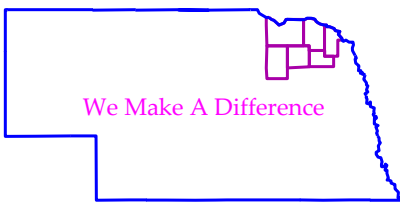


Distillers' Grain Research Report

August 15, 2007



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Resource Conservation & Development Council

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This report is being provided to share information gathered recently from a Distillers' Grain Research project. The project came about after a discussion concerning the marketing of distillers' grain and how ethanol plants could stay competitive with that by-product as more plants come on line.

There are many cattle feeders in Nebraska that could, but are not yet using distillers' grain. Ethanol plant officials said they lacked good data to share with cattle feeders that would give them assurance that the distillers' grain they're buying provides consistent and high quality nutrition they need for their livestock.

Project Partners are:

- Husker Ag LLC Ethanol Plant at Plainview had personnel pull 3 distillers' grain samples weekly for an 11 month period
- Servi-Tech Laboratories analyzed the samples of distillers' grain for dry matter, crude protein, crude fat, phosphorus, sulfur & total starch
- Nebraska Cattlemen's Association provided a nominal cash match
- Antelope County Corn Growers Association also provided a nominal cash match
- Northeast Nebraska Resource Conservation & Development (RC&D) Council, Plainview served as the fiscal agent, handled grant administration & report distribution
- Antelope County Extension assisted with project planning & report distribution

The project was implemented in July 2006 and testing concluded June 2007. It was funded in part by a grant from the Nebraska Rural Development Commission's Agricultural Innovation and Value-Added Agriculture Partnership Act.

We hope you'll find the information valuable.

Sincerely,

/s/

Bud Knuth, President

August 9, 2007

Re: Report on Husker Ag LLC sampling project

There is little known about the average nutrient composition of wet distillers grains plus solubles and variability from loads or days. This project is important to adequately characterize both the average nutrients, but also quantify variation.

There are two measures of variation that are commonly used. Standard deviation can be calculated from a group of samples. A rule of thumb is that 66.7% of the samples fall within the average +/- 1 standard deviation, 95% of the observations fall within the average +/- 2 standard deviations, and essentially all (99%) of the observations fall within the range of average +/- 3 standard deviations. Another common measure of variation is coefficient of variation, or CV. A CV is expressed as a percentage and gives an indication of variability, calculated as the standard deviation divided by the mean, multiplied by 100. In general, a CV of less than 5% would be considered good and not much of a concern assuming there are plenty of samples that were used for the calculation. However, when the average is low (such as with certain minerals), then the CV can be inflated and is likely meaningless.

There were a total of 117 samples analyzed for moisture (or dry matter, DM), crude protein, fat (or oil content), calcium, phosphorus, magnesium, potassium, sulfur, and starch. All of these fall within the ranges that I have typically observed with wet distillers grains. However, this is a modified wet distillers grains plus solubles, therefore the DM should be approximately 42 to 44%. However, the CP, fat, P, and other minerals should be similar to other distillers grains on a DM basis.

Table 1 provides a tabular summary of sampling results for daily samples collected from July, 2006 to June, 2007. Modified distillers averaged 42.6% DM with a CV of 2.6%. This is fairly low variation in DM percentage. Protein is also quite consistent, averaging 28.8 and a CV of 2.7%. Fat, P, and many other minerals were 4 to 5% CV, which are also acceptable variation. The fat content averaging 11.92% and only a 4% CV is good for end-users as that is one of the nutrients contributing energy. Sulfur, starch, and calcium were more variable than other nutrients. However, the only one of any concern would be sulfur, as the starch will not cause any nutritional problems and the calcium variation from the CV is an "artifact" of low averages. Distillers grains is not expected to contain calcium, so variation and the low average are not a concern. Sulfur averaged 0.64% with a CV of 15.7%. Therefore, samples will likely range from 0.44 to 0.84 for 95% of the samples assuming the variation is normally distributed around the mean of 0.64%.

Table 2 and Table 3 are provided as supplemental information. We have been collecting 50 samples per week (10 samples per day, 5 days) in July, 2006 and February, 2007. Similar averages were observed for DM, fat, and P between these two sampling weeks. These nutrients were also quite similar to samples collected during the entire year as presented in Table 1. However, S was slightly greater in these two sampling weeks (0.71 and 0.76%) compared to the annual sampling results (0.64%). Variability was larger for S than other nutrients and CV's were 36.3% for one week in July, 2006, 12.8% for one week in February, 2007, and the samples collected throughout the year had a CV of 15.7%. While S can be a concern, and variation is a challenge, this is likely expected due to procedures used in ethanol plants and varying amounts of sulfur-containing compounds used during ethanol production. Plants should focus on methods to decrease S variation, as well as absolute concentrations of S in distillers grains. Fortunately, fat concentration did not vary greatly with CV's consistently less than 5%. In my opinion, DM (or moisture), fat, and sulfur are the most critical nutrients to quantify for end-users as well the most critical to monitor in terms of variability.

In terms of comparing this plant's data to others, there are no other sources of data to compare to except for the weekly sampling results from Table 2 and Table 3 where other plants are participating. Based on preliminary results from those samplings, there is little difference in variability between Husker Ag and other ethanol plants, but more sampling results will be summarized in the near future.

Please let me know if I can address any questions or if I can help. I can be reached at 402 472-6402 or by email at gerickson4@unl.edu.

Sincerely,



Galen Erickson, Ph.D.
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Table 1. Average and variation associated with nutrient composition of modified wet distillers grains plus solubles from Husker Ag from August, 2006 to June, 2007. All values expressed as a % of DM, except moisture. Coefficient of variation (CV) is probably the best measure of variation, and is expressed as a percentage. CV is calculated as standard deviation divided by the mean.

	AVERAGE	ST. DEV.	CV, %
Moisture	57.37	1.10	1.92
DM, %	42.63	1.10	2.59
CP	28.80	0.78	2.69
Fat	11.92	0.50	4.23
Ca	0.03	0.01	20.2
P	0.83	0.04	5.03
Mg	0.33	0.02	5.02
K	1.04	0.05	4.42
S	0.64	0.10	15.7
Starch	10.31	1.45	14.1

DM = dry matter, CP = crude protein or nitrogen multiplied by 6.25, Fat is a measure of oil content, Ca = calcium, P = phosphorus, Mg = magnesium, K = potassium, S = sulfur, and starch is residual starch measured as glucose.

Table 2. Average and variation associated with nutrient composition of modified wet distillers grains plus solubles from Husker Ag from one week in July, 2006. All values expressed as a % of DM. Samples consist of 50 samples from a 5-day period (10 samples per day).

	AVERAGE	ST. DEV.	CV, %
DM, %	43.93	0.68	1.54
CP	30.87	0.53	1.71
Fat	12.50	0.35	2.78
P	0.83	0.02	2.55
S	0.71	0.26	36.3

DM = dry matter, CP = crude protein or nitrogen multiplied by 6.25, Fat is a measure of oil content, P = phosphorus, and S = sulfur.

Table 3. Average and variation associated with nutrient composition of modified wet distillers grains plus solubles from Husker Ag from one week in February, 2007. All values expressed as a % of DM. Samples consist of 50 samples from a 5-day period (10 samples per day).

	AVERAGE	ST. DEV.	CV, %
DM, %	42.74	0.61	1.42
CP	30.83	0.47	1.52
Fat	11.72	0.22	1.85
P	0.84	0.02	1.98
S	0.76	0.10	12.84

DM = dry matter, CP = crude protein or nitrogen multiplied by 6.25, Fat is a measure of oil content, P = phosphorus, and S = sulfur.



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July 9, 2007

Introduction

Husker Ag, LLC has completed a modified wet distillers' grains (wetcake) study. The study was designed to show the consistency of Husker Ag's wetcake production. It is expected that Husker Ag's wetcake production is pretty consistent. This report includes the testing data and analysis of this data. The costs associated with the testing are included for the purpose of the grant reimbursement. However, these costs are not discussed.

Methods

Sampling Protocol:

The proposed study was designed that three samples per week be taken from Husker Ag's wetcake inventory. The samples were to be randomly taken over the course of the week. It was intended that Husker Ag's staff pull samples Monday, Wednesday, and Friday if possible. If for some reason this did not happen, the samples were to be taken each on a different day approximately three times per week. The product sampled was to be representative of what had been recently produced. The sample was intended to be fresh and from within the wetcake inventory pile. More specifically, the wetcake loader was to remove a payloader bucket of wetcake from the inventory pile that was in near proximity to the wetcake discharge conveyor thus exposing fresh wetcake. The sample was then taken from within the pile in this freshly exposed area. This assured a random test sample. The sample collected for analysis was not intended to represent a composite of a truckload or a composite of a day's production but rather a random check.

Analysis:

Servi-Tech was utilized to perform all wetcake testing. The following tests and their associated methods are included below:

Moisture:	G17 method from the Analytical Methods of the Corn Refiners Association
Crude Protein:	AOAC method 990.03 (Combustion) LECO Analyzer
ADF:	Ankom Company Standard Procedure 1/02
Crude Fat:	Soxtec Apparatus using petroleum ether
Total Starch:	YSI Analyzer Amyloglucosidase
Ca, P, Mg, K, S:	ICAP

Results

Data is represented in the attached table and graphs in the Microsoft Excel file titled Wetcake Study Report. The testing costs are also included in this file.

Discussion

The results of the wetcake consistency study are close to what was expected. Each component of interest will be broken down for further analysis. When looking at the data, the standard deviation predicts a range that a sample should vary from the average. The lower the coefficient of variation, the more consistent the data is.

The moisture number has varied a little more than desired. Overall the variation isn't extreme but the highs and lows need to be eliminated. The standard deviation has been calculated at 1.1 which means that our product consistently varies only +/- 1% from the average. This gives us a 2% window in which the product should vary. Most livestock producers would find this range very acceptable. It should also be noted that the coefficient of variation is also relatively low. One data anomaly that should be discussed is that there was an increase in moisture % in November and the beginning of December. This was a result of a planned moisture increase. The ethanol production process may dictate changes to the co-product for various reasons. When this occurs, the livestock producers using Husker Ag's wetcake should be made aware of these changes so that they can adjust their rations accordingly.

Both the crude protein and crude fat numbers are fairly consistent. These numbers are dependent mostly on incoming corn values and are therefore outside of production control. Both values were fairly consistent. Energy values were measured but were excluded from the report. They are less useful because they are calculated values. This data could be made available upon request.

Sulfur is becoming a critical component to monitor in distillers' grains. The sulfur content fluctuates a little too much but improvement was made towards the end of the study. These improvements were brought about by changing some procedures internally.

The starch number is fairly consistent. The increase in starch content in September and October was due to a malfunction in equipment. The equipment was repaired at the scheduled shutdown in late October. If the cook process is running smoothly, the starch content should fluctuate very little. However, there are a lot of factors affecting cook so this number is a little difficult to manipulate.

In conclusion, this trial was successful. The wetcake seemed quite consistent over nearly a year's time. Moisture and sulfur content could be fine-tuned; however, the wetcake sold by Husker Ag should meet most livestock producers' expectations. There were no major obstacles or challenges to report throughout the trial.

Jenny Forbes
Microbiologist/Lab Manager
Husker Ag, LLC

