National DDGS Library Nutritional Profile

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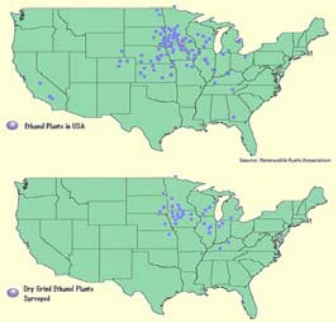
INTRODUCTION

The National Corn-to-Ethanol Research Center (NCERC) established a National DDGS Library based on DDGS samples collected on a quarterly basis from 36 participating ethanol plants. These plants represent one third of the dry-grind plants in the U.S., and their geographical distribution was similar to the national distribution (Fig. 1).

Fig. 1 Distribution of Ethanol Plants

All Plants in the U.S.:



Plants in Survey (36):

We have performed analyses of moisture, crude protein, crude fat, neutral-detergent fiber, fermentable sugars, bulk density, color, and particle size on the respective samples and the nutritional variability of DDGS was investigated.

ANALYTICAL METHODS

The analytical methods used in this study are listed below:

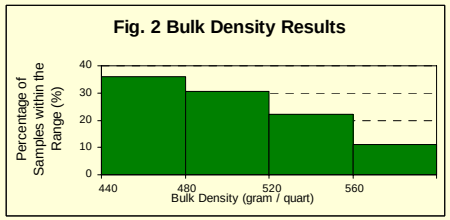
Bulk Density (Quart Kettle)
Color (HunterLab)
Crude Fat (AOAC 945.16, **AFIA recommended**)
Crude Protein (AOAC 990.03, **AFIA recommended**)
Moisture (NFTA 2.2.2.5., **AFIA recommended**)
Neutral Detergent Fiber (AOAC2002.04)
Particle Size (Sieve Shaker analysis)
Starch (modified AOAC 996.11)

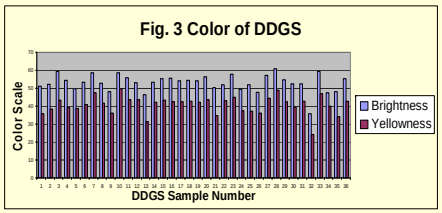
RESULTS

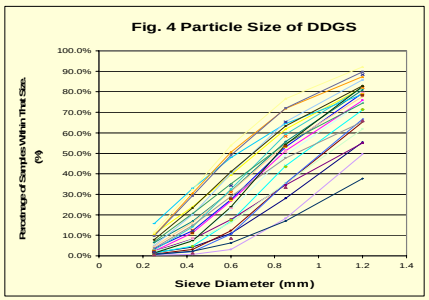
The results of proximate analysis are shown in Table 1 and the data for bulk density, color and particle size are shown from Fig. 2 to Fig. 4.

Table 1. Proximate Analysis of DDGS (N = 36)

Component	Mean ± SD	Minimum	Maximum
Dry matter (%, w/w as received)	89.3 ± 1.3	87.5	93.0
Crude protein (%, w/w dry)	29.9 ± 1.5	27.8	33.3
Fat (%, w/w dry)	11.1 ± 1.2	8.3	13.1
NDF (%, w/w dry)	30.3 ± 3.1	24.4	36.0
Residual sugars (%, w/w dry)	7.9 ± 2.2	4.4	14.7







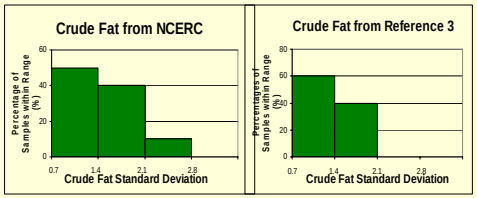
We compared the proximate analysis data generated by NCERC with data published recently (Table 2) (1, 2), both the means and the standard deviations are very close between the two groups.

Table 2. Comparison of Proximate Analysis Data Between NCERC (first column) and Recent Literature (second column)

Component	Mean ± SD	Mean ± SD
Dry matter (%, w/w as received)	89.3 ± 1.3	89.3 ± 1.5[1]
Crude protein (%, w/w dry)	29.9 ± 1.5	30.8 ± 1.5[1]
Fat (%, w/w dry)	11.1 ± 1.2	11.1 ± 1.7[1]
NDF (%, w/w dry)	30.3 ± 3.1	28.1 ± 5.3[2]
Residual sugars (%, w/w dry)	7.9 ± 2.9	8.1 ± 1.6[2]

The variation within ethanol plants in the NCERC data set (13 ethanol plants based on 3 quarterly DDGS samples) is compared with published data (10 ethanol plants with 12 samples from each) (3). The distributions of standard deviations for moisture, crude protein and crude fat are similar between the two studies. Fig. 5 shows the comparison for crude fat data.

Fig.5 Distribution of Standard Deviation of Moisture in DDGS Within Ethanol Plants



DISCUSSION

The potential sources of nutritional variability have been attributed to variation of incoming corn, intentional and unintentional variation of dry grind ethanol plant production processes, and analytical testing methods. The use of recommended analytical methods for DDGS reduced the variability caused by analytical testing, in the following, we examine the impact of the other two factors on the variations of ingredients in DDGS.

Moisture Content: most of the coefficients of variance (CV) are lower than 15% between plants and within plants. Ethanol plants set target maximum moisture level in DDGS (most at 13%). The majority of plants surveyed use rotary drum dryers, and a few use ring dryers.

Crude Protein: most of the CVs are lower than 5% between and within plants. Limited data on incoming corn showed a CV of 4% in crude protein, and 84% of the ethanol plants surveyed reported "no change" in their feedstock source. The crude protein is not sensitive to ethanol production process and is likely controlled by the feedstock.

Neutral Detergent Fiber: the CVs are lower than 10% between plants and within plants. This ingredient is not sensitive to ethanol production process.

Crude Fat: most of the CVs are lower than 15% between plants and within plants. This ingredient could be influenced by thin stillage recycle rate since most of the crude fat stays in thin stillage instead of in wet cake.

Residual sugars: the CVs are lower than 25% between plants. This ingredient is influenced by ethanol production process. Both total sugar level in the drop sample and total amount of uncooked starch have impact on residual sugars in DDGS.

CONCLUSIONS

1. Proximate analysis data from the DDGS Library of NCERC are similar to those published recently.
2. The ingredients of crude protein and neutral detergent fiber have CVs lower than 10% within and between ethanol plants, and those ingredients are mainly influenced by feedstock.
3. The ingredients of moisture, crude fat and residual sugars have CVs up to 25% within and between ethanol plants, and those ingredients are mainly influenced by ethanol production process.

REFERENCES

1. Jerry Shurson, University of Minnesota, http://www.ddgs.umn.edu/profiles.htm
2. Hans Stein, College of ACES, U of I, Swine Focus #001
3. Spiehs et al, 2002. Journal of Animal Science, 80 (2639 – 2645)