Value of distillers grains beef cattle diets and implications for carcass quality

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Origin of distillers grains

Ethanol is produced when the starch in grain is fermented by yeasts. This alcohol is distilled out of the mix and captured for use as beverage (whiskey) or fuel. The remaining mash is called distillers' grain (DG). If the mash is dehydrated, it is designated dried distillers' grains (DDG). If solubles from the liquid portion are added back to the mash, it is referred to as dried distillers' grains with solubles (DDGS).

By weight, wheat (and corn) are at least 2/3 starch, so with the removal of the starch, other components are concentrated about three-fold. For example, CPS wheat averages near 13% crude protein, so removal of the starch results in a product that around 39% crude protein. Accordingly, levels of phosphorus also increase from about 0.3 up to about 0.9%. All other remaining nutrients are similarly concentrated.

In the past, distillers' grains were primarily used as a protein source in the diets of dairy cattle, but with increasing production of fuel ethanol, the supply of DG has exceeded the demand for its use in dairy diets. Distillers' grain is now priced and sold like barley and wheat - as a source of energy with little value placed on its protein. And like other grains, there is economic incentive to maximize its use. However, questions still remain on the feeding value of DG when used as a source of energy and the implications that it may have of both carcass quality and composition. Inclusion of DDGS in beef cattle diets also has environmental implications as a result of the feeding of excessive levels of protein and phosphorus. Although there has been considerable research done with corn DG, the wheat DG market is still in its infancy.

Composition of distillers from different cereals

Although fuel ethanol can be produced from wheat, triticale or corn, compositional differences among grains may affect the value of the distillers' grains produced during ethanol production. Corn is approximately twice as high in oil compared with wheat (4 vs 2%). As a result, corn DG often exceeds 12% oil whereas wheat DG rarely exceeds 6%. Oil can be a valuable source of energy, but elevated levels of unsaturated fats (such as oils from grains) can be toxic to rumen microbes, reducing digestion. High levels of unsaturated fats may also have implications for carcass quality and composition. As a result, corn DG may be more valuable at low feeding rates but wheat DG may be more valuable at elevated levels. Research in Nebraska has shown that the most efficient use of wet corn distillers occurs when fed at less than 20% of the dry matter.

Analysis of wheat and corn DDGS compared to barley and barley silage*

	Barley	Silage	Wheat DDGS	Corn DDGS
Dry matter, %	88	35	92	90
Protein, %	12.5	12.3	39	32
ADF, %	7.5	33	19	15
NDF, %	25.5	51	29	29
Oil, %	2.5	1.6	5.0	13
Calcium, %	0.06	0.47	0.14	0.06
Phosphorus, %	0.40	0.30	0.94	0.93
Magnesium, %	0.12	0.22	0.38	0.39
Sulfur, %	0.1	0.13	0.45	0.66

*Averages from samples taken in Southern Alberta.

Wet vs. dried distillers

Most of the corn DG research that looks so favorable was conducted using the wet product. Over heating feeds can reduce protein and energy digestibility, so errors in the dehydrating process can reduce quality. Hence, many assume wet DG is superior to dried DG even though this is not always supported by

research. Higher energy content of the wet product is based on lower intakes with similar gains when it was compared to the dried product. Simple indicators (i.e., color, ADIN) are poor measures of distillers' grain quality. Assuming dried and wet distillers are 90 and 35% dry matter, respectively, the value of the wet product is worth at least 39% the value of the dried product. Because using wet DG is only feasible within a small radius of the plant due to freight costs, this discussion will focus primarily on the dried product that includes solubles (DDGS).

Research summary

The Canadian Cattlemens Association funded a trial conducted at the Lethbridge Research Centre that investigated the feeding value of DDGS from wheat. This product was provided by Husky Energy, and Wilbur Ellis who markets all of the DDGS from the Husky plant at Lloydminster. The feedlot crew and the technical work of Fred Van Herk and Ashley Stronks also deserve recognition.

To determine how increasing levels of wheat DDGS affect cattle performance, heifer calves (325 kg initial weight) were individually fed typical barley / barley silage feedlot diets with increasing levels of wheat DDGS. During the 55-day backgrounding period, the control diet (0% DDGS) contained 40% barley, 55% silage, and 5% supplement (dry matter basis). The equivalent as-fed formula is 22.5% barley, 2.5% supplement, and 75% silage. Treatment diets contained either 20 (plus 20% barley) or 40% DDGS. During the 133-day finishing period, five diets were fed with DDGS included at 0, 20, 40, and 60%. The fifth diet contained 60% DDGS with additional calcium to elevate the calcium:phosphorus ratio above 1.5:1. The control diet contained 85% barley, 10% silage, and 5% supplement on a dry matter basis which equates to 74.7% barley, 21.3% silage, and 4% supplement as fed. Control diets contained at least 13% protein with levels increasing up to 27% in the 60% DDGS diet. Fecal and manure samples were obtained through-out the trial to determine how inclusion of DDGS affected N and P excretion.

The addition of DDGS to back-grounding diets did not affect intake, gain, or feed efficiency, indicating that in low energy diets, DDGS has a similar energy and economic value as rolled barley. During the finishing period, there was no effect of the extra calcium in the 60% DDGS diet, so this diet was not considered when evaluating linear trends with inclusion of DDGS. In the remaining diets, intakes linearly increased with increasing levels of DDGS. Higher intake is likely due to the reduced levels of the rapidly fermented starch from barley that was displaced by the DDGS. Elevated protein levels have also increased intakes in some trials. Rate of gain increased slightly, but feed efficiency linearly declined with increasing levels of DDGS. Increasing intakes with minor effects on gains (reduced feed efficiency) is a common observation when lower energy feeds are included in finishing diets. By comparing performance of cattle fed the control and 60% DDGS diet, economic and nutritional value was calculated. Despite the linear reduction in feed efficiency with increasing levels of DDGS, it had similar economic value as rolled barley due to the higher gains it provided. Because feed efficiency linearly declined with increasing levels of DDGS, it can be assumed that the value increases at lower levels of inclusion. For example, energy content was actually higher than barley when DDGS was included at 20% in finishing diets (2.08 and 1.42 MCal/kg of NEm and NEg respectively) as was its economic value (10% higher than rolled barley).

Levels of backfat and AAA carcasses were highest on the 20% DDGS diet and lowest on the control diet but these differences were not consistent. Based on these results it appears that DDGS had little effect on carcass fat but more cattle are needed to assess differences clearly. Summaries of trials have been compiled to determine effects of corn distillers on carcass quality. A 21 trial summary compiled by Minnesota researchers found that carcass fat (including quality and yield grade) tends to increase with inclusion of low levels of corn DG (< 30% of diet dry matter). However, in some trials, carcass quality was reduced when levels exceed 30% of dry matter. Further work is required to assess the effects of wheat vs corn DG on carcass quality.

Performance of cattle fed 0, 20, 40, or 60% DDGS

	Control	20%	40%	60%	60%+Ca
d 1-55					
Animals	24	24	72	-	-
Start weight, kg	326	325	324	324	326
DMI, kg/d	5.82	5.79	5.86	-	-
ADG, kg/d	0.95	0.96	0.98	-	-
Gain/feed	0.159	0.163	0.166		
D 56-188					
Animals	24	24	24	24	24
DMI, kg/d	10.48b	10.76b	11.56ab	11.72a	11.44
ADG, kg/d	1.52	1.56	1.63	1.60	1.50
Gain/feed	0.146	0.145	0.142	0.137	0.132
D 1-188					
DMI, kg/d	9.12c	9.31bc	9.88ab	10.05a	9.78abc
ADG, kg/d	1.36	1.39	1.42	1.44	1.36
Gain/feed	0.148a	0.149a	0.145ab	0.143ab	0.140b
Final weight, kg	581	586	591	594	582
Dressing %	58.2	58.3	58.9	57.6	60.1
Backfat, mm	10.0	14.0	12.1	11.7	11.3
% AAA	13	43.5	16.7	16.7	25

- abc - Values in the same row followed by different letters differ ($P < 0.05$). This means there is greater than a 95% probability that differences are due to treatment.
- 1 divided by gain /feed = feed/gain.

Effects of high protein and phosphorus diets on performance and environment

Feed proteins are metabolized as a source of energy when the nitrogen is removed. Nitrogen from feeding excess protein is excreted in urine and manure, so, as expected, nitrogen (and phosphorus) levels in manure increased with increasing levels of DDGS. An intake of 9 kg of the 60% DDGS diet represents an extra 200 g of nitrogen excreted, or an increase of nearly 250%. To excrete this nitrogen, urea must be formed which has an energetic cost equivalent of about 250 g of carbohydrate. This equates to a 3% loss in feed efficiency for an animal consuming 9 kg of the 60% DDGS diet. There was actually a 3.3% reduction in feed efficiency on the 60% DDGS diet.

Elevated phosphorus levels may affect environment, but probably not performance. Assuming all of the extra phosphorus is excreted, increasing dietary phosphorus from 0.38 (control diet) to 0.73% (60% DDGS) will increase excretion by about 350%. Increased manure nitrogen and phosphorus content has implications for feedlots with a limited land base available for manure disposal.

Observations from the field

The Husky plant at Lloydminster has been producing ethanol for just over a year with 12 feedlots using the majority of the DDGS produced. Most feedlots have fed less than 25% of the dry matter as DDGS in finishing diets. Some have fed slightly more in backgrounding diets. Initially, there were occasional production challenges at the plant resulting in intermittent use in rations. Positive effects on intake were demonstrated with the interrupted usage. Tens of thousands of cattle fed DDGS have been slaughtered with only a couple of speculations that there may be an affect on carcass quality. Higher dietary phosphorus levels may be contributing to the increased incidents of water belly in heavy cattle (long fed) at one feedlot. To this point, very little DG has been used where it likely has the most nutritional value – on the ranch as a supplement to low quality forages of for fattening cull cows.