



The Impact of Ethanol and Biofuel Production on the Beef Industry

**A VIDO Beef Technical Group¹ (VBTG) Discussion with
Dr. John McKinnon
Saskatchewan Beef Industry Chair at the University of Saskatchewan**

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A) Overview of Ethanol and Biodiesel Production in Canada

- 1. What grains can be used for ethanol production?**
Primarily corn (U.S. and eastern Canada) and wheat (western Canada). This does not rule out other sources of starch such as peas, barley, rye, etc., but supply and price dictate that corn and wheat will be the primary sources for the foreseeable future.
- 2. What grains can be used for biodiesel production?**
Here we are dealing with oilseed crops such as soybeans, canola, mustard, etc.
- 3. Will these grains be replaced by other materials in the future?**
There is an expectation that cellulose-based fermentation will come on stream in the future as technology and fermentation systems develop. When this will happen is not clear, although research in this area has ramped up considerably across North America in the last few years.
- 4. How much ethanol is produced from a bushel of wheat?**
A rough rule of thumb is 1/3 ethanol, 1/3 by-product feeds and 1/3 carbon dioxide. Thus, 100 tonnes of wheat (as fed) typically yields 35,000 litres of ethanol.

¹ <http://www.vido.org/producers/techgroups/beef/index.php>

- 5. How is ethanol processed and transported after being distilled?**
It is denatured (i.e., a small percentage of gas is added to it) and is then trucked to refineries for blending.
- 6. What is the projected growth of the Canadian ethanol industry during the next 5-10 years?**
Canada's ethanol industry is expanding to keep relative pace with that of the U.S. We expect that as current plants under construction come on stream, production capacity will expand from 750 million litres of ethanol (July 2007) to 1.43 billion litres in 2008 or so. In 2010, Canada's inclusion mandate will call for 2.1 billion litres of ethanol in gasoline – it is reasonable to expect the industry will reach this level. Further growth will depend on ethanol demand and export opportunities.
- 7. Is Canadian ethanol exported or consumed domestically?**
I believe it is all being used for domestic composition at present, but that does not rule out an export potential, depending on factors such as supply, price, or politics!
- 8. Does the U.S. ethanol industry influence the Canadian industry?**
Much like cattle, markets tend to get set in the U.S. and influence what and how we do things here in Canada. As ethanol expands in the U.S., it is currently trying to fill a domestic demand. As infrastructure expands (i.e., getting ethanol to markets), this demand is expected to rise (i.e., E85 fuel). The Canadian industry is likewise expanding to meet provincial and federal mandates. Once local markets are filled in the U.S. and/or Canada, plants may start looking for export markets. Once again, supply, demand, and pricing will influence export opportunities.
- 9. What is the expected growth of the ethanol industry over the next 10 years?**
This is very open-ended question – obviously how fast cellulose-based ethanol comes on stream will influence the grain-based plants in existence. Mandates instituted by provincial, state and federal governments will also have a major impact and the development of infrastructure to distil and transport ethanol across North America will impact growth. The value of oil, the Canadian dollar, grain supplies and price, and trends and developments in development of the auto industry (E85) will also influence the ethanol industry. This large number of potential variables makes it very difficult to predict the future.
- 10. Will ethanol and biodiesel production affect grain production?**
During the next 5 years, it is estimated that between 20 and 40 per cent of the domestic use of corn in the United States will go to ethanol. This usage has practically eliminated the reserve stocks in the United States. There is no doubt that this “new” market for corn has put upward pressure on cereal grain prices. However, long term impacts on cereal grain prices will depend on a variety of factors which normally influence cereal grain prices. These factors include crop yields, acreage seeded, drought and other natural disasters, development of new

technology (i.e., cellulose-based ethanol), etc. Clearly ethanol will put upward pressure on cereal grain prices but the exact magnitude and duration of these price increases remains to be seen.

B) Ethanol By-products as a Livestock Feed:

1. What by-products are produced during ethanol production?

First, they can be grouped as wet products versus dry products. The wet products may include thin stillage (7 per cent solids), condensed distillers syrup (30 per cent solids), or wet distiller's grain. The dry by-products include either dry distiller's grains (DDG) or dried distiller's grains with solubles (DDGS). The type of by-products produced may depend upon the plant. Frequently, the plant takes the "whole stillage," which is what remains after distilling off the alcohol, and centrifuges it to separate a "wet mash" and the liquid material or thin stillage (7 per cent solids). Both the thin stillage and the wet distiller's grain may be fed directly to cattle (Pound-Maker Feedlot, Lanigan, SK) but more frequently the liquid is evaporated down to 30 per cent dry matter (condensed syrup). The condensed syrup is usually added back to wet distiller's grain and the combination dried down uniformly to produce DDGS. If the condensed syrup is sold separately then the wet distiller's grain may be dehydrated to produce DDG.

2. What by-products are produced during biodiesel production?

Biodiesel production involves the extraction of oil from oilseeds such as canola, mustard or soybeans. Typically, processing involves a cold press to remove the oil. The residual meal can be fed to livestock. Due to the process involved (cold press) these meals differ from conventional oil seed meals in that they are higher in residual oil. Not a lot of research has been carried out in terms of feeding value. One would assume, however, that these by-products should be higher in energy than conventional oilseed meals as they contain higher fat levels. Glycerine can also be produced as a by-product of biodiesel production.

3. Will ethanol by-products change as fermentation becomes more efficient?

Most definitely! There is considerable research underway which focuses on both pre- and post-fermentation technology to improve the efficiency of grain-based ethanol production. Technologies include de-branning wheat prior to fermentation or the addition of fiber-degrading enzymes to fermenters to enhance glucose yield or digestibility of end-products. These technologies will ultimately impact the nature and quantity of by-products produced. Cellulose-based ethanol production, when it becomes commercially viable, is another area where the available by-products will be greatly affected.

4. Will ethanol production affect all sectors of the livestock industry?

It appears that ethanol is having a widespread impact on agriculture beyond livestock alone. As the industry develops, there is a greater supply of cereal grains going to ethanol (more than 20 per cent of domestic U.S. corn usage is for

ethanol). This demand is putting positive pressure on grain prices, land value and planting decisions. With respect to livestock, higher grain prices influence all sectors of the industry, particularly cattle and hogs which are not protected by prices artificially set by marketing boards.

5. What livestock feed opportunities exist for ethanol by-products?

This varies by sector – these by-products are high in protein, relatively high in energy, and have high fibre content as well as high mineral levels. The amino acid make-up of the protein is not ideal for species such as pigs or chickens and the high fibre nature of these by-products also limits their use with these species.

6. Can ethanol by-products be stored and transported?

The dry product—DDGS—are 90 per cent dry matter and can be stored indefinitely and transported anywhere in the world.

The wet products – either wet distiller’s grains (30 per cent dry matter) or thin stillage (7 per cent solid matter) – have a short shelf life. In the summer, they may be stored for only 3 to 4 days, and possibly 7-10 days in the winter. Salt has been added as a preservative in the U.S., which prolongs the shelf life, but transportation costs will still limit usage of wet products to the immediate vicinity of an ethanol plant. Basically, wet products have a limited shelf life.

7. Will ethanol production have a long-term effect on feed costs?

There is no question that ethanol production, as long as it remains grain-based, will continue to put upward pressure on feed grain prices. Currently, 20 to 30 per cent of U.S. corn is used for ethanol, and 5 years ago this consumption was near zero. In response to this increased consumption, there has to be either an increased supply or increased prices. Producers are not creating a greater supply of corn, so the ethanol industry is driving up corn prices. Last winter when corn went to \$4/bushel, people blamed ethanol and said it was having a negative impact on feed prices. Today, corn prices are down to \$3/bushel so there are a number of global factors affecting the price. American ethanol production will have a continued impact on feed prices and may elevate the floor price. The price of corn will not go down appreciably until there is change in the dynamics of supply versus demand.

The Canadian situation with wheat is similar in many ways. We produce approximately 25 million tonnes of wheat per year, with half of this exported and a quarter consumed domestically. A relatively minor amount of wheat goes into feed and the remaining 4 to 6 million tons per year are left as carry-over. That carry-over has always been the factor limiting wheat prices to \$3-\$4/bushel over the last 30 years. When you look at the Canadian ethanol production capacity coming on stream, then this industry could consume half the annual wheat carry-over. Depending on how large the industry gets, it could easily eliminate the entire carry-over. If that occurs then there will be substantial upward pressure on price. Wheat and barley prices are, however, tied to corn prices in the U.S. so

there is already an increase in grain prices. The price of feed grains may be further increased if there's more incentive to plant wheat acreage rather than barley acreage. Ethanol has the potential to change the face of agriculture as long as it remains a grain-based industry.

- 8. How much reserve production capacity is there in the U.S. Land Reserve?**
 People say that these acres can come back out of that program and go into cereal grain production if economics dictate this. Despite a lot of the reserve land being of marginal production capacity, there was a record number of U.S. acres planted to corn this spring. They are projecting a record U.S. corn crop from these increased acres. This is, in part, helping bring corn prices down, but this factor alone is not of sufficient magnitude to displace the increased demand by ethanol. There is not a substantial potential to increase supply simply by planting more acres.

C) General Issues Regarding Ethanol By-products in the Cattle Industry

- 1. Can ethanol by-products be used by all sectors of the cattle industry?**
 Both beef and dairy producers are in an ideal position to use these products. Dairy producers can incorporate DDGS as a bypass protein supplement and beef producers can use these products as both energy and protein sources. Inclusion levels for beef cattle will depend on other feeds used and whether they are used for protein supplementation (i.e., at 5 to 10 per cent) of ration or as an energy supplement. We have replaced all the barley in experimental growing rations with no adverse affects on cattle and others have fed this level in finishing rations.
- 2. Are there nutritional concerns when feeding ethanol by-products?**
 Yes. Specific issues may arise depending upon the level of by-product incorporated into the ration. First, you may be overfeeding protein and minerals such as phosphorus and sulphur to the cattle. It is a good idea to work with a nutritionist when developing rations that incorporate these products so the by-products are incorporated into a balanced ration. For example, zinc may be 150 parts/million in DDGS which is not within a toxic range to cattle, but is likely to be three to four times the requirement of the animal. You'd be overfeeding zinc if DDGS was 100 per cent of the diet but we don't do that. If you strategically include DDGS to meet protein and energy levels then you need to know what you're doing in terms of mineral content, protein content, and fat content. Knowing how you are changing the balance of your ration is most important.

It is critical to have a feed analysis of the DDGS, especially if purchasing directly from the distiller. For example the wheat-based product is expected to be 35 to 40 per cent protein. Depending upon the plant and the drying process for each batch of DDGS, there may be heat damage which renders the protein unavailable. In the U.S., they have a series of color cards (ranging from light brown to black) which judges heat damage. Black is severely burnt and a light golden color is the other

extreme. The best way to determine protein damage is to have the DDGS commercially tested. These products should be screened for heat damage, protein content, and lipid content and you should know if you are buying corn-based versus wheat-based distiller's grain. These products have significantly different energy levels. The fibre in DDGS has increased digestibility which adds energy to the product. Minerals are also concentrated in DDGS but there is no reason that fermentation and dehydration should alter the bioavailability of these minerals.

3. Are there health concerns with feeding ethanol by-products?

Health issues with any of these products are fairly minimal. The one problem is sulfur. Wheat has 0.15 per cent sulfur and DDGS has 0.4 to 0.5 per cent sulfur. If you live in an area where there is concern about polio (thiamine deficiency) in cattle then once the ration exceeds 0.4 per cent to 0.5 per cent sulfur then there may be a higher incidence of polio. When distiller's grains are at 0.5 per cent sulfur then feeding 100 per cent DDGS could exceed the acceptable dietary threshold for sulfur but again, we would not feed a diet that is 100 per cent DDGS; rather, it will only make up a specific proportion of the diet (i.e., 20 to 40 per cent of dry matter). However, it is always a good idea to be aware of other sources of sulfur in the diet, particularly in the water, and to watch total dietary sulfur intake.

Another health concern related to fertility, which may be unique to the dairy industry, may be feeding excessive protein (>18.5 per cent CP) during the breeding season. It is important to know total protein when formulating the ration.

There has also been concern regarding *Fusarium spp.* contamination in grains since it can be concentrated three-fold in DDGS. This is not an area extensively evaluated by research but it is believed that fusarium is just as toxic after fermentation. The ethanol plants screen the wheat for *Fusarium spp.* prior to fermentation. It is also important to remember that cattle are relatively tolerant of fusarium toxicity since the rumen is a great detoxifier.

4. Are ethanol by-products cost-effective when compared to grains?

Presently, they are linked in price. A year ago everybody thought there would be such a large supply of these by-products that the price would drop below barley. The cost of DDGS has dropped to the level of barley, or slightly higher. Presently, the volume of distiller's by-products is still limited, so they have maintained that pricing structure. If you go to a feed company selling this, then you'll pay slightly higher than barley. The only advantage is that you don't have to process the DDGS product. Producers will soon see more ethanol plants, one in Saskatchewan and one in Manitoba, coming into production in the next couple of months. The volume of product from these plants should put more pressure on the price of DDGS. Also, research to date indicates that as barley is replaced with DDGS from wheat that animal performance is at least equal or better. The final decision will come down to the cost of putting the by-product into the ration. If you can

purchase and deliver DDGS at the same or a cheaper price than grain then there will be an economic advantage to feeding the product.

5. Will transportation costs limit access to ethanol by-products?

With dry products, transportation costs will be just like any other commodity you purchase. On a bulk density you are getting approx. 40-45 tonnes DDGS on a super B, so you would be delivering the same nutrient load that producers would get with barley

6. Do ethanol by-products affect carcass quality?

There is much work going on regarding this issue in the U.S. Research and industry experience in the U.S. indicates that as the level of corn distiller's grain is increased in the ration, marbling has been negatively affected as well as yield grades.

There has been no evidence to date in Canada that wheat-based products have a negative influence. No indication of adverse carcass effects has come from Pound-Maker's experience of feeding wheat-based products for 15 years but these animals are sold live. Our own research has been limited but this fall we will compare corn versus wheat distiller's products and directly address the carcass quality issue.

7. Can feeding ethanol by-products affect animal behaviour?

No. If there is any ethanol left in the distiller's grain then the ethanol plant is doing a very poor job. Also, any alcohol which enters the rumen is rapidly degraded by fermentation.

8. Are there environmental issues when feeding ethanol by-products?

The issues will vary with location. For example, a new feedlot in an area with minimal prior livestock activity and a large land base for spreading manure will be different from a feedlot in the Picture Butte or Lethbridge areas where manure has been spread year after year. When you look, the distiller's byproducts are high in protein (40 per cent) and phosphorous (1 per cent) when compared to either wheat or barley. Once you start overfeeding protein or phosphorus to cattle, then the excess is excreted in either urine (nitrogen) or manure (phosphorous). For example, if 18 per cent protein is being fed to feedlot cattle that only have a requirement for 13 per cent, then there is a lot of nitrogen coming through in the manure. If this manure is to be spread in an environmentally-sustainable fashion then issues of land base, nutrient content of the soil, and nitrogen usage by the crop must be considered. It is critical to develop a manure management plan.

In Manitoba, there are additional concerns regarding phosphorous levels causing algal blooms in the big lakes. Phosphorus can be very high in distiller's by-products so you have to be aware of what's passing through the cattle and what you are spreading on the land.

D) Incorporating Ethanol By-products into the Cattle Ration

1. Can distiller's products be fed to calves or when backgrounding?

There is no doubt you can use it as a direct replacement to barley in creep feed or backgrounding rations. How high you go is the issue. A recently completed trial used a 40 per cent grain ration with the remainder in oat hulls (straw-based diet). In this ration, half the barley was replaced with DDGS. There was a significant response to the distiller's grain. So in either the backgrounding or finishing rations, we can find a home for virtually as much DDGS as you want to feed. But, how high can you go? Perhaps 60 per cent is overfeeding even though the cattle do well. It is important to talk to a nutritionist to identify the optimum level.

2. Can distiller's products be incorporated into the cow ration?

There is one example I know of using the syrup, which is around 30 per cent dry matter, in a cow ration. The syrup is high in protein, high in fat, and can be fed as a liquid material. A producer near Lloydminster, AB, was swath grazing and used distillage syrup as a top dressing on swaths. This worked well until there was a blizzard and the swaths became iced over. This blocked access to the swaths so the producer then gave the cows direct access to the syrup as the sole source of feed. A number of the cows died and post-mortem examination resulted in a diagnosis of grain overload. Condensed syrup is very acidic with a pH around 4 so it is critical to have adequate advice when feeding distiller's products.

There have been no research trials done specifically with wheat-based by-products, but work at the Termuende Research Farm (operated by the Western Beef Development Centre, Lanigan, SK) is starting to look at this question with DDGS. If there is strategic supplementation for grazing/winter needs, these products will work very nicely. For example, when pasture quality is limiting, it may be beneficial to supplement with DDGS. These by-products may also be ideal on a limited basis as a feed supplement to wintering cows. The only caution may be when feeding beef cows immediately pre- and post-calving when DDGS should be restricted to a couple of pounds per day as an energy supplement.

3. How can distiller's products be used in the feedlot ration?

a) Thin stillage (after solids have been centrifuged) in feedlot rations:

The best way to do this is the system used at the Pound-Maker Feedlot (Lanigan, SK). The thin stillage is distributed through the waterbowl where calves drink it as a source of fluids. The liquid is approximately 7 per cent solid material and an animal drinking 8 gallons/day is ingesting the equivalent of 3 to 4 pounds of barley. This is a tremendous boost to productivity. The experience at Pound-

Maker is that cattle adapt well to thin stillage and most find it very palatable. The rare animal will not adapt to it so it is important to have an alternative source of water in the pen or remove it from the pen.

If you don't have the appropriate infrastructure to distribute through the waterbowls then there are alternative delivery methods. For example, there is a product called condensed whey which is sold from the milk plant in Saskatoon. A number of feedlots add this whey to their dry hay-based or grain and hay-based rations as a wetting agent. The condensed whey adds moisture to the diet and is also adding a nutritional component. In a similar fashion, thin stillage could be incorporated into a dry feedlot ration. Most producers won't have access to thin stillage because transportation costs will restrict access to the immediate vicinity of ethanol plants.

b) DDGS in feedlot rations:

It can go in as a protein supplement or it can start to replace barley as energy. How high you go will depend more on your environmental plans (manure spreading) than anything else. At 20, 30, 40 per cent in the diet, cattle will do well; the question just becomes, how much protein and phosphorous can producers afford to feed from an environmental perspective?

Prepared by the VIDO Beef Technical Group (VBTG)
Vaccine and Infectious Disease Organization
120 Veterinary Rd.
Saskatoon, SK S7N 5E3
Tel: (306) 966-7465 | Fax: (306) 966-7478
info@vido.org
www.vido.org