RESEARCH ABSTRACT
ANIMAL SCIENCE

Title: Gut physiology and metabolomics profile of pigs fed diets with carbohydrases enzymes and distillers dried grains with solubles – **NPB #14-045**

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Scientific abstract: This study evaluated the effects of carbohydrase supplementation to diets with wheat middlings (**WM**) or corn distillers dried grains with solubles (**DDGS**) on growth performance, digestibility of nutrients, cytokine profile and characteristics of intestinal mileu of growing pigs. In Exp. 1, The efficacy of 11 commercially available carbohydrases was evaluated measuring *in vitro* digestibility of nutrients and GE. After incubation of WM and DDGS pretreated with carbohydrases in pepsin and pancreatin, the residues were analyzed for DM and GE. A subset of hydrolysis residues were incubated with fecal inocula and allowed to ferment for 72 h. Compared with no enzyme controls carbohydrases increased ($P < 0.05$) *in vitro* ileal digestibility of DM (3.2%) and GE (4.2%) in WM, but not in DDGS. The concentrations of glucose (73.2 vs. 54.1 mg/dL) and soluble protein (1.27 vs. 1.10 mg/mL) released during hydrolysis were increased ($P < 0.05$) by the addition of carbohydrases compared with the non-enzyme treated WM control, but there was no effect in DDGS. During *in vitro* fermentation, gas and VFA production was less ($P < 0.05$) and took longer ($P < 0.05$) time (6.3 vs. 4.8 h) to reach half assyntote $T/2^{-1}$ in the hydrolysis residue from WM treated with carbohydrases. For DDGS, the total gas production (358 vs. 416 mL/g DM) was less ($P < 0.05$) and $T/2^{-1}$ (13.9 vs. 17.6 h) was increased ($P < 0.05$) in several carbohydrase sources compared with the no enzyme control. The WM control had greater ($P < 0.05$) disappearance of DM (45.1 vs. 49.8%) during fermentation than WM supplemented with 5 out the 11 carbohydrases tested, whereas there were no differences observed among DDGS with or without carbohydrases. In Exp. 2, fifty-four individually housed pigs (25.33 ± 0.41 kg) were blocked by BW and sex and fed 1 of 6 dietary treatments (n = 9) in a 2 × 3 factorial design with 2 levels of carbohydrases (0 vs. 100 mg/kg;1,500 U/g xylanase, 1,100 U/g beta-glucanase, 110 U/g mannanase, 35 U/g galactosidase) and 3 basal diets (corn-soybean control, CSB; CSB + 40% DDGS; or CSB + 30% WM). Titanium dioxide (0.5%) and phytase (1,000 FTU/kg) were added to all diets. Pig BW and feed intake were determined weekly. On d 28, pigs were euthanized and intestinal contents were collected to determine digestibility, pH, and rheology. Pigs fed diets that contained DDGS or WM had less ($P < 0.05$) ADG (755 and 751 g/d, respectively) and ADFI (1,474 and 1,435 g/d, respectively) compared with pigs fed CSB diets (803 g/d and 1,582 g/d, respectively). Carbohydrases tended to improve ($P < 0.10$) ADG (787 vs. 752 g/d) and ADFI (1,529 vs. 1,465 g/d). Pigs fed CSB diets had greater ($P < 0.05$) AID and ATTD of DM, OM, and GE compared with pigs fed DDGS and WM diets. Carbohydrases supplementation improved ($P < 0.05$)

AID of DM, GE and CP and ATTD of ash in WM diets, but not in DDGS or CSB diets. The addition of carbohydrases increased ($P < 0.05$) viscosity of cecal digesta supernatant only in CSB diet, but decreased peak shear stress (14.2 vs. 28.2 Pa, $P < 0.05$) and K (16.6 vs. 20.9 Pa, $P < 0.05$) in jejunum digesta regardless of basal diets. The metabolome of intestinal content was affected by WM or DDGS, but not by carbohydrases. In conclusion, adding DDGS and WM to CSB diets decreased GE and nutrient digestibility and impaired growth performance. Carbohydrases supplementation improved growth performance of growing pigs by modifying rheology characteristics of intestinal contents and modifications to the epithelial immune system.