Distillers Grains

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Distillers grains are a byproduct of whiskey and fuel ethanol production. They have a very long history of being fed to livestock; the first study in the United States about feeding distillers grains to cattle was published in 1907. The tremendous growth in fuel ethanol production has greatly increased the supply of distillers grains, resulting in increased interest in feeding them. Annual production of distillers grains (on a dry basis) was about 1 million tons in 1998, about 10 million tons in 2006, and is estimated to reach 16 million tons by 2010.

In the United States most of the ethanol produced currently is made from corn but other grains can be used. The corn is processed and mixed with yeast that converts the starch into ethanol and carbon dioxide. The ethanol is distilled off and the remaining liquid is centrifuged to remove some water. This residue is called wet distillers grains and usually has 30 to 35% dry matter (DM) and contains most of the fiber, fat, protein, and minerals found in the original grain used to make the ethanol. The liquid removed by centrifuging is usually partially dried and becomes condensed distillers solubles. Condensed solubles are a good source of protein, energy, and vitamins but have the consistency of molasses, making feeding difficult. Most distilleries add the condensed solubles back to the wet distillers grains making wet distillers grains with solubles (WDGS). The wet products are either fed as-is or are heat-dried producing dried distillers grains with solubles (DDGS). The nutrient value of the products with and without solubles differs slightly, but only WDGS and DDGS will be discussed further.

Nutrient Composition

The nutrient composition of distillers grains is a function of the starting grain and the specific methods used to make the ethanol and distillers grains. Distillers grains have very low concentrations of starch because most of the starch in the starting grains was converted to ethanol. Concentrations of protein, fiber, fat, and minerals are increased depending on the concentration of starch in the grain. Corn grain is about two-thirds starch and when most of the starch is removed, concentrations of the other nutrients are increased about three-fold (table 1). With a few exceptions (discussed below) composition of WDGS and DDGS on a DM basis is similar.

Table 1. Average composition of corn grain and corn distillers grains with solubles

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Corn grain (%)</th>
<th>Distillers grains (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>9.4</td>
<td>30</td>
</tr>
<tr>
<td>Neutral detergent fiber</td>
<td>9.5</td>
<td>40</td>
</tr>
<tr>
<td>Starch</td>
<td>70</td>
<td>4</td>
</tr>
<tr>
<td>Crude fat</td>
<td>4.2</td>
<td>12</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.3</td>
<td>0.8</td>
</tr>
</tbody>
</table>

¹Nutrient composition on a DM basis. Data taken from several sources published since 2000.
Variability in Nutrient Composition

The nutrient composition of all feeds varies, but using feeds that are highly variable can reduce profitability of livestock operations because of increased feed costs and/or reduced production. Reduced production occurs when a diet does not contain adequate concentrations of a particular nutrient because a feed has less than anticipated concentrations of that nutrient. Increased feed costs occur when diets are over supplemented to avoid reduced production. The nutrient composition of “average” distillers grains can be quite variable (table 2). In comparison, soybean meal has a coefficient of variation (CV) for protein of <2%, which is much less than that for distillers grains. However, the CV for fat concentration in whole cottonseed is 8%, which is similar to that of distillers grains. Variation can be managed, but you need to know the variation in nutrient composition of the feed. Some distilleries will provide average concentrations of major nutrients and the standard deviation for the distillers grains they sell. Otherwise analyze an adequate number of samples and calculate standard deviations (all spreadsheets will make this calculation). To reduce variability, purchase distillers grains from a single source that practices good quality control. As shown in table 2, some suppliers have very good quality control practices in place (low CV). If the distillers grains being fed are highly variable, inclusion rate should be limited. Limiting the inclusion rate of any feed will reduce the impact of its variation on animal performance and will reduce the need to greatly over supplement the diet.

### Wet or Dry Distillers Grains?

Dry distillers grains are available throughout the country but because WDGS is 65% water, transportation costs limit their availability to livestock facilities that are in close proximity to the distillery (probably less than 100 miles).

#### Advantages of WDGS

- Lower cost per unit of DM (drying adds to the cost of making DDGS)
- Higher energy concentration (drying causes a reaction between proteins and carbohydrates that can reduce energy digestibility in DDGS)
- Mixes well into a total mixed ration and the moisture of the product can reduce diet sorting when fed to cows

#### Disadvantages of WDGS

- Higher transportation costs per unit of DM
- Higher storage costs per unit of DM
- Lower concentrations of rumen undegradable protein (same reactions that reduce energy digestibility also reduce protein degradation)
- Not stable, thus spoilage can be very high
- Total diet can become too wet if silages are the predominant forage

Excessive spoilage can negate any cost saving of using WDGS but spoilage can be managed by:

1. **Keeping storage time to a minimum.**
   - Depending on the ambient temperature, spoilage becomes excessive after one or two weeks of storage.

2. **Storing in a plastic bag.**
   - Bagging typically costs around $5/ton of feed but greatly extends shelf life.

3. **Adding preservatives at the distillery.**
   - This service typically costs $3 to $5/ton but can be effective at increasing shelf life.

4. **Ensiling the wet product with other feeds.**
   - Mixtures of WDGS and corn silage or soybean hulls are more stable than WDGS alone if the final mix is not drier than 50% DM. Logistics of mixing the feeds before ensiling may limit the usefulness of this technique.

Table 2. Variation in nutrient composition of dried distillers grains with solubles (DDGS)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Average Concentration</th>
<th>Average CV</th>
<th>Range in CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>30.2</td>
<td>6.4</td>
<td>2.1–10.2</td>
</tr>
<tr>
<td>Fat</td>
<td>10.9</td>
<td>7.8</td>
<td>4.4–10.5</td>
</tr>
<tr>
<td>NDF</td>
<td>42.1</td>
<td>14.3</td>
<td>2.4–23.1</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.89</td>
<td>11.7</td>
<td>3.1–15.3</td>
</tr>
</tbody>
</table>

1Concentrations are in percentage of DM. Twelve samples of DDGS were taken from 10 different distilleries to calculate the coefficient of variation (CV) within each distillery and average CV. Source of data: J. Animal Sci. 80:2638 (2002)
What Are Distillers Grains Worth?

Animals do not require specific feeds; they require nutrients. If the value of nutrients can be determined (for example, rumen undegradable protein is worth so many cents per pound) then the value of a feed can be calculated by summing up the value of its nutrients. The value of nutrients can only be determined using market prices of numerous feeds and these values constantly change. A computer program developed at The Ohio State University is available (SESAME, www.sesamesoft.com) that can calculate the value of nutrients based on current feed prices. This approach is probably the most accurate method of determining whether the market price of distillers grains is a good buy (i.e., the value of its nutrients exceeds the market price), a neutral buy, or a poor buy. However, this method can require a substantial amount of time. A simple method to determine the breakeven price for DDGS that appears reasonably accurate is based on the price of ground corn grain and soybean meal (SBM).

Breakeven price of DDGS ($/ton) =
\[ \{ \text{Corn ($/bu) x 17.85} \} + \{ \text{SBM ($/ton) x 0.5} \} \]

The price for SBM is for SBM with 48% crude protein, and all prices (corn, SBM, and DDGS) are delivered prices.

Example:
Ground corn grain delivered to farm @ $4/bu ($143/ton)
Soybean meal (48% protein) delivered to farm @ $210/ton
Breakeven price for DDGS (assuming average nutrient composition) is:

\[ ($4 \times 17.85) + ($210 \times 0.5) = $176/ton \]

Feeding Distillers Grains to Cattle

All types of cattle can efficiently utilize distillers grains when they are part of a balanced diet. Equal or better performance (rates of gain for beef cattle or milk yield in dairy cows) are usually reported when diets with up to 20% of their DM from distillers grains are compared with control diets (usually the distillers grains replace corn grain and soybean meal). When dietary DM is comprised of more than about 30% distillers grains, DM intake, milk yield, and milk protein concentrations are often reduced.

For dairy cattle, the amount of fat in the distillers grains may be the limiting factor for how much can
be fed without adversely affecting milk yield or composition. If other sources of supplemental fat are not being fed, fat from distillers grains can make up about 2% of the diet. Therefore, dividing 2 by the percentage of fat in the distillers grains (and multiplying by 100) is an estimate of the maximum amount of distillers grains that should be fed. For example, if distillers grains contained 12% fat, then \((2/12) \times 100 = 16.7\); the diet should contain no more than about 17% of its DM as distillers grains DM. The amount of distillers grains (up to the limit) that should be included in the diet is strictly a function of price. If distillers grains are quite inexpensive relative to other feeds, then diets may contain up to about 20% distillers grains. If they are not a good buy, diets do not need to include any distillers grains. The price would have to be quite low, relative to other feeds, to include more than about 20% distillers grains in dairy cow diets because of the likelihood of reduced animal performance.

**Sources for More Information**

Purdue University: Extensive site containing fact sheets on ethanol production and distillers grains (multiple livestock species)
http://www.ces.purdue.edu/bioenergy/

University of Minnesota: Extensive site on ethanol production and distillers grains including feeding guidelines (multiple livestock species)
http://www.ddgs.umn.edu/info-dairy.htm

Illinois Integrated Livestock Focus Team: Web site with information on ethanol production and distillers grains (multiple livestock species)
http://ilift.traill.uiuc.edu/distillers/

Distillers Grains Technology Council: Site with recent information on nutrient composition of distillers grains and nutrient value (multiple livestock species)
http://www.distillersgrains.org/