dry, pregnant stage. Additional calcium may be required to maintain a 1.4 to 1.0 calcium to phosphorus ratio. So it's important to realize that mineral supplementation programs for rations using distillers grains can be formulated with little to no phosphorous in them.

According to NRC the maximum tolerable concentration of sulfur for beef cow rations is .40%. When beef cow rations are evaluated using distillers grains, the sulfur concentration also should be evaluated.

For example, mid to late bloom alfalfa and fescue hays have between .25% to .3% and .15% to .2% sulfur respectively.

For this type of alfalfa or fescue hay, it takes only 7 or 10 lbs of DDG daily to reach the maximum daily sulfur intake when the distillers grains has .8% sulfur. Keep in mind this is intake only from the feed. Some water supplies can be high in sulfates, and this will add to total sulfur intake.

In most nutritional management situations, protein and energy requirements are met well before these feeding levels are utilized. However, due to low-priced distillers grains, some producers may push to higher feeding levels.

The chart in table 1 shows acceptable, caution and excess levels of sulfur (with an average Iowa hay having 0.2% sulfur) when fed in combination with varying levels of distillers grains that can contain sulfur levels ranging from 0.4% to 1.4%.

Feeding Considerations in Alternative Cow-Calf Management Systems

The number and type of rations involving distillers grains are nearly endless, and to effectively discuss them is impractical in this publication. However, it is possible to show some as examples and briefly describe them. Because producers are interested in earlier weaning of calves and maintaining cows in more confined or limited pasture situations, rations to meet these objectives are 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 cornstalk and distillers combinations.

Table 1. Ration Sulfur Content with Distillers Grain and Hay*

% Sulfur in DG	Distillers Grains as a Percent or lbs Fed in Ration, Dry Matter basis				
	10% 3 lbs	20% 6 lbs	30% 9 lbs	40% 12 lbs	50% 15 lbs
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 .2% S, 1994-95 summary.

Total ration sulfur does not include winter intake.

Color code: Green-acceptable S levels, Yellow-caution S levels, Red-excess S levels.

Management Considerations

Beef cattle readily consume wet/dried distillers grains and condensed distillers solubles and will compete aggressively at the feed bunk for their share.

Like any high energy or protein supplement fed in limited quantities, producers need to think about how it is offered so all animals get their required allotment. If distillers grains are supplemented as a single feedstuff, 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 some other feed, be sure that ingredient separation does not occur causing ration "hot spots."

Table 2 addresses the various stages of production, from 1st trimester pregnancy with no calf nursing to cows in mid lactation (the early stages of pregnancy.) The flexibility built into the table was intentional so producers can get an idea of how rations change due to wide variations in how different people might manage their cows from a calf weaning standpoint.

Notice that as we ask more of the cow from a production standpoint (milk production and pregnancy) the more need there is for the inclusion of distillers grains. For instance, in the limited hay ration examples the amount of WDG or WDGS ranges from 8 lbs in early pregnancy and no calf nursing to 30 lbs in the first two months of calf nursing. Table 2 also addresses how you would substitute DDGS (modified distillers grains) or corn gluten feed for the WDGS in those rations.

Feeding the earlier weaned calf to normal market weight is another consideration in alternative cow management systems. If you use distillers grains in cow feeding then you also should consider using it in your calf feeding system. Obviously the size of the weaned calf can have a considerable impact on how you would formulate a ration.

Table 2. Rations formulated for 1350 lb British, Higher Milk Beef Cow in Maintenance Condition Score to Begin Calving March 20th.**

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

Ration Type	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
	1st Trimester Gestation	2nd Trimester Gestation	Pre-Calving	Early Lactation	Mid Lactation
Limit fed Hay Corn Stalks Wet Distillers Grain	Hay 2 lbs. Stalks 20 lbs. WDG 8 lbs.	Hay 3 lbs. Stalks 20 lbs. WDG 12 lbs	Hay 5 lbs. Stalks 20 lbs. WDG 20 lbs.	Hay 7.5 lbs. Stalks 20 lbs. WDG 30 lbs.	Hay 5.5 lbs. Stalks 20 lbs. WDG 22 lbs.
Corn Silage Corn Stalks Wet Distillers Grain	Corn Silage 8.5 lbs. Stalks 20 lbs. WDG 5.5 lbs.	Corn Silage 10 lbs. Stalks 20 lbs. WDG 6.5 lbs.	Corn Silage 18 lbs. Stalks 20 lbs. WDG 11.5 lbs.	Corn Silage 26 lbs. Stalks 20 lbs. WDG 17 lbs.	Corn Silage 20 lbs. Stalks 20 lbs. WDG 13 lbs.
Corn Stalks or Poor Quality Grass Hay Wet Distillers Grain	Stalks/Hay 25 lbs. WDG 6 lbs.	Stalks/Hay 25 lbs. WDG 10 lbs.	Stalks/Hay 25 lbs. WDG 21 lbs.	Stalks/Hay 25 lbs. WDG 34 lbs.	Stalks/Hay 25 lbs. WDG 24 lbs.
Good Quality Hay Corn	Hay 22 lbs. Corn 0 lbs.	Hay 25 lbs. Corn 0 lbs	Hay 28 lbs. Corn 3 lbs.	Hay 28 lbs. Corn 8 lbs.	Hay 28 lbs. Corn 4 lbs.

**Dried distillers grains and dried corn gluten feed will substitute for WDG at about 0.4 to 1. For instance, if feeding 8 lbs of WDG, you can substitute 3.2 lbs of DDG or dried CGF for the WDG. Modified distillers grains will substitute for WDG at about 0.7 to 1. If feeding 8 lbs of WDG, you could substitute 5.8 lbs of the modified distillers grains for the WDG.

Table 3 presents sample rations for calf weight ranges from 300 to 600 lbs gaining from 2 to 2.5 lbs daily. This weight gain goal coincides with how the calves would gain if they were still nursing their mothers. Along with these weight ranges are a number of potential feed combinations that can be used. It's imperative to realize these rations have not been balanced for minerals and vitamins and close work with your nutritionist or feed company is likely in order.

Feeding and Storage Management Considerations

Using corn co-products in beef cow operations can be challenging due to storage issues and managing the products in a feeding system. For instance, rations that balance off either cornstalks or poor quality hays may only require from 8 to 15 pounds of wet distillers grain per cow on a daily basis. For a herd of 50 cows that is only 400 to 750 lbs daily and most ethanol plants will only sell the products in 50,000 pound truck loads.

A truck load can last a producer over 60 days. The shelf life for wet distillers grains without proper storage is less than this especially in warm weather. Higher storage loss results in higher feed cost per cow.

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

Using dried distillers grains does not prevent these types of problems, but you need to store the dried product in an area where losses from wind and rain are minimized. A feed commodity shed is preferable.

Storage experimentation and demonstration projects have shown that straight modified distillers grains (50% dry matter) can be stored in silo bags. But wet distillers grains (30-35% dry matter) cannot be so stored because of their high moisture content.

However, some Nebraska demonstration work has shown mixing the wet product with forages allows for successful storage in a bag. On a dry basis the reported forage optimums are: grass hay – 15%, alfalfa hay – 22.5% and wheat straw – 12.5%. Corn stover inclusion would likely be 12 to 15%.

Tackling storage in a bunker silo is slightly different when compared to bagging. Nebraska reported that with larger-scale experimentation using wet distillers grains with

grass hay, 30% grass hay on a dry matter basis worked okay and required less storage space. However, 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 a strong suggestion that higher levels be utilized. Based on bagging results the Nebraska researchers said wheat straw would be optimal at the 25 to 32% inclusion rate in a bunker.

When storing wet distillers grains piled in a pyramid, other researchers have utilized plastic covers sealed to the ground with varying degrees of success. The product seems to store well; however, upon opening the plastic covered pyramid it's imperative to utilize all of the product in three to four weeks.

Table 3. Rations formulated for varying weight bull or implanted steer calves early weaned to gain 2.0 to 2.5 lbs daily.***

These rations are intended for budgeting purposes and need mineral and vitamin supplementation balancing except heifers to gain 10% or less.

Ration Type	Weight Range 300-350	Weight Range 350-400	Weight Range 400-450	Weight Range 450-500	Weight Range 500-550	Weight Range 550-600
Grass Hay Corn stalks Wet Distillers Grains	Hay 4 lbs. Corn 5 lbs. WDG 5 lbs.	Hay 4 lbs. Corn 6.5 lbs. WDG 5 lbs.	Hay 4.5 lbs. Corn 6.5 lbs. WDG 5.5 lbs.	Hay 5 lbs. Corn 7 lbs. WDG 6 lbs.	Hay 5.5 lbs. Corn 7.5 lbs. WDG 6.5 lbs.	Hay 6 lbs. Corn 7.5 lbs. WDG 7 lbs.
Grass Hay Corn stalks Wet Distillers Grains	Hay 3 lbs. Stalks 3 lbs. WDG 13 lbs.	Hay 3 lbs. Stalks 3 lbs. WDG 16 lbs.	Hay 3.5 lbs. Stalks 3.5 lbs. WDG 17 lbs.	Hay 4 lbs. Stalks 4 lbs. WDG 18 lbs.	Hay 4.5 lbs. Stalks 4.5 lbs. WDG 18 lbs.	Hay 5 lbs. Stalks 5 lbs. WDG 18 lbs.
Grass Hay Corn Stalks Wet Distillers Grains Corn	Hay 2 lbs. Stalks 2 lbs. WDG 6 lbs. Corn 5 lbs.	Hay 2 lbs. Stalks 2 lbs. WDG 6.5 lbs. Corn 5.5 lbs.	Hay 2 lbs. Stalks 2 lbs. WDG 7 lbs. Corn 6.5 lbs.	Hay 2 lbs. Stalks 2 lbs. WDG 7.5 lbs. Corn 7 lbs.	Hay 2 lbs. Stalks 2 lbs. WDG 8.5 lbs. Corn 8 lbs.	Hay 2 lbs. Stalks 2 lbs. WDG 9 lbs. Corn 8.5 lbs.
Grass Hay Soyhulls Wet Distillers Grains Corn	Hay 3 lbs. Soyhulls 3 lbs. WDG 4 lbs. Corn 3 lbs.	Hay 3 lbs. Soyhulls 3 lbs. WDG 4 lbs. Corn 4 lbs.	Hay 3 lbs. Soyhulls 3 lbs. WDG 4 lbs. Corn 5 lbs.	Hay 3.5 lbs. Soyhulls 3.5 lbs. WDG 4 lbs. Corn 5.5 lbs.	Hay 3.5 lbs. Soyhulls 3.5 lbs. WDG 4 lbs. Corn 6.5 lbs.	Hay 3.5 lbs. Soyhulls 3.5 lbs. WDG 4 lbs. Corn 7.5 lbs.
Good Quality Hay Corn All Natural Supplement	Hay 3 lbs. Corn 6 lbs. Supplement 1.5 lbs.	Hay 4 lbs. Corn 6.5 lbs. Supplement 1.5 lbs.	Hay 4 lbs. Corn 7.5 lbs. Supplement 1.5 lbs.	Hay 5 lbs. Corn 8 lbs. Supplement 1 lbs.	Hay 5 lbs. Corn 9 lbs. Supplement 1 lbs.	Hay 5.5 lbs. Corn 9.5 lbs. Supplement 1 lbs.

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