

## ANIMAL SCIENCE

**Title:** Strategies to modify fiber structure and increase digestible energy in corn distillers dried grains with solubles – NPB #17-036

**Investigator:** Pedro E. Urriola

**Institution:** Department of Animal Science, University of Minnesota

**Co-PI's:** Zhikai Zeng and Gerald C. Shurson

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**Scientific abstract**

Volatile fatty acids produced from fermentable fiber contribute to digestible energy (DE) and metabolizable energy (ME) content of high fiber ingredients, while unfermented fiber reduces DE and ME content. Characterizing fiber portions into fermentable and unfermentable fractions may enhance the accuracy of estimating DE and ME content in fiber-rich ingredients. Therefore, the objective of the study was to determine the concentrations of fermented and unfermented neutral detergent fiber (NDF) among sources of corn distillers dried grains with solubles (DDGS) and determine their relative contributions to DE and ME content. A second objective of this study was to increase degradation of fiber in corn DDGS to increase digestibility of energy. For Exp. 1, 15 samples of corn DDGS with known values of apparent total tract digestibility (ATTD) of NDF were selected for their known content of DE and ME. Samples of DDGS (0.5 g) were mixed with fecal inoculum and incubated *in vitro* for 8, 12, and 72 h. Ash corrected NDF (NDFom) content of DDGS residues at each time point were determined. The disappearance coefficients of NDFom were 21.6, 29.0 and 68.6% after inoculated with feces for 8, 12, and 72 h, respectively. The ATTD of gross energy (GE) increased as the unfermented NDF decreased at 8 h (uNDFom8;  $R^2 = 0.83$ ;  $P < 0.01$ ) and 72 h (uNDFom72;  $R^2 = 0.83$ ;  $P < 0.01$ ). Likewise, ME content of DDGS increased with the decreased uNDFom72 ( $R^2 = 0.59$ ;  $P < 0.01$ ). The best fit DE equation was  $DE \text{ (kcal/kg DM)} = 2,175 - 3.07 \times \text{uNDFom8 (g/kg, DM)} - 1.50 \times \text{uNDFom72 (g/kg, DM)} + 0.55 \times \text{GE (kcal/kg DM)}$  [ $R^2 = 0.94$ ,  $SE = 36.21$ ]. The best fit ME equation was  $ME \text{ (kcal/kg DM)} = 1,643 - 2.31 \times \text{uNDFom8 (g/kg, DM)} - 2.54 \times \text{uNDFom72 (g/kg, DM)} + 0.65 \times \text{GE (kcal/kg DM)} - 1.42 \times \text{crude protein (g/kg DM)}$  [ $R^2 = 0.94$ ,  $SE = 39.21$ ]. These results indicate that *in vitro* fermented fiber is strongly negatively associated with GE and NDF digestibility. Therefore, we studied the structural characteristics of fiber in corn DDGS that are associated with unfermented fiber. We used x-ray diffraction to measure crystallinity index of two sources of DDGS with low (44.5%) and high (57.3%) ATTD of NDF. We observed that crystallinity index of

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DDGS with low ATTD of NDF (12.2%) was greater than in DDGS with high ATTD of NDF (9.2%). For Exp. 2, we used ammonia fiber expansion (AFEX) to increase degradation of fiber in corn DDGS. We collected DDGS from two ethanol plants with very distinct processes (A and B). The *in vitro* digestibility of dry matter (IVDMD) was less ( $P < 0.05$ ) in DDGS A and in DDGS B and addition of carbohydrase enzymes did not increase IVDMD. Pretreating DDGS with AFEX increased IVDMD of DDGS A to a greater extent ( $P < 0.05$ ) than DDGS B. There was an interaction ( $P < 0.01$ ) between DDGS sources and AFEX for energy disappearance during fermentation ( $GE_f$ ) and estimated *in vitro* digestible energy (DE) of DDGS. The pretreatment (AFEX) decreased ( $P < 0.05$ )  $GE_f$  in a greater manner for DDGS A (332 kcal/kg DM feed) compared with DDGS B (154 kcal/kg DM feed). However, pretreatment (AFEX) increased ( $P < 0.05$ ) DE in a greater manner for DDGS A (922 kcal/kg DM feed) compared with DDGS B (526 kcal/kg DM feed). Consequently, the AFEX pretreatment increased the DE of both sources of DDGS but the effect was greater for source A. Calculated DE of DDGS A after AFEX 4,502 kcal/kg was greater ( $P < 0.05$ ) than DDGS B 4,225 kcal/kg. In conclusion, composition of fiber varies among sources of corn DDGS. This change in composition of fiber has an impact on the energy value of DDGS; where sources of DDGS with greater content of unfermentable fiber have less energy value because unfermentable fiber appears to decrease digestibility of other dietary components (especially protein and lipids). The reason that some sources of DDGS have less digestible fiber appears to be due to the crystalline configuration of fiber. Pretreating DDGS with ammonia fiber expansion increased digestibility of energy in corn DDGS.