Western Beef Resource Committee

Cattle Producer's Library

Nutrition Section CL334

Feeding Ethanol Co-products from Corn to Beef Cattle

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Most have heard the phrase, "When you are handed lemons, make lemonade." Cattle producers have observed the rapidly growing ethanol industry and its hunger for corn. So, how can they make lemonade out of this? The answer is by using the co-products of ethanol production, such as distiller's dried grains, which are becoming increasingly available and can be a cost effective feed ingredient. This fact sheet discusses how ethanol is made from corn, the nutritional value of ethanol co-products, and storage concerns of the co-products.

Ethanol Production

The ethanol industry in the U.S. is expanding rapidly because the production of ethanol from corn has become a strategy to reduce our reliance on foreign crude oil. Two types of milling processes are currently used to produce ethanol—wet and dry milling—with the vast majority of ethanol in the United States coming from dry milling.

Wet milling is the more complex of the two processes because the corn kernel is partitioned into several components to facilitate high value marketing. During this process, corn is "steeped" and the kernel's components are separated into bran, starch, gluten meal, germ, and soluble components. This process requires high quality corn because it typically results in numerous products, primarily for human use, such as corn oil and corn sweeteners like high fructose corn syrup and dextrose. Co-products of this process that can be used as livestock feed are corn gluten feed and corn gluten meal (Fig. 1).

The dry milling process is relatively simple (Fig. 2). Corn is ground, fermented, and the starch converted to ethanol and carbon dioxide, with about a third of the dry matter (DM) remaining as co-product (this is because corn is about two-thirds starch). Quantitatively, dry milling 100 pounds of corn will result in approximately

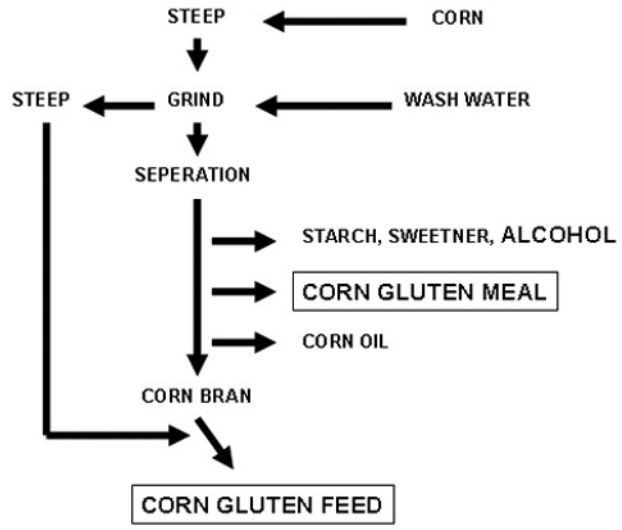

Fig. 1. Flowchart of the corn wet milling industry.

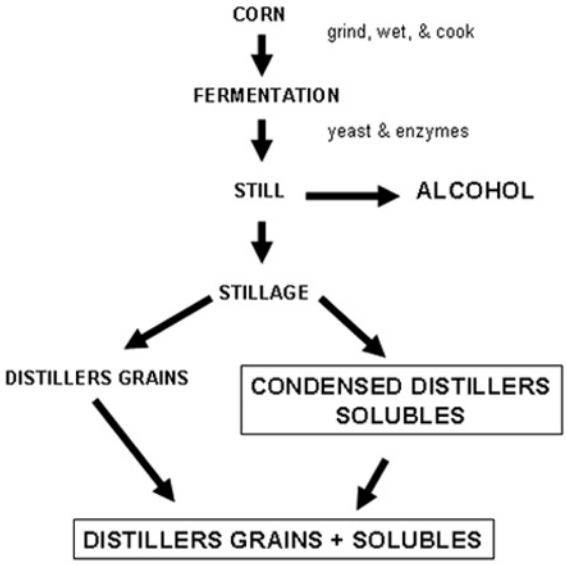

Fig. 2. Flowchart of the corn dry milling industry.

Table 1. Nutrient content (%; DM basis) of ethanol co-products.

Item	Ethanol co-product					
	WDG	CDS	DDG	DDGS	CGF	CGM
DM	25-35	23-45	88-90	88-90	90	90
CP	30-35	20-30	25-35	25-32	20	65
TDN	70-110	75-120	77-88	85-90	80	86
Fat	8-12	9-15	8-10	8-10	2.8	2.2
Calcium	0.02-0.03	0.03-0.17	0.11-0.20	0.10-0.20	0.07	0.08
Phosphorus	0.50-0.80	1.30-1.45	0.40-0.80	0.40-0.80	1.1	0.53
Sulfur	0.4-1.2	0.3-1.4	0.4-1.2	0.4-1.2	0.33	0.72

WDG = wet distillers grains; CDS = condensed distillers solubles; DDG = dried distillers grains; DDGS = dried distillers grains with solubles; CGF = corn gluten feed; CGM = corn gluten meal

4.8 gallons of ethanol, 32 pounds of distillers dried grains, and 32 pounds of carbon dioxide.

The distillers dried grain is a good supplemental feed for cattle. With approximately one third of the dry matter of corn remaining after fermentation, all of the leftover nutrients (primarily protein and fat) are concentrated about three-fold. For example, whole corn grain contains about 4 percent oil and 9 percent crude protein. After dry milling, dried distillers grain contains about 12 percent oil and 30 percent crude protein.

Ethanol Co-products

The main co-products of ethanol production used as livestock feed are listed in Table 1.

Wet Milling

Wet corn gluten feed (CGF) is a popular protein and energy source for feedlot cattle because it is rich in highly digestible fiber and moderate in crude protein. It is the highest volume co-product of the wet milling process. Contrary to its name, CGF does not contain gluten but rather a mixture of corn bran and condensed "steep" solubles. Most CGF is fed within 100 miles of a processing plant as a wet product; however, dry CGF is also available and is often marketed as a pelleted product.

Research with feedlot cattle has suggested that the energy value of wet CGF is about 92 to 100 percent of the energy value of whole shelled corn. Another positive aspect of wet CGF is that it can be fed to cattle in large amounts (up to 50 percent of the diet) and still maintain acceptable performance. It should be noted that CGF can be a variable in nutrient composition both within and between processing plants. This is because the ratio of corn bran to corn steep liquor will vary depending on the markets available.

Corn gluten meal (CGM) is golden-yellow and is mainly gluten, the protein part of the corn kernel. As a result, it is used primarily in the swine and poultry industries as a protein supplement. However, it is a good source of undegradable intake, or "escape" protein that is sometimes used in the diets of rapidly growing calves or high producing dairy cows.

Dry Milling

Distillers grains are the primary co-product of the dry milling process. It can be sold as a wet (about 35 percent DM), modified (about 50 percent DM), or dry product (about 90 percent DM). However, due to the large quantity of distillers grains being produced and limited livestock availability near ethanol plants, the dried product is the most commonly available to cattle producers in the western U.S.

Another product of the dry milling process is condensed distillers solubles (CDS). This results from removing distillers grains from the liquid fraction, frequently called thin stillage, which remains after ethanol production. Thin stillage is further evaporated, or condensed, to produce CDS, which is also referred to as "syrup." Many ethanol production facilities will either market the CDS or combine it with various forms of distillers grains. As a result, types of distillers co-products available to beef producers from dry milling are: wet distillers grains (WDG), WDG plus solubles (WDGS), modified distillers grains (MDG), MDG plus solubles (MDGS), dried distillers grains (DDG), and DDG plus solubles (DDGS).

Dried distillers grains plus solubles is the co-product most available to cattle producers in the western U.S. Distillers grains can be fed to cattle with little, if any, of the negative effects on forage digestion normally seen with feeding high levels of starch containing grains (e.g., corn, wheat, barley, etc.). This is because the starch has been fermented to produce ethanol, leaving little to interfere with fiber digestion. Also, on a DM basis, wet, modified and dry distillers grains are relatively similar in nutritional composition, containing from 30 to 35 percent crude protein and 8 to 12 percent fat (Table 1). Research has shown that WDG and WDGS may contain from 5 to 15 percent more available energy than dry-rolled corn (based on feedlot performance) with DDG and DDGS being equal to dry-rolled corn.

Mineral Concerns—Distillers grains can have high levels of phosphorus and sulfur. The increased phosphorus is normally a benefit to cow-calf producers because most pasture- or hay-fed cattle are at least

marginally deficient in phosphorus. In contrast, the potentially high sulfur content can affect copper status and cause sulfur-induced polio if proper nutritional management is not followed.

The sulfur content of distillers grains can vary dramatically (Table 1), however, most will average between 0.6 and 0.8 percent sulfur. Therefore, when considering use of ethanol co-products, it is essential to analyze the sulfur content of water sources and factor that into the nutritional program. According to Mineral Tolerances of Animals, cattle consuming 85 to 100 percent concentrate diets can tolerate 0.3 percent total dietary sulfur, whereas cattle consuming 40 to 100 percent forage diets can tolerate 0.5 percent total dietary sulfur.

A management option to consider that may reduce the potential for sulfur-induced polio is to provide 150 to 200 mg per head per day of thiamine when the dietary sulfur concentration is greater than 0.35 percent of diet DM with concentrate diets or when distillers grains make up more than 40 percent of the diet DM in forage fed cattle. If cattle showing signs of polio are given a 2000 mg intravenous dose of thiamine early (before cattle go down) they will often recover. In addition, a dietary sulfur concentration greater than 0.3 percent can reduce copper availability, requiring additional dietary copper to maintain adequate copper status (see CL315 and CL327 for more information on copper status).

Distillers grains can be an economical, and effective, protein and energy supplement for cattle producers. Research has shown that beef cattle can be successfully fed as much as 40 percent of their diet as distillers grains (DM basis); however, current recommendations for forage-based diets are to not feed over 10 pounds of distillers grains (DM basis) per day to mature beef cows, primarily because of the high fat content and potential sulfur concerns. For backgrounding or growing diets, calves can be safely fed up to 30 percent of their diet, or roughly 3 to 6 pounds of DM, as distillers grains.

Storage Concerns of Ethanol Co-products

An important consideration in using co-products of ethanol production is how they will be stored and fed. Dried products can be stored for extended periods of time, can be shipped greater distances more economically and conveniently than wet products, and can be easily blended or mixed with other dietary ingredients. However, it should be noted that DDGS and CGM will "bridge" in mixers and storage bins.

If DDGS are to be stored for more than 1 week, use of a commodity bin or concrete pad should be considered. It is also recommended to let any dried product cool before storage to help reduce bridging. Dried distillers grains are also susceptible to wind. It is important to keep them protected from strong winds during storage. Unfortunately, functional pellets or range cubes made entirely from DDGS are not commercially available at this time.

Wet distillers grains will normally remain fresh and palatable for only 5 to 7 days. However, this length of time is dependent on environmental temperature, with spoilage and reduced palatability occurring more rapidly in hot weather. In contrast, WDG has been kept in acceptable condition for up to 3 weeks during cool/cold temperatures. In some cases, WDG can be treated at the ethanol plant with a preservative or mold inhibitor that can effectively increase "shelf life" by 2 weeks or more depending on the amount of preservative added.

There have been some reports of WDG being preserved for more than a year in silo bags, without preservatives, but filling the bags can be difficult because WDG settles easily and can result in split bags. Caution should be exercised when filling bags to not overstretch the bags, particularly on the sides. Also, there have been reports that WDG can be successfully mixed with a forage source to make palatable and nutritious silage.

Condensed distillers solubles (CDS), like all liquid feeds, requires special handling and feeding equipment. Storage tanks should be maintained indoors or underground to prevent freezing in cold temperatures. Also, CDS will need to be routinely mixed using a recirculation or agitation pump to minimize settling if stored for extended periods of time and/or before adding it to the feed ration or mixer.

Summary

Distillers grains normally contain from 30 to 35 percent crude protein and 10 to 12 percent fat. Current recommendations for forage-based diets are to limit the amount of distillers grains to about 10 pounds DM per day to mature beef cows. For backgrounding or growing diets, calves can be fed up to 30 percent of the diet as distillers grains.

Distillers grains can be an economical, and effective, protein and energy supplement for cattle producers. It is an excellent source of protein, energy, and phosphorus for cows and growing calves. Hopefully you have found a little "lemonade" in this information.

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Schingoethe, D. J. 2006. Feeding ethanol by-products to dairy and beef cattle. Proceedings of the California Animal Nutrition Conference, May 10-11, 2006, Fresno, CA. pp. 49-63.

Selected on-line information concerning co-products of ethanol production:

http://beef.unl.edu/byprodfeeds/manual_02_05.shtml

http://www.ddgs.umn.edu/

http://www.distillersgrains.com/

http://www.iowarfa.org/index.php

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