

Title: Development of equations to predict the metabolizable energy content of distillers dried grains with solubles (DDGS) samples from a wide variety of sources – **NPB #08-174**

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Scientific Abstract:

The objective of this study was to develop regression equations to predict the metabolizable energy (ME) content of DDGS based on its chemical composition. The study used DDGS samples obtained from 17 sources (ethanol plants) that were chosen to represent the variation in nutrient content currently available to the industry in the US. The mean particle size of the samples (as-received) was $665.8 \pm 284.4 \mu\text{m}$, with a range from 265 to 1557 μm . Consequently, 15 of the 17 samples were ground through a hammermill to a particle size of $344 \pm 36 \mu\text{m}$; 2 of the samples had relatively low initial particle sizes of 265 and 318 μm and were not ground.

The DE and ME contents of 18 experimental diets (a corn-based control and the 17 DDGS sample diets) were measured in a standard energy balance study carried out in metabolism crates. The corn-based control diet contained 89.5% corn supplemented with 8.0% sodium caseinate, 1.0% limestone, 0.65% dicalcium phosphate, and 0.85% minerals and vitamins; for the DDGS diets, 50.4% of the corn was replaced with the respective sample of DDGS. Barrows ($17.2 \pm 0.9 \text{ kg}$ initial BW; $n = 18$) were used in an incomplete block design (block = adaptation/collection period) with the corn-based control diet and each of the DDGS diets being fed to a total of 36 and 8 pigs, respectively. Experimental diets were fed for 7 d consisting of a 4-day adaptation period followed by a 3-day collection period during which total collection of feces and urine was carried out. Gross energy of diets, feces, and urine were determined by bomb calorimetry. Chemical composition (crude protein, crude fat, crude fiber, ADF, NDF, ash, and starch) of each DDGS sample was analyzed by two independent commercial laboratories. Equations to predict the ME content based on chemical composition and particle size after grinding were developed using the R-square selection method of the PROC REG procedure of SAS. To test for differences between laboratories, equations were developed based on the chemical analysis of each laboratory separately and for the average of the results of the two laboratories.

These research results were submitted in fulfillment of the Nutritional Efficiency Consortium research projects.

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There was considerable variation in the energy content and chemical composition of the 17 DDGS samples. For example, the mean GE content was 5311 ± 64.4 kcal/kg DM, with a range from 5,177 to 5,421 kcal/kg DM; equivalent values for chemical composition (average of the results of the two laboratories) were: Ash 4.45 ± 0.51 %, 3.50 to 5.59 %; Crude Protein 30.28 ± 1.28 %, 27.30 to 33.34 %; Crude Fat 11.65 ± 1.53 %, 8.72 to 14.63; Crude Fiber 7.52 ± 0.72 %, 5.87 to 8.87 %; ADF 12.52 ± 2.13 %, 9.12 to 17.90 %; NDF 34.57 ± 6.41 , 25.30 to 43.51 %; Starch 4.74 ± 1.96 , 1.63 to 9.08. There were relatively large differences between the results of the chemical analysis for the two laboratories for a number of the chemical components particularly crude fat (10.51 vs. 12.78 % for Laboratory 1 and 2, respectively), ADF (13.05 vs. 11.98 %, respectively), NDF (28.90 vs. 40.23 %, respectively), and starch (5.49 vs. 3.98 %, respectively).

The DE and ME values for corn determined in the energy balance study were $3,893 \pm 71.4$ and $3,813 \pm 60.6$ kcal ME/kg DM, respectively (Table 4). The DE content of the DDGS samples, determined by the difference method, ranged from 3,663 to 4,107 (mean $3,954 \pm 112.5$) kcal/kg DM and the ME content from 3,381 to 3,876 (mean $3,700 \pm 118.7$) kcal/kg DM (Table 4).

In general, correlations between chemical composition and the DE and ME value of DDGS were relatively weak and differed between the two laboratories. For Laboratory 1, the strongest correlations with DE and ME were for ADF (-0.51 and -0.50, respectively). In contrast, the strongest correlations with DE and ME for Laboratory 2 were for crude fat (0.60 and 0.67, respectively) and crude fiber (-0.56 and -0.52, respectively). Equations to predict the ME of DDGS based on chemical components also differed between laboratories. Equations based on proximate analysis components (ash, crude protein, crude fat, and crude fiber), either individually or in any combination, were relatively poor predictors of ME content. For example R^2 values for the 4-variable equation including all proximate analysis components were 0.33 and 0.58 for Laboratory 1 and 2, respectively. Adding other chemical components to the 4-variable equation based on proximate analysis increased R^2 values. For example, the 7-variable equation that included ADF, NDF, and GE with the 4 proximate analysis components had R^2 of 0.78 and 0.80 for Laboratory 1 and 2, respectively. There was little increase in R^2 values from including additional variables beyond these 7. Equations were developed based on the chemical components other than proximate analysis. For these equations, there was little increase in R^2 values beyond the 3-variable equation which for Laboratory 1 included ADF, NDF, and GE for both laboratories (R^2 of 0.72 and 0.58 for Laboratory 1 and 2, respectively).

This study highlights the large variation that is found in practice in the nutrient composition and energy content of DDGS samples from different sources in the Midwest of the US. In addition, equations have been developed to predict the ME content of DDGS based on chemical composition. A critically important finding is that these equations differed between the two laboratories used for the chemical analysis. As in many situations, the choice of the most appropriate equation to use will be based on a balance between the accuracy of the equation compared to the costs of carrying out the chemical analyses. Equations based on all possible combinations of the chemical components determined in this study are presented in this report to allow individuals to choose the equation that is most appropriate for the particular situation. These prediction equations relate to ground DDGS samples with a particle size within the range 265 to 403. However, further study is required to validate these equations before their widespread adoption can be recommended.