

ETHANOL COPRODUCTS FOR BEEF CATTLE

Fourth in a series of six ethanol coproducts publications from the Iowa Beef Center

Distillers Grains for Beef Cows



The ethanol boom has significantly impacted Iowa's livestock industry by providing an abundance of fresh corn coproducts for use as either a primary feed ingredient or supplement for cattle in all stages of production. For many producers in the Cornbelt, these coproducts, when combined with average- to low-quality forages, have become common place in cow-calf rations. However, with advancements in technology, a new wave of coproducts is stemming from the evolving dry milling process and offering new feedstuffs for producers to consider for beef cow rations.

Distillers Feeds

Distillers grains are a versatile feedstuff that provides a concentrated package of energy and crude protein for use in all classes of beef diets. Specifically, when used as a supplement in beef cow diets that are forage based, distillers grains have a theoretical energy value of 100%-140% of the corn it was derived from (Lundy and Loy, 2014: [IBCR 200B](#)). Forage quality and quantity, as well as dry matter content and amount of solubles added back to distillers grains are major factors affecting the energy feeding value of the coproduct. In brief, larger amounts of forage in the diet, lower quality forages, and drier coproducts result in energy values closer to 100% that of corn. When coproducts are wetter, and/or when fed with higher quality forages, greater energy feeding values are realized.

The most common types of distillers grains are wet, modified, and dried, differing in dry matter contents of approximately 35%, 50%, and 90% respectively. It is important to keep in mind that the chemical composition of distillers grains can vary from plant to plant and even between batches within a plant, thus optimum feeding results are achieved when the distillers grains are analyzed. Furthermore, as new technologies are adopted by the corn ethanol industry, nutritional composition of the resulting coproducts are likely to evolve, and thus continuous analysis of these feedstuffs will remain crucial.

Distillers Grains for Beef Cows

Distillers grains are a rich source of both crude protein and energy, which make them appealing for use as a supplement to beef cows, particularly in the fall and winter months when low quality forages are abundant. In the Cornbelt, where fall and winter forage resources are primarily cornstalks, coupling cornstalks and distillers grains allows producers to economically meet both protein and energy requirements through a single supplement.

Furthermore, as distiller grains are high in fiber and low in starch, they are an ideal energy supplement in high-forage diets since they do not lower rumen pH or negatively affect fiber digestion the way corn and other starch-based feeds may. Table 1 illustrates protein and energy requirements of a 1400-lb. cow with average body condition and milk production at various stages of the production cycle, as well as approximate amounts of cornstalks and dried distillers grains needed to meet those requirements.



Figure 1. Energy requirements of beef cows and heifers (NRC, 2000)

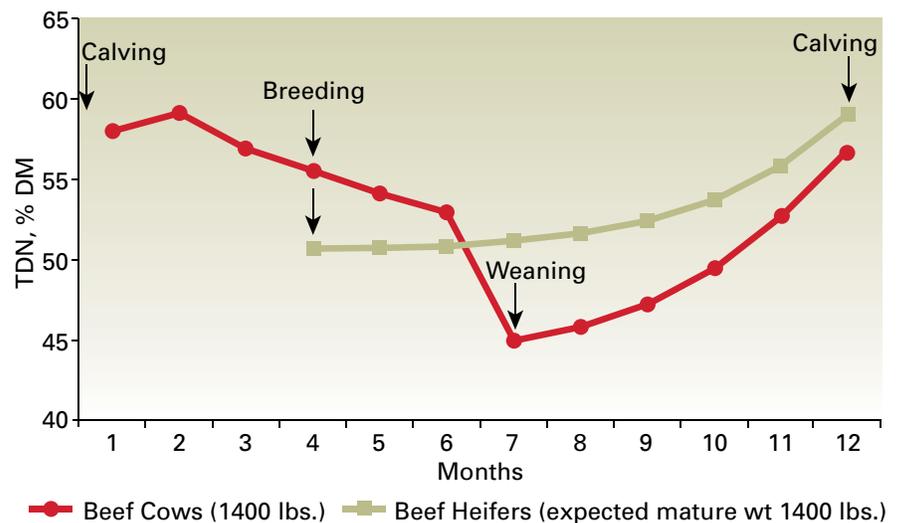


Table 1. Approximate beef cow protein and energy requirements by month and distillers dried grain supplementation of cornstalks^{1,2}

Month after calving	Total digestible energy required (% DM)	Crude protein required (% DM)	Total digestible energy (lbs DM)	Crude protein (lbs DM)	Total dietary intake (lbs DM)	Intake of DDGS (lbs DM)	Intake of DDGS (% of total DM)
1	58.0	9.76	17.1	2.88	29.5	6.5	22
2	59.1	10.31	18.0	3.14	30.5	7.8	26
3	56.8	9.95	17.8	2.99	31.3	6.6	21
4	55.5	8.94	16.8	2.70	30.3	5.4	18
5	54.1	8.29	15.9	2.44	29.4	4.6	16
6	53.0	7.73	15.2	2.21	28.6	3.5	12
7	45.0	6.00	11.8	1.63	27.2	1.2	4
8	45.8	6.20	12.1	1.67	27.0	1.5	6
9	47.3	6.53	12.6	1.75	26.9	2.1	8
10	49.5	7.04	13.4	1.89	26.8	2.7	10
11	52.6	7.80	14.2	2.11	27.0	3.6	13
12	56.6	8.88	15.6	2.45	27.6	4.9	18

¹ NRC(2000) Appendix Table 23, 1400 lb. cows, medium milk

² Assumes nutrient analysis of corn stalks as 85% DM, 50% TDN and 5% CP (DM basis)

Assumes nutrient analysis of distillers dried grain as 90% DM, 90% TDN and 30% CP (DM basis)

1. Cows in moderate body condition during the last trimester of gestation need 3-5 lb. of distillers dried grain, 5-9 lb. of modified distillers grain, or 8-13 lb. of wet distillers grain per day to meet their protein and energy requirements when fed as a supplement to cornstalks.
2. Cows in moderate body condition during early lactation need 6-8 lb. of distillers dried grain, 11-15 lb. of modified distillers grain, or 15-21 lb. of wet distillers grain to meet their protein and energy requirements when fed as a supplement for cornstalks.
3. These recommended levels of supplementation are for 1400 lb. cows in moderate body conditions with moderate milk production and need to be adjusted for cow size, body condition, level of milk production, environmental conditions (especially cold stress), and feed analyses. Additionally, a good vitamin-mineral supplement needs to be offered free-choice.

Ration analysis programs like Beef Ration and Nutrition Decision Software (BRANDS) may be a helpful tool for this purpose (visit your local Extension office or www.iowabeefcenter.org for more information).

Distillers Grains for Developing Heifers

Distillers grains are an effective supplement in replacement heifer development diets in numerous production settings. Coproduct supplementation helps to meet or exceed nutrient requirements for young, growing females as they approach puberty and establishment of pregnancy. Studies conducted at the University of Nebraska—Lincoln (UNL) would suggest that supplementing as little as 1.5 lb. of dried distillers per day maintained or improved pregnancy rates in yearling heifers. Moreover, a study at New Mexico State University increased DDGS supplementation from 1.5-4 lb. per heifer daily for 21 days prior to AI and improved the number of heifers that had attained puberty at breeding. In addition, female offspring from distillers grain supplemented first-calf heifers had increased first service AI conception rates and weaned heavier calves through 3 years of age.

Distillers and Beef Cow Reproduction

Distillers grains can be fed to beef cows as either a primary crude protein or energy source. Both types of supplementation have been shown to improve performance of cows during gestation and lactation when compared to cows on a non-distillers diet. Studies have shown that distillers grain supplementation may shorten the postpartum interval



as well as improve first-service and breeding season pregnancy rates compared to control supplemented cows during the postpartum period. Furthermore, researchers at Purdue University reported that cows given access to low quality forage and supplemented dry distillers grains at 0.6%-1.2% of body weight, had an artificial insemination conception rate average increase of 14 percentage points (64% versus 50%) over cows fed a traditional wintering or stockpiled forage diet.

Because distillers grains are a concentrated source of both unsaturated fatty acids and protein, the mechanisms that influence improved beef cattle reproductive success noted in many studies is still under investigation. In dairy cattle, diets with increased concentrations of unsaturated fats have been shown to increase pregnancy rates, perhaps through improved ovarian function. Similarly, beef cattle studies at the University of Missouri have shown that feeding whole soybeans as a high-fat feedstuff improved first service conception rates.

It should be highlighted that distillers grains are also rich in rumen undegradable protein that bypasses rumen degradation and enters the small intestine, along with microbial protein synthesized in the rumen, to provide metabolizable protein to meet the animal's protein requirement. Various studies have noted that heifers developed on diets that include distillers grains or other feedstuffs rich in rumen undegradable protein, experienced greater milk production as well as increased pregnancy and herd retention rates. Therefore, both unsaturated fat and rumen undegradable protein appears to have a positive impact on performance and reproductive success in beef cows, and when combined into a singular feedstuff such as distiller grains, may have a synergistic positive effect on

performance. Further research is being conducted at Iowa State University (ISU) to determine the effects of source and amount of protein on reproduction. With the evolution of the ethanol industry resulting in a more de-oiled product available to producers as a feedstuff, it is critical to evaluate the effects of these emerging high-protein, lower-fat feedstuffs on cow performance and production.

Storage and Preservation

Although distillers grains are typically an economically viable supplement for beef heifers and cows, it should be noted that wet distillers grains can deteriorate rapidly and spoil when exposed to air. In circumstances where producers are in close proximity to a corn ethanol plant, concerns with spoilage of wet distillers grains may be minimized if producers can obtain less product more frequently. Preservatives can be added at the processing plant that may extend storage life; however, this may not provide enough protection when a large load is delivered and relatively small quantities of distillers grains are fed per day. In these cases, it may be more desirable to look at long term storage in oxygen-limiting structures. This option has been successfully demonstrated with high moisture distillers grains alone, or in combination with cornstalks, wheat straw, corn silage, beet pulp, and soyhulls.

Various research and demonstrations projects at ISU, UNL and Purdue University have shown that silo bag and bunker storage of coproducts in combination with ground cornstalks, wheat straw, and corn silage extends shelf life of those feeds. In addition, when mixed at the right ratios, the combination of these feedstuffs may make for a complete feed for cows. Several studies on stored coproduct-forage mixes found no negative effects on beef cow performance during gestation or early lactation settings when fed as an energy source in the diet. A more wide-ranging and in-depth review of handling and storage considerations of all classes of ethanol coproducts can be found in a companion paper of this series (Gunn et al., 2014: [IBCR 200E](#)).

Ration Costs

The ultimate question remains as to whether distillers grain-based rations will result in reduced cow feed costs. This, of course, is dependent on ingredient costs, inclusion level, and type of delivery (bunk versus pasture supplement). Even though supplementation to cows may initially seem costly, there are economic benefits from supplementing both cows and calves to meet their nutrient



requirements. In a 2010 study, Bohnert et al. reported that when cows calved in a body condition score ≥ 5 , they had healthier calves and producers saved \$6.63/head on calf treatment in the feedlot. In addition producers realized \$7 greater returns from calves when dams were supplemented during last trimester of gestation. Further, ownership returned \$71-\$130 per cow, respectively, when calves were sold at weaning or at the end of the finishing phase. In addition, supplementing cows with 5-6 lb. per head per day of dried distillers during their second trimester, aided in maintaining body condition scores thru the winter and proved cost effective compared to no supplementation (\$18.82 per head advantage).

It should be noted that distillers supplementation may be of value during the grazing season as well. In an ISU study at McNay Research Farm, fractionated dried distillers grains with solubles (Dakota Bran) were supplemented on pasture during the summer months to effectively maintain existing heifer numbers on less pasture. At distillers supplementation levels of 1.5% of body weight or greater on a dry matter basis, forage consumption decreased by as much as 26% based off of sward height measurement. Yet, small differences were noted in pasture consumption at supplementation rates less than 0.5% of body weight. Additionally, a study conducted by UNL found that supplementation of 1 lb. of dried distillers grains saved almost 2 lb. of forage while maintaining or increasing cattle gain. However, results from the latter study have failed to be replicated; rather, forage substitution rates have been reported closer to 0.5 lb. of grass dry matter saved per 1 lb. of supplemented DDGS.

The total economic value of distillers grains will be specific to individual operations and scenarios within that operation. Establishing the comparative values for energy and protein supplements should be based on nutrient cost and is a simple calculation. For example:

Corn priced at \$4.00/bu costs \$0.089/lb of TDN,
 - $91\% \text{ TDN} \times 0.88 \text{ dry matter/lb} = 80\% \text{ TDN}$ on an as-fed basis; $\$4.00 \div 56 \text{ lb/bu} \div 0.80 \text{ TDN} = \$0.089/\text{lb}$ of TDN.

While distillers grains priced at \$120/ton costs \$0.075/lb of TDN.

- $91\% \text{ TDN} \times 0.88 \text{ dry matter/lb} = 80\% \text{ TDN}$; $\$120/\text{ton} \div 2000 \text{ lb/ton} \div 0.80 = \$0.075/\text{lb}$ of TDN.

This type of comparison can be made for both supplemental energy and protein. More complex calculations may be needed to establish inclusion in more complex rations to attain optimum performance (Loy and Lundy, 2014: [IBCR 200C](#)).

Concerns

While distillers grains have been shown to be effective in beef heifer and cow diets, and in many instances, improve both performance and pregnancy rates, caution should be used to not overfeed these coproducts. When distillers are fed at moderate to high levels, potential problems can occur from excess phosphorus, sulfur, acidity, and crude protein.

Of primary concern in beef cow rations is the elevated concentrations of phosphorus found in distillers coproducts. Limestone or other forms of calcium may be needed to ensure that an optimal Ca:P ratio (at least 1.5:1) is obtained. This is of particular concern in late gestation and early lactation cows as a low or even inverted Ca:P ratio can result in milk fever post-calving. It should be noted however, that the base forage of the ration will likely dictate need for supplemental Ca. Even poorer quality hay will likely have sufficient Ca concentrations, whereas lower quality byproduct forages such as cornstalks and wheat straw will be low in both Ca and P.

Sulfur is another potential concern when balancing co-product based rations for beef cattle. Sulfur is required at relatively low levels (0.15%) in gestating and lactating cow diets. However, when distillers are fed as a primary energy source in the diet or are mixed with forages such as alfalfa and fescue, which contain 0.25%-0.30% and

0.15%-0.20% sulfur respectively, the maximum tolerable concentration (0.50% in high roughage diets) can be quickly approached. Producers should be mindful of water sulfur concentrations, as this will add to the total sulfur intake by the herd and potentially magnify borderline excessive dietary sulfur concentrations. It is more likely that cow-calf diets containing distillers grains may surpass 0.30% total dietary sulfur, a concentration at which sulfur is likely to have a negative effect on absorption of microminerals such as copper, zinc, and selenium. However, the magnitude of micromineral absorption suppression and the amount of time needed on a high sulfur diet to induce this effect still warrants further research. A more detailed approach to avoiding sulfur risks associated with distillers-based diets is illustrated by Drenowski et al. (2014: [IBCR 200F](#)).

Finally, it has been hypothesized that feeding protein significantly above the requirement could negatively impact reproductive function of beef cows. Excess protein during late gestation can result in greater calf birth weights and increased incidence of dystocia (Gunn et al., 2014) and has been associated with suppressed pregnancy rates in dairy cows when dietary protein was provided from rumen degradable protein sources such as soybean meal and urea. To date, there is limited data relating the long term effects of grossly overfeeding protein on beef cow reproduction; however, research is currently being conducted at ISU to help shed light on this area. Nonetheless, management practices that prevent gross overfeeding of distillers grains should be maintained.



Conclusions

Distillers grains are an excellent source of energy and protein for inclusion in beef rations. In young, growing cattle, distillers dried grains can provide an additional source of bypass protein and boost in energy for growth. In adult beef cows, distillers grains have been shown to be an excellent source of protein and energy (fat) when used for wintering rations. Challenges do exist relative to storage and the potential for excessive crude protein, phosphorus and sulfur levels. The ultimate decision surrounding the use of energy and/or protein supplements depends on what nutrients are first limiting in the diet and the nutrient cost. Nevertheless, distillers grains have proven to be a viable alternative to feeding corn and have the potential to optimize performance in beef herds.

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