

**Title:** Evaluation of an *in vitro* digestibility procedure for dietary fiber in high fiber feed ingredients fed to growing pigs – NPB #13-014 revised

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**Scientific abstract:** Dietary fiber from distillers dried grains with solubles (DDGS) decreases feed efficiency and nutrient utilization in growing pigs. Current methods that measure the concentration of dietary fiber in feed ingredients such as neutral detergent fiber (NDF) and total dietary fiber (TDF) do not accurately predict utilization of dietary fiber in high fiber feed ingredients by growing pigs. Therefore, the objective of this project was to develop and validate an *in vitro* “nutritional tool” to measure digestibility of fiber among high fiber feed ingredients. A second objective was to measure gut morphology and function of growing pigs fed diets with high concentration of dietary fiber. Wheat straw (WS), soybean hulls (SBH), and corn dried distillers grains with solubles (DDGS) were selected for their high concentration of insoluble dietary fiber and their inherent differences in apparent total tract digestibility (ATTD) of dietary fiber. We selected 16 sources of all 3 ingredients (WS, DDGS, and SBH) to measure *in vitro* dry matter digestibility (IVDMD) after stomach and small intestine hydrolysis (IVDMD<sub>h</sub>), and after inoculating the hydrolysis residues with fecal inocula of pigs fed corn-soybean meal diets for a fermentation of 72 hours (IVDMD<sub>f</sub>). Kinetics of gas production were calculated using a monophasic model, where the amount of gas produced during fermentation (A: mL/g DM incubated), time to half asymptote (B: h), and a constant for the sharpness of gas production (C) were the main response variables. The IVDMD<sub>h</sub> for WS (14.5%) was less ( $P < 0.01$ ) than that of SBH (19.7%), and SBH was less ( $P < 0.01$ ) than that for corn DDGS (55.8%). The IVDMD<sub>f</sub> of WS (41.7%) was less than DDGS (52.7%), which was less ( $P < 0.01$ ) than IVDMD<sub>f</sub> for SBH (68.5%). These differences in IVDMD<sub>f</sub> were also in agreement with greater amount of gas produced for SBH (383.9 mL) compared with DDGS (238.1 mL) and WS (115.6 mL). In addition to these differences among feed ingredients, we also observed a wide range ( $P < 0.05$ ) of IVDMD<sub>h</sub> (45.3 to 63.2%) and IVDMD<sub>f</sub> (41.4 to 64.2%) among sources of corn DDGS. The IVDMD<sub>h</sub> had a strong negative correlation with TDF ( $P < 0.01$ ,  $r = -0.98$ ), NDF ( $P < 0.01$ ,  $r = -0.98$ ), and ADF ( $P < 0.01$ ,  $r = -0.99$ ); but a mild positive correlation with hemicellulose ( $P < 0.01$ ,  $r = 0.36$ ). The IVDMD<sub>f</sub> was not correlated with TDF ( $P = 0.62$ ), NDF ( $P = 0.44$ ), and ADF ( $P = 0.99$ ), but it was negatively correlated with hemicellulose ( $P < 0.01$ ,  $r = -0.49$ ). For kinetics of gas production parameters, asymptotic gas production (A) was negatively correlated to hemicellulose concentration ( $P < 0.01$ ,  $r = -0.55$ ) and positively correlated to IVDMD<sub>f</sub> ( $P < 0.01$ ,  $r = 0.87$ ). Time to reach half asymptotic gas production (B) was positively correlated to TDF ( $P < 0.01$ ,  $r = 0.43$ ), NDF ( $P = 0.02$ ,  $r = 0.35$ ), ADF ( $P < 0.01$ ,  $r = 0.48$ ), and IVDMD<sub>f</sub> ( $P < 0.01$ ,  $r = 0.59$ ), but negatively correlated with hemicellulose ( $P < 0.01$ ,  $r = -0.70$ ) and IVDMD<sub>h</sub> ( $P < 0.01$ ,  $r = -0.45$ ). The C value was negatively correlated with hemicellulose ( $P < 0.01$ ,  $r = -0.46$ ) and positively correlated with IVDMD<sub>f</sub> ( $P < 0.01$ ,  $r = 0.84$ ).

In a second experiment, we measured the impact of insoluble dietary fiber on gut function and morphology. There were differences ( $P < 0.01$ ) in ATTD of DM, GE, CP, EE, and TDF among the 3 types of diets based on WS, SBH, and DDGS.

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The diets containing SBH had greater ( $P < 0.01$ ) ATTD of DM, GE, and TDF than the DDGS diets, which were greater ( $P < 0.01$ ) than observed with the WS diets. The DDGS diets had greater ( $P < 0.01$ ) ATTD of CP than the WS diets, which was greater ( $P < 0.01$ ) than the SBH diets. The WS diets had greater ( $P < 0.01$ ) ATTD of AEE than SBH diets, which was greater ( $P < 0.01$ ) than DDGS diets. In conclusion, these data suggest that among sources of corn DDGS, large differences exist in ATTD of TDF. However, these differences in ATTD of TDF among high fiber feed ingredients can be reasonably predicted using this in vitro procedure which simulates gastric and small intestine hydrolysis, as well as large intestine fermentation and gas production. Additionally, dietary fiber from these feed ingredients affects gut physiology and function in different fashion that it is not predicted by the concentration of TDF or NDF in the diet. Therefore, more detailed information on the carbohydrate structure and interaction with gut epithelium is necessary to improve utilization of high fiber feed ingredients fed to growing pigs.