ETHANOL COPRODUCTS FOR BEEF CATTLE

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

Factors Affecting the Economics of Corn Coproducts in Cattle Rations

As the ethanol industry has expanded across Iowa and the Midwest, various corn coproducts have become more abundant and available. Opportunities to reduce feed costs and improve profitability of livestock operations continue to be plentiful through the utilization of these feeds. However, proper ration formulation, economic analysis, and feeding management are important in developing a cost competitive and profitable feeding system. Some of the factors that weigh heavily in decisions relative to coproduct feed pricing and inclusion rates are: nutrient value of the feeds, nutrient value of competing feeds, consistency of the product, reliability of supply, consistency of pricing, and transportation and storage losses.

Nutrient Value

Much of the economic value of any feed is directly determined by the nutrients that it contains. Many nutrients that contribute to the economic value of feedstuffs can be directly analyzed, making feed analysis an important component of this evaluation. Protein, dry matter, fat, fiber, and mineral levels are easily analyzed and can be compared to various other feedstuffs and coproducts to help determine optimum feeding levels.

Several factors can affect the nutrient values of coproducts including the nutrient content of the original grain and variation of processing methods. Increasingly, ethanol plants are extracting corn oil altering the fat content of the coproduct produced. The fat level in the coproducts varies substantially depending on how the oil was extracted during ethanol production. The majority of the ethanol plants already have adapted to extracting corn oil, but few plants have started going beyond corn oil extraction to fiber extraction through cellulosic ethanol production. Existing book values will most likely differ from the actual analysis due to changes in processing methods.

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A greater challenge is determining the appropriate energy value to be used in pricing the feedstuff. Energy values cannot be directly measured by laboratory feed analysis. With feedstuffs that approach or exceed corn in energy content, the economic value of that energy often drives the value of the coproduct. Estimates of energy value of these feeds must come from research (usually feeding or metabolism studies) under very specific conditions. This is an active area of research; new and more accurate information is constantly being added to the knowledge pool.

As new technologies are refined and used in coproduct production, determining the feeding value of those coproducts becomes a moving target. Good communication with nutritionists well-versed in new research and current information is important to ensure having the best available estimates of feeding and economic values. More information regarding these changes can be found in the first (IBCR 200A) and second (IBCR 200B) publications in this series.

Economic Value of Competing Feeds

Once the nutrient analysis of a coproduct feed has been established, the value of that feed has been determined in large part by nutrient values from competing feeds. Feeds that compete with the coproduct depend on the primary nutrient(s) contributed. For example, for beef cattle protein needs, feed values have historically been determined by urea (in finishing cattle) or soybean meal. For energy, corn historically has been the low-cost source that most feeds are compared to in the upper Midwest. In recent years, high moisture coproducts often have been priced locally at levels below competing feeds. In those situations, feeding limitations and optimum inclusion levels become more important than relative value compared to competing feeds.

Reliable Supply and Pricing

Ration consistency is important to support high rates of production. For feedlot cattle managed for quick growth and improved feed efficiency, a ration consistent in nutrient content helps maintain performance and reduce digestive upsets. In addition, budgeting or projecting the performance of new cattle requires a reliable assumption of feed prices and cost of gain. Thus, consistency of coproducts from a given source and the ability to use risk management strategies or assure price consistency is important to feedlot producers.

On the other hand, low-cost, "quick sales" may sometimes be available. During plant production changes, off-specification materials may be produced. These feeds may provide a tremendous value for producers as well as an excellent source of high quality nutrients. These feeds work best in lower production, lower cost systems such as stocker, backgrounding, or cow-calf programs, or at low inclusions in feedlot diets.

Effect of Moisture

Research suggests that high moisture distillers grains have a higher energy value per unit of dry matter than dried distillers grains, with modified or partially dried distillers grains between those moisture levels (typically 45%-55% dry matter). Moisture also may negatively affect economics by increasing storage and handling costs and storage losses. These factors need to be accounted for when establishing the value of high moisture coproducts that are difficult to handle. Wet distillers grains can spoil rapidly with the first signs of spoilage within a week in warm weather. However, by using silage preservation methods that exclude exposure to oxygen, wet and modified distillers grains can be stored for months. This allows small producers to accept truckload quantities, and all producers to take advantage of seasonal pricing opportunities. Based on research conducted at Iowa State University, expect storage losses to range from 7%–12% of the dry matter.

Wet and modified distillers grains can vary widely in color and physical appearance. When more solubles are added, the material may seem more liquid and less "stackable." This may or may not have a relationship to the actual moisture level or chemical composition of the coproduct.

Producers are encouraged to monitor moisture levels of incoming loads using on-farm dry matter determination and continually monitor nutrient analysis, through sampling or communication with suppliers.

Establishing Value

There are several ways of estimating the value of any feedstuff including coproducts. These range from simple calculations based on the value of one nutrient in one common feedstuff to very specific ration analyses and comparison. The simpler methods may help determine if a feedstuff is reasonably priced, making it a competitive feedstuff. More sophisticated methods evaluate very specific situations. The following are some general methods of establishing feedstuff value:

1. **Simple nutrient value rules of thumb.**
   a. Compare to soybean meal protein value.
   b. Compare to corn energy value.

2. **Relative value or shadow prices.**
   This is the maximum value based on the nutrient content in a ration balanced to meet but not exceed the major nutrient requirements of the animal.

3. **Situation-specific calculations.**
   In this situation, a producer may be contemplating substituting one corn coproduct for another coproduct with different analyses. A current example of this would be evaluating the effect of changing oil level on economic value of distillers grains.

4. **Ration-specific calculations.**
   This compares a current ration in detail to an alternative in equal detail.

Examples

The following are examples of pricing using some of the methods described for distillers grains and some assumptions on competitive feed pricing.

1. **Simple nutrient value.**
   If soybean meal (SBM) is 50% crude protein, 88% dry matter, and $350 per ton, and dried distillers grains with solubles (DDGS) is 30% crude protein and 90% dry matter, then the value of DDGS as a substitute for soybean meal as protein source is:
   $350 per ton / .88 dry matter / .50 crude protein of SBM = $795 per ton dry matter of SBM × .90 dry matter of DDGS × .30 crude protein = $215 per ton value of DDGS

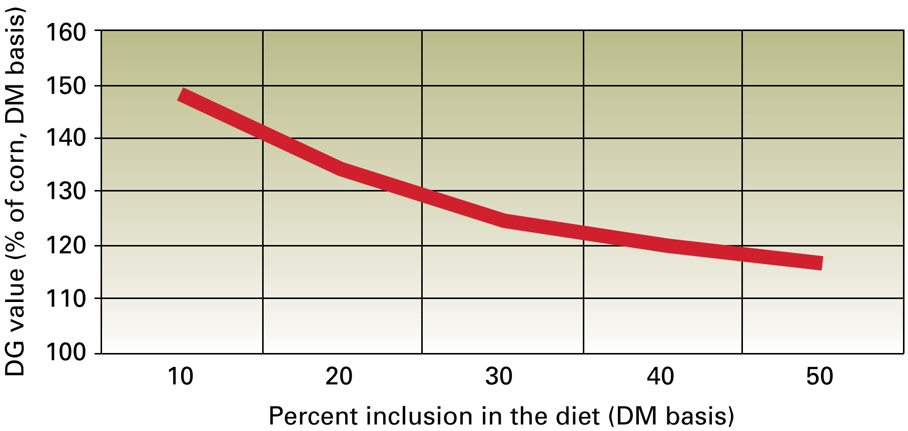
   On an energy basis, if it is assumed that DDGS and corn are similar and the value of corn is $4.50 per bushel, then the value of DDGS as a replacement for corn energy is:
   $4.50 per bushel / 56 pounds per bushel / .85 dry matter of corn = $.095 per pound of dry matter of corn × .90 dry matter of DDGS × 2000 pounds per ton = $170 per ton value of DDGS

2. **Relative value or shadow prices.**
   By using more advanced algebra or computer programs that use linear programs, relative value or shadow prices can be established. Basically, this method determines the value of each nutrient multiplied by the value of the analyses. The result is the maximum value for a feedstuff in a perfectly balanced ration. By repeating this process over a range of corn and soybean meal prices the following can be developed for dried distillers grains (see Table 1).

Table 1. Relative value of dried distillers grains with solubles based on nutrient content of corn and soybean meal

Corn price	Soybean meal price				
	$200.00	$300.00	$400.00	$500.00	$600.00
$ 3.00	$156.40	$195.00	$238.60	$273.20	$314.00
$ 4.00	$183.10	$221.70	$260.40	$299.00	$337.60
$ 5.00	$209.90	$248.50	$287.00	$325.70	$364.30
$ 6.00	$236.60	$275.20	$313.80	$352.40	$391.00
$ 7.00	$263.30	$301.90	$340.50	$379.10	$417.75

Figure 1. Value of distillers grains relative to corn



As the inclusion of distillers grains increases beyond meeting the protein requirement, then the incremental increase beyond that level has the economic value as a replacement for corn (energy source). Figure 1 demonstrates this. This is an example of the complexities of pricing distillers grain and how the value can change depending on how it is fed. In this example, it is assumed that 20% modified distillers grains (dry matter basis) can meet the protein requirement of the cattle. Also in this example (600 pound steer calves), the first 11% of distillers grains inclusion would compete with soybean meal as a source of rumen undegradable protein or "bypass" protein. In this formulation the protein from the next 9% added distillers grains could have been added as urea, which has a lower cost per unit of crude protein.

Other assumptions used to generate this figure are an expected price relationship between soybean meal ($/T) and corn ($/bushel) to be soybean meal price = corn price × 79.6. This is based on long-term (ten-year) price projections published by the USDA. The chart (see Figure 1) demonstrates the idea that each percentage point increase in inclusion is substituting for different nutrients. This also has the conservative assumption that modified distillers grains are equal to corn in energy value. Data has shown this to be higher with distillers grains of normal fat content, especially at inclusion levels less than 40%.

3. **Changing distillers grains—effect on value.** It is estimated that for each 1% reduction in oil content of distillers grains, the feeding value is reduced by 1.64% (Lundy and Loy, 2014: IBCR 200B). This equates to slightly less than 1% reduction in total digestible nutrients (TDN) per percentage unit of oil removal. This has a greater negative impact on economic value at inclusions that exceed protein requirements. As oil and other components such as fiber are reduced in distillers grains, protein, and minerals are concentrated. In beef cattle diets, this had considerable value at low inclusion levels but has little value when distillers grains are added at levels in excess of 20%–30% of the dry matter.

Advancements in fractionation, further fermentation, and enzyme technologies will extract more fiber and other nutrients in the future. Staying current with evaluation of these products through research and also nutrient composition monitoring will become increasingly important as the ethanol industry and its coproducts evolve.

4. **Ration analysis and substitution.** The litmus test for adding a new coproduct to an existing ration involves analysis of that ration, and development of a new ration using the new coproduct balanced for nutrients and under specific feeding conditions. Economic comparisons and recommendations can then be made with greater confidence. This is how most nutritionists will ultimately approach the recommendations for coproduct use in beef cattle diets.

Table 2 is an analysis of two rations from the Beef Ration and Nutrition Decision Software (BRANDS) computer ration program. Ration A is a balanced ration using corn, modified distillers grains fed to meet the protein requirement, alfalfa-brome hay, cornstalks, and a mineral balancer supplement. With the assumed feed prices, the feed cost per pound of gain was $0.65. Ration B substitutes modified distillers grains at a rate equal to 35% of the ration dry matter. The higher inclusion of distillers grains increases the overall net energy for gain (NEg) of the ration. The feed cost per pound of gain in this example is $0.59. So what is the cost savings in this example? If a 150-day feeding period at 3.8 pounds per day is assumed for Ration A, then the $0.06 feed cost savings is multiplied by 570 pounds of gain over the feeding period. Therefore, making this change would reduce feed cost by approximately $34 per head.

Performance expectations change according to cattle type, weight, condition, and environment. Only a specific analysis for each individual situation can determine the best option using a ration analysis program.

Table 2. Balanced conventional ration (A) vs. ration including modified distillers grains (B)

	Ration A	Ration B
Ingredient, [pounds as-fed (% of diet dry matter basis)]		
Corn	19.8 (73)	13.9 (52.5)
Alfalfa-brome hay	1.4 (5)	1.4 (5)
Ground corn stalks	1.5 (5)	1.5 (5)
Modified distillers grains	5.8 (15)	13.1 (35)
Mineral balancer	0.5 (2)	0.6 (2.5)
Projected cattle performance		
Average daily gain (pounds)	3.82	4.08
Feed/gain (dry matter basis)	5.72	5.64
Cost of gain (with $0.40/d yardage)	$0.65	$0.59

References

Lundy, E. L. and D. Loy. 2014. Ethanol Coproducts for Cattle: Changing Distillers Grains. Iowa Beef Center. Iowa State University Extension and Outreach fact sheet. IBCR 200B.

Lundy, E. L. and D. Loy. 2014. Ethanol Coproducts for Cattle: The Processes and Products. Iowa Beef Center. Iowa State University Extension and Outreach fact sheet. IBCR 200A.

Prepared by: Dan Loy, professor of animal science, Iowa State University Extension and Outreach and Erika L. Lundy, graduate assistant Iowa State University Extension and Outreach.

Photos by Erika Lundy, graduate assistant, Iowa State University Extension and Outreach. Photo on page 5 by Daryl Strohbehn, retired extension beef specialist, Iowa State University Extension and Outreach.

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