ETHANOL PRODUCTION AND BYPRODUCTS

Dr. Matt Gibson
Dakota Gold Marketing

Matt Gibson, PhD, received his BS and MS from Texas Tech University and his PhD from Washington State University. He currently serves as the vice president of technical services and marketing for Dakota Gold Marketing and the executive director of the Dakota Gold Research Association.

The Dakota Gold companies are part of the Broin Companies – the world leaders in ethanol technology, and the largest dry-grind ethanol producers. They currently market more than one billion gallons of ethanol annually. DGM is the largest marketer of Distillers Products; DGRA is the leading Distillers Grains research organization.

The ethanol industry is really focused on the energy sector. We're feed. We feed animals. That is, we focus on the feed which comes out of the ethanol plants. But when I talk about feed to the ethanol people they have no idea what I'm talking about, and when I talk to the feed people about ethanol and try to explain our constraints, usually feed people don't know what that is all about. I want to tie those together today and mostly talk bout what the ethanol industry is and let Dr. Erickson and Dr. Pritchard speak more to how we use the distillers grains for cattle product.

A lot of people are interested in ethanol. This chart is a summary of how we used the corn in last year's crop year of 2004/2005. Ethanol consumed about 1.4 billion bushels out of roughly 11 that were produced that year. Even two years ago a lot of people were pretty interested in ethanol with increased production.

Who is interested in ethanol?

Uses of Corn – '04 / '05*

Use	Amt[1]
Feed	6,100
Export	1,900
Ethanol	1,400[2]
Fructose	550
Starch	250
Sweetener	200

1 Million bushels
2 ~ 14 %
* Broin, '05

You see ethanol everywhere. There are industry publications out there. One company has a distillers grains publication. You see ethanol in the Indy racing arena. This year they used 10% ethanol, next year they will use 100% ethanol. You see E85 stations all over the place.

Where ethanol comes from

What is fuel ethanol and how do we get it? I'll go through a brief overview of how we produce ethanol and get the feed products.

Most of the distillers grains come from the dry grind process and this ethanol is being primarily used for fuel. Potable ethanol, whiskey and that sort of thing is a very similar process with a few distinct differences.

We start with whole corn which we grind through a hammer mill. We add water to create a slurry, which we can start processing. Also, this allows us to basically pump the mash around. From there we have to cook it in a jet cooker. This cook process is very similar to steam-flaking corn so the cattle get more available starch from the corn.

We add enzymes which go in and start digesting the starch - cleaving off the glucose from the starch molecules. The glucose is what's converted into ethanol. We have to cool that down mixture down so we don't kill the yeast. All of that mash goes into a fermenter in to which we add yeast. It's basically like bakers use. We let it ferment for about 60-70 hours.

During fermentation the yeast convert the glucose into ethanol. As a by-product of that process they release CO_2. Some plants will capture that and compress it for the commercial market. Some will just scrub it and vent it to the atmosphere.

After several hours we drop the fermenter and what we get out of there is what we call "beer." (I'll try to give you some ethanol lingo as we go along – "beer" is part of that lingo.) It's basically high-test corn beer. It then goes through a fractional distillation system where we get 190 proof which is pretty good. That is as good as we can get out of fractional distillation. There is still 5% water - we run it over molecular sieves to take out that water and we get 200-proof pure fuel ethanol. In order so it's not consumed or "potable", we add back 5% gasoline making it toxic. That then is what we call 200-proof denatured ethanol fuel product.

Coming out of the bottom of the still is whole stillage - a fairly thin, watery liquid. We run it across a modern centrifuge – basically, like you would find in a rendering plant. We get separation of a real watery portion called thin stillage and the coarse or wet grain, or "wet cake." The thin stillage we evaporate into a thick, viscous "syrup." This is not sweet like sweet corn syrup. We add the two back together, dry it and that gives us the dried distillers grains with solubles.

Most people focus on quality around the dryer, but there are a lot of steps in the processing that affect the quality.

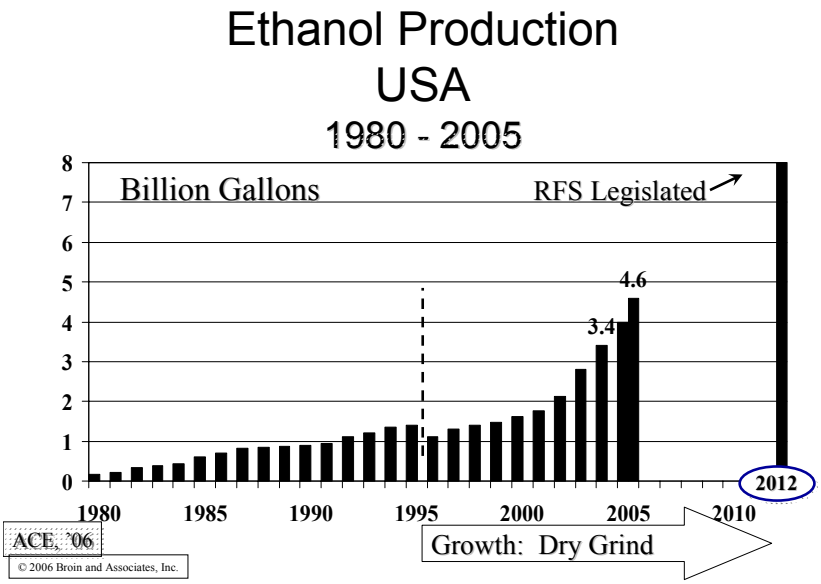
At the plant, the corn comes into the grains receiving building. It will be ground, blown over to the processing building where it will be fermented, dried and then the distillers grains will be blown back and stored in the concrete silo or flat storage. It's very clean, there's no dust, very little vibration, very little noise. Ethanol plants are, generally, good corporate neighbors. You will have trains coming in to offload the ethanol and distillers; also, they haul both away in trucks.

The fuel ethanol industry

For further information, I would recommend Renewable Fuels Association (www.EthanolRFA.org), American Coalition for Ethanol (www.Ethanol.org) and National Ethanol Vehicle Coalition (www.E85Fuel.com). Also, please see our web-site (www.DakotaGoldMarketing.com).

Ethanol is primarily produced in the Midwest. We have some plants going up in Texas, some in California, one in Idaho, but the fuel ethanol is primarily produced in the Midwest. Today, as best I know, there are 107 plants operating. We currently have 45 under construction. Iowa is by far the leader producing 1.1 billion gallons of ethanol last year. You can see the big five ethanol states are Illinois, Iowa, Nebraska, South Dakota and Minnesota. The four surrounding states follow them in production and even Colorado is a third-tier production state.

When you look at ethanol production for the past 25 years, (starting in 1980), you can tell it took us a long time to get from a few hundred million gallons to a billion gallons. Then, from 1996 until 2006 we went from 1 billion to around 4 billion. We were projected to do 4 billion this year (2006), but in 2005 we did 4.6 billion. I don't have the updated number for 2006 but it should be close to 5 billion. We are scheduled to go to 8 billion according to the RFS legislation by 2012. We will be at 8 billion well before 2012, so we are increasing our production very fast.



One of the key things from a feed standpoint is that all of the growth since 1995 has been in that dry grind process that we just talked about. Before 1995, we had some dry grind ethanol but most of it was from wet mills. Since 1995 all of this growth in ethanol production has yielded distillers grains.

What is ethanol used for?

We can use it as a renewable fuel, such as E85 which is 85% ethanol and 15% petroleum gas. Most of you are probably familiar with that.

What you're probably less familiar with is that ethanol is a tremendous octane booster. It has an octane value of 113. The blenders can actually take subgrade unleaded, add ethanol and create normal 87 grade gasoline. Or they can take 87 and create midgrade by adding 10% ethanol.

It is replacing MTBE as an oxygenate. In the USA, the EPA has identified specific areas where we have auto emission problems and we have to add oxygenates to the gasoline. In the past we've had several molecules to choose from, MTBE being the main one. One problem with MTBE is that it may cause problems with groundwater contamination if it is spilled. So most blenders have chosen to remove that voluntarily and they are using ethanol as a replacement.

We can use ethanol blends in basically any motors in the U.S. today that burn gasoline. Small engine and marine can use E10. Automotive can use E10 and E85. And, now for aviation we have aviation gas (AGE-85).

Today about 3% of our total gasoline usage is made up by ethanol. About 40% of the gas that we burn is blended with ethanol. If these numbers sound funny – like they don't jive – it's because we are using ethanol for an oxygenate molecule and an octane booster as well.

Of the ethanol plants that are producing today, about 50% of them have some farmer ownership in them or they are owned outright by farmers. It's a very nice "American agricultural thing" even though we are dealing with the energy sector.

Another interesting myth that we hear is, "It takes more energy to make a gallon of ethanol than you get out of a gallon of ethanol." This is inherently not true. People who say that are strictly basing their calculations on old equations and assumptions.

The Aspen model from the DOE depicts the energy balance (in BTUs) expressed on a gallon basis. You can see that to actually produce a gallon of ethanol costs about 43,000 BTU. The ethanol itself has about 76,000 BTU. We have a net remainder of 33,000 which is gives us a positive energy balance of about 1.77. We get about 77% more energy from a gallon of ethanol than it takes to produce it.

This was based on 2005 figures. We are actually improving our efficiency pretty dramatically today.

ASPEN PLUS® Model

Energy Balance (Btu) / Gallon*

Process	Energy
Corn Production	(12,457)
Corn Transport	(1,411)
Ethanol Conversion	(27,799)
Ethanol Distribution	(1,467)
Total	(43,134)
Ethanol Content	76,330
Net Difference	33,196
Energy Ratio	1.77

* 2005, Dry Grind Process

Feed products from the ethanol process

When we talk about distillers products, most producers "know" about them. I used to work for a feed company where we used a lot of distillers grains. The distillers products we have today are very different than the distillers products we had then.

We've referred to the wet milling process several times. Sometimes it helps us define what something is if we understand what it is not. This is particularly true of

distillers grains. You'll hear people talk about "gluten feed." Gluten feed comes from the wet milling process. These producers do use corn and it is possible to get ethanol from this process. But they also get other food products like starch, high-fructose corn syrup, corn oil. The feed products that come out of wet-milling operations are corn steep liquor and bran. If you add the steep liquor and the bran you get gluten feed. When you extract protein you get gluten meal. You can also get germ meal which is a feed product in an of itself. It may be also be classified as hominy feed or you can add that back into the stream which goes into the gluten feed. These feeds coming out of the wet milling industry are not to be confused with what comes out of the dry-grind ethanol industry.

In the dry grind ethanol industry we ferment the whole corn. We get the stillage that is separated and the feed products coming out would be the coarse grains by themselves: either wet distillers grains or you can dry them. We also get the solubles, the watery portion, sometimes called syrup. If you add those together you can get wet distillers grains with solubles or dry distillers grains with solubles. Then there is another other beast called modified distillers grains. The bottom line is this: most of the product is sold as dry distillers grains with solubles with the exception of Nebraska where we see most of that being sold as wet distillers grains and the syrup.

The feedstocks that we use today are basically corn. But that is not the only one ethanol plants can use. They can toss in wheat, sorghum, whatever. Anything that has starch in it like midds or grits can go in there.

A key thing to remember is according to AAFCO definitions, the majority grain is what goes on the label. So we describe it as "corn" dried distillers grains with solubles, even if it only has 51% corn. Our process is 100% corn, someone else's may have 51%. This is one factor which leads to some of the confusion we see out there.

So how much ethanol do we get out of a bushel of corn? A bushel of corn gives us about one-third ethanol. On an industry average, that equals about 2.8 gallons. We also get about a third distillers grains and a third CO_2. We're having all this corn going to the process but a third of it does come back as animal feed.

Since we have a about a third of it coming back, whatever is in the corn, as a general rule of thumb, is concentrated up about three-fold. We're seeing distillers grains having about .75 phosphorous, corn has about .25. If you see something in distillers grains that doesn't really fit that 3-to-1 rule, then you may have a little aberration.

Ingredient markets

How much does distillers grains cost? This is a really good question. This chart tracks the Minnesota spot price for the last eight years. Starting in 1999 through this month, distillers grains costs, on average, $80/ton with a low of $70 and a high of $90. In that eight years, distillers grains has broken out of those prices only seven times. And they just barely broke out of the bottom and barely broke out of the top with two exceptions. Everyone remembers what happened with the soybean meal in 2004 and then what's happening with corn right now. Otherwise, distillers grains historically cost $80/ton.

How much are we producing? We started in 1996 building all of these dry grind facilities. In 1996 we produced about a million tons of distillers grains and you can see the growth through 2005. Through this year we projected our total production would be about 9 million tons and we actually think that this year's production will be closer to 10 million tons. Basically in 10 years we've gone up 10-fold.

During those 10 years some new technologies have come along. Our company has been one who has been leading this technological revolution. One new technology is BPX™; another one is BFrac™.

How much distillers do we think will be produced in the next few years and how much corn do we think will be fed? If we look at millions of tons of distillers vs. million bushels of corn, here are the projected numbers. (Up until the year indicated we had very good figures because those were actual numbers. The following data are projections.)

The economists think that feed corn is going to stay right in that 5-6 billion bushels consumed and you can see that distillers grains production over the next few years will double. It looks like we are going to reach 12 million tons of distillers in the crop year of 2008 is what they are projecting.

In our company we track how much is actually produced. We actually hit a million bushels (per month) in September of this year. Instead of hitting 12 million bushels (per year) in two years, we're actually hitting 12 million bushels today. We are growing much faster than anyone projected – including our own commodities group.

Where is all the distillers grains going to go? In 2003 I reviewed the amount of feed consumed by some of the U.S. production animals. I looked at sort of a conservative or reasonable inclusion rate of dietary DDG/S, and estimated grand total of about 13.4 million tons of DDG/S consumed. We're going to get to that level in a hurry.

Market Opportunities[1]

USA Production Animals

Species	Feed[a]	% Incl[b]	DDG/S[a]
G/F Pig	34.4	10	3.4
Fin. Cattle	37.9	5	1.9
Dairy	31.5	10	3.2
Broilers	43.4	5	2.2
Layers	13.5	10	1.4
Turkeys	13.2	10	1.3
Total			13.4

[1] Feed Mgmt Mag '03
[a] Tons x 1,000,000
[b] Reasonable or Conservative

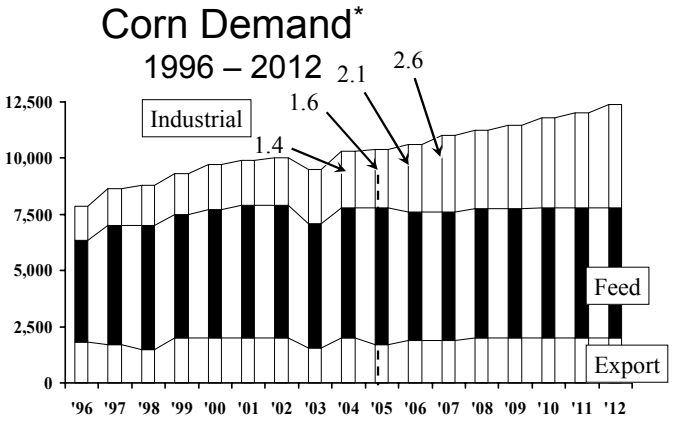
Luckily we see a lot more people including distillers grains in their diets these days – and at higher rates than originally estimated – and so this slide indicates an updated consumption figure for 2006 from some professionals who look at commodities. These guys estimate the consumptions much higher than I did three years ago. They estimate consumption from 7.5 to 60 metric tons. Obviously, there is going to be a lot of it fed in the U.S. By the way, these figures do not include pets or horses.

We also see a lot of it being exported. If we look at the top five export destinations last year, they took a total of about 675,000 tons; about a million total tons were exported. The number one country is Ireland, Mexico is number two. The year before that Mexico was not even on the chart, and next year Mexico will probably take a million tons alone. We're seeing some dramatic shifts in where we are marketing the product for export. We don't have Southeast Asia on this chart, but next year – as a group – it will probably be number two.

Effect on corn demand

So what is this doing to our corn demand? If we look at corn uses since 1996 projected through 2012, you can see that two years ago we used about 1.4 billion bushels for industrial use (ethanol). This year (that we just finished) we will have used about 1.6 billion bushels. Next year we're projected to use about 2.1 and then 2.6 after that. The thing to remember is every time we go up by one-half a billion bushels, that's about 3 million corn acres that have to be bought to supply the corn.

Feed is staying very static and export is staying very static. We will see dips and drops as we go through and right now we are seeing a dip in export.



* Adapted from CMC, '05

Nutrition considerations

When we talk about distillers we have to say a few things that we generally believe are true. I would suggest you go to our website www.DakotaGoldMarketing.com. We have a complete listing of nutrients for each product we have in our database. Further, our product is a premium distillers grains. Other information on our web-site will give you an idea of what is going on in the industry.

Generally you'll see that distillers runs about 30% protein and about 10% fat on a dry matter basis. Obviously our base ingredient is #2 yellow corn.

What about mold and mycotoxins? These molecules are concentrated up during the process. This is a key point for you guys to remember. Mycotoxins are concentrated up three-fold from the corn. If we have 10 ppb of aflatoxin in the corn, we'll have 30 ppb of aflatoxin in the distillers grains. These are very tough molecules that are not destroyed during processing, fermentation or drying. We hear people say that fermentation takes care of it, or the drying will, but they are very tough molecules. Whatever is in the corn will show up in the distillers grains.

The main mycotoxins of concern would be the aflatoxins, especially B1, the fumonisins, especially B1, DON or vomitoxin, and zearalenone. Those are the four that we see. They are generally spotty. Certain geographies will have them. Also they vary annually in occurrence. Some years we will see a big DON surge and other years not. They are annual and geographic but you need to understand they will be in the DDG/S if they are in the corn.

One of the complaints we get is there is a lot of variability in distillers grains. A report in 2004 by Robinson looked at the variability for different nutrients. He went out and sampled distillers grains in California coming off of the rail cars and analyzed it at the lab for a bunch of different variables. He also took one supplier, Supplier D, and measured the stuff coming out of their 10 plants and looked at both the means and standard deviations.

DDG/S Variability

Source to Source

	Source	
Nutrient*	Industry-wide	Supplier D
CP	30.1 (2.6)	30.7 (1.2)
Fat	11.5 (3.5)	11.9 (0.7)
ADICP	28.9 (11.7)	8.2 (2.3)
NE_L	1.93 (0.14)	2.19 (0.04)
P	0.88 (0.14)	0.70 (0.10)

* Mean (Std Dev)

Robinson, 2004

You can see for some of those nutrients like fat and protein there is no difference in the mean values between what is going on in the industry or any specific supplier. But for some of these variables –for example, acid detergent insoluble crude protein (a measure of heat damage) – you can see we have some very high levels out there compared to some low levels. Because of the heat damage the calculated energy might be quite different.

Certainly we see some means which are the same and some means which may be different. But even more importantly when we look at the measure of variance, in this case standard deviation, you can see that single source suppliers generally give you much more consistent product.

Feeding beef cattle

Let's review a few selected nutrients in DDG/S which are important for beef cattle., the things we would generally look at is that we keep it pretty low in moisture and it runs about 29% protein. The fat is running about 11%. Because of all the fat it would be slightly higher than corn in both Net Energy values. The fiber levels from a generally available industry source would be around 15 and 40 for ADF and NDF.

There is virtually no calcium. Some of the old books will list that you have .25% calcium, but there's virtually no calcium. For all nutrients, make sure you obtain and use good values, don't just rely on a book value. Another key point is that phosphorous is about three times higher than it is in corn. So make sure to balance calcium and phosphorous. Distillers grains has a good level of potassium and a high level of sulfur.

Selected Nutrients[1]

Beef Cattle

Dry Matter	90	Calcium	0.0
Crude Protein	29	Phosphorus	0.9
Crude Fat	11	Sodium	0.2
NE_M[2]	103	Potassium	1.1
NE_G[3]	68	Sulfur	1.0
ADF	15	Copper	8
NDF	40	Zinc	100

[1] Typical Product
[2] Corn = 91
[3] Corn = 65

We talked about the variability in the product, but you have to remember that our base ingredient is corn. Corn is extremely variable when you look at nutrient components of the corn coming into our plants. This slide indicates analysis of Corn samples coming into our plants during the crop transition from the 2004 to the 2005 crop year. The corn from crop year 2004 had protein levels on an average of about 9.5. Then when we transitioned into the new crop year it went from about 9.5 to about 8.5.

The point is this: if we lose a percent protein in the corn we'll lose about 3% protein in the distillers grains. (Remember nutrients are concentrated up about three-fold.) The protein in the distillers grains does go down if the protein in the corn does go down. With the new varieties and high yields we are seeing, corn protein has definitely gone down over the past couple of years.

If you have guys who are balancing for amino acids, amino acids may be independent of the protein. If you look at our data just for lysine in these three crop years (2003-2006), we saw very high variability in corn protein. However, the lysine means for those years were virtually the same. If you look at the standard deviation for the lysine in those years, we had lower standard deviation during the second and third years. This would be from some pretty extensive amino acid data and more than 100 samples in each. We're confident in those numbers. If you have folks who are using amino acid nutrition for their cattle, you need to pay attention to what's going on there and make sure you get good data.

Hinders published the limiting amino acid content for dairy cattle as indicated in this chart. Soybean meal had the highest levels for lysine and methionine and it goes down from there with DDG/S at the bottom. However, when we review the data specifically for Dakota Gold® brand of DDG/S, we see an improved profile.

Limiting AA Content
As % of Total Amino Acids

	LYS	MET	L:M
Soybean Meal[1]	6.29	1.44	4.36
Canola[1]	5.62	1.87	3.00
Alfalfa Hay[1]	4.34	1.46	2.97
Cottonseed[1]	4.35	1.71	2.54
Corn Silage[1]	2.51	1.53	1.64
DDG/S[1]	2.24	1.82	1.23
Dakota Gold[2]	**3.59**	**2.18**	**1.65**

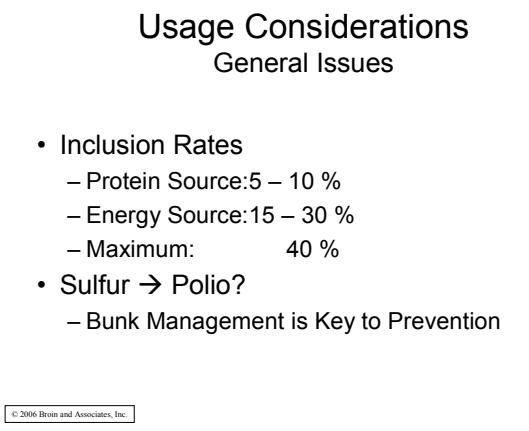
1 Hinders, 2003
2 DGRA, unpublished

If we adjust those amino acids for bypass values we should use a UIP value for soybean meal of 30, which is a reasonable value. If someone chooses a different value, that's okay. But if you adjust those amino acids as a percent of the total, and adjust those for UIP, and then compare that to distillers grains (with a high by-pass value), actually distillers grains become a very good source of bypass lysine and methionine – even better than soybean meal.

We talked about heat damage. You'll see people commonly refer to distillers grains as either golden or brown distillers grains. The reason why they are presented separately is the golden distillers grains are much-less heat damaged. Why is that important? The golden DDG/S doesn't have lower lysine digestibility in particular. A study in chicks showed golden-type distillers had high digestible lysine. The brown-type distillers with heat damage had very low digestible lysine. The same is true in cattle. If it bypasses the rumen and is heat-damaged it will bypass the digestive tract entirely.

Usage considerations

For cattle, these are some general issues. For inclusion rates we generally see people using it as a protein source at low inclusion rates. We see people using it as an energy source at higher inclusion rates. We would certainly recommend no more than 40%. When you get to the 40% level you have to be cognizant of the sulfur content. Do we cause polio with high levels? We would suggest that polio is more of an issue of bunk management than high sulfur levels.



"Wet cake" does present us with some particular challenges. Because it is so wet it is highly variable and you have to be concerned about the price of the product on a dry matter basis - particularly when you add on the freight. It's only about 35% dry matter, so you're hauling bout 2 lbs. of water for every pound of wet cake.

If the feedlot is close to the plant it's a wonderful source for feedlot cattle and very economical. If you're too far your cost starts getting pretty high because of hauling the water.

You also have to be fairly cautious about storing the wet stuff. In the summer you can only store it about 3-5 days. In the winter you can go a little further. If you're just going to put it out on the ground you need to feed it up pretty quick or rotate the pad or whatever.

If you are going to store it, it needs to be in some sort of oxygen limiting container like a silo or bag. If you are going to pile it on the ground you might consider spraying a preservative or mold inhibitor on top of it. It'll form a crust and limit oxygen.

New technologies

One of the new ethanol production technologies introduced in 2004 was the BPX™ technology. For hundreds of years we've always had to cook the mash to gelatinize the starch before we ferment. Now we have figured out that we can take the cooker out of the process. One benefit of this technology is an energy savings - we reduce the energy going into cooking the mash. Another benefit of the BPX™ technology is that we increase our production of ethanol. We go from around 2.6 gallons of ethanol per bushel of corn to three gallons of ethanol. Also, remember back to our model that shows we are getting 77% more energy from the ethanol than we put into the process. Now we're getting even more – making our efficiency even higher than 1.77. The main reason we're able to do so that is because we have much less heat damage because we've removed the cook step.

The cook step causes Maillard non-enzymatic browning which ties up the starches; by removing the cooking, we get a lot more of that starch available for fermentation into ethanol.

Also, remember we said that most people associate quality with the severity of drying. Also, remember we said that anytime you change a process in one place it

changes the quality of the distillers grains. The distillers grains coming out of this BPX™ process look very different than conventionally produced distillers grains.

The BPX™ product looks a little darker. But, in fact, the chromophores – the things that make color – are destroyed during the heating. In order to quantify the color, we use a Hunter colorimeter to determine specific color scores. When we compare the Dakota Gold BPX™ to conventionally-produced DDG/S, we see equivalent Hunter L* scores (meaning they are the same "lightness"); higher Hunter b* scores (meaning the BPX™ product is yellower); and higher Hunter a* scores (meaning the BPX™ product is redder). So, although your eye may deceive you into thinking the BPX™ product is darker, it's actually lighter, yellower, and redder.

The BPX product has less heat damage as measured by ADICP. The BPX process also changes the physical characteristics of the DDG/S – it handles better, it's easier to pellet and it's more dense.

Bio-refining

As an industry, we are now moving away from grinding whole corn. Whenever we move away from grinding whole corn – and we're just taking the endosperm – we actually have to do the same BPX process because the endosperm is fairly difficult to ferment. Also when we remove the bran we can't put the syrup back on the resulting distillers grains because the bran is what holds the syrup. Therefore, we end up with an actual DDG. Our company currently has this process up and running today.

We get different feed products out of this bio-refining operation. We mill the whole corn into three different fractions. One is the full-fat germ which we dry. This can be fed and it is being fed today. Corn germ dehydrated is its name.

The bran goes into a different stream and the endosperm is what goes into fermentation. That's where we get the high protein distillers grains. Syrup is still being formed off of that fermentation process. We add that back to the bran and we call that blended product Dakota Bran®.

The Dakota Gold HP is the distillers grains that comes off of there and instead of being 29% protein it's 43% protein because we removed the germ and bran. The fat has gone down dramatically. Because we have lowered the fiber fraction we have very good energy values. Because the protein is up we change the level of amino acids and furthermore we shift the ratio of amino acids because now we're taking different fractions of protein from that corn. The phosphorous has dropped dramatically as well.

The corn germ that comes out of there before we ferment usually has about 15% protein, 20% fat. Because the germ is the really high-value protein portion of the corn kernel, the amino acids are of high value and there are high phosphorous levels as well.

Other new technologies

Another new technology on the horizon is removing the oil from the syrup stream. As we see an increase in bio-diesel production, we will see this oil go into that sector. We see some plants doing that today. It's a very crude oil but certainly useful for bio-diesel, and it's very cheap to do.

One thing our feeders are going to have to worry about is when we do that we will have much lower fat in the DDG/S. We'll go from 11 to 5%. In our company, we

tested this technology but it lowered the energy of the distillers grains which lowered its value as a feed product.

In summary, the ethanol production that we see today is primarily from corn. I think everyone will agree that we are seeing an explosive growth in the ethanol industry and in particular in the dry grind process. The feed products coming out of there are dry distillers grains with solubles. But we have some rapidly evolving technology just around the corner.

QUESTIONS

Gibson: A question was is there any truth that distillers grains is being burned and then the follow-up question was we are going to use every part of the distillers.

Some folks are pursuing a combustion use of the distillers, absolutely. We have engineers working on that in our own company. Is it being done today? It's not a wide-spread practice today.

Is everything being used out of the corn? Today it already is. We're using it for something.

Question: Are the new processes changing the product that you get?

Gibson: From a wet chemistry standpoint, the BPX process does not because all we've done is remove one of the steps. But because we removed the cooking, we really reduced the Maillard reactions so we end up with more fermentable substrate for ethanol and we end up with less browning products in the feed. Otherwise it has the same phosphorous and same fat. The bio-refining process does dramatically change the product streams.

Question: My understanding is that sometimes antibiotics are added to the distillers grains to reduce or control microbial contamination. Do we have to be concerned about residues in our product?

Gibson: The FDA has on file a letter of no objection written to SKB who had virginiamycin in 1993. That's not an approval but a letter of no objection is somewhat similar. In effect they have allowed the use of virginiamycin for controlling infection in fermenters. There are no others that are allowed today – that I know of – but virginiamycin is not disallowed. The virginiamycin is either consumed during fermentation or it is heat labile and when it goes through distillation and drying it is destroyed.

<u>For more information</u>

Other review papers on this topic are available on the Dakota Gold website. These papers are organized in written format with appropriate graphics and references, and are easy to read.

To view these papers, go to www.DakotaGoldMarketing.com