Feeding 10% of a carbohydrate product derived from Microalgae improved growth (6% greater ADG), feed intake (4% ADFI), and indicators of health (less injectable treatments) of newly weaned pigs compared with conventional diets. We followed this investigation by using LC-MS metabolomics of liver tissues and observed that liver of pigs consuming the microalgae product had less ornithine and arginine than pigs consuming a control diet. These data suggest that microalgae carbohydrates may have a significant impact on amino acid metabolism and benefit young pigs. This is the first time that microalgae derived carbohydrates have been observed to have this effect on liver metabolome, health, and growth of pigs.

doi:10.1093/tas/txy013

Digestibility of fiber differs among sources of corn DDGS, we observed that sources of DDGS with low fiber digestibility had higher crystalline index (a measurement of crystalline configuration of fiber). Likewise, the greater content of undigestible fiber in DDGS, the less digestibility of gross energy, protein, and lipids. Consequently, the greater content of undigestible fiber in DDGS, the less DE and ME in DDGS. Therefore, we treated DDGS with ammonia fiber expansion (AFEX), a process combining pressure, temperature, and alkali treatment. This treatment increased the in vitro digestibility of energy (DE) by 725 kcal/kg DM.

Urriola et al. (2018) Report submitted to the National Pork Board

Improving digestibility of energy in high fiber coproducts continues to be necessary to improving the environmental footprint of pork production. However, dietary fiber in cereal based coproducts are difficult to degrade. We used 11 different types of enzymes commercialized for degrading fiber in an in vitro assay. We observed an increase in fiber degradation in wheat coproducts with primary increase in small intestinal disappearance of dry matter. Nevertheless, total tract dry matter digestibility remained unchanged. These observations suggest that enzymes degrade a rapid fermentable portion of fiber within wheat coproducts which is also degraded by microbes in the large intestine. We did not observe any effects of enzymes on corn coproducts.

In vivo, use of fiber degrading enzymes does not affect energy or nutrient digestibility in growing pigs. However, use of the enzymes does cause changes to gut physiology in spite no changes in nutrient or energy digestibility. These observations indicate that enzymes may have beneficial effects to gut physiology and potentially animal growth and productivity that is not accounted by increase in energy digestibility.

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The power of LC-MS metabolomics continues to help understanding of nutrition. This year, LC-MS metabolomics was used to investigate the events affecting growth of mice while consuming thermally oxidized oil. A significant increase in metabolites involved in tryptophan catabolism and synthesis of nicotinamide in mice consuming thermally oxidized corn oil was observed. We are yet to investigate in detail changes in metabolome of pigs consuming thermally oxidized oil. We have observed a decrease in serum levels of tryptophan. These observations suggest that we may need to revise the requirement for tryptophan of pigs consuming corn oil of variable quality.

doi.org/10.1016/j.jnutbio.2018.04.009

Redox imbalance may be caused by consumption of thermally oxidized oils, but it also may be elicited by consumption of antinutritional factors in feed ingredients. In collaboration with partners from Norway, we observed that pigs consuming rapeseed coproducts had a significant increase in sinapine, sinapic acid, and gluconapin as well as increase in multiple oxidized metabolites and aldehydes in liver and serum. This oxidative state may significantly decrease growth of pigs.

doi:10.1093/jas/sky080

Ethanol plants are in continual evolution generating new feed ingredients and significant changes to nutritional composition of current feed ingredients. We observed significant changes on phytate and phosphorus content among sources of distillers dried grains with solubles. This change in phytase is attributed to the use of phytase to upstream and fermentation processes.

Reis et al. (2018) Ind Eng Chem Res 57:14861-14869
doi: 10.1021/acs.iecr.8b02700
Another trend in ethanol plants is the introduction of grain separation technologies that increase ethanol yield and produce high protein distillers dried grains with solubles (HP-DDGS). Current use of synthetic amino acids and changes in coproduct production appear to affect our ability to include these coproducts at high concentration in diets for young pigs. We recently fed 0, 10, 20, and 30% HP-DDGS to weaned pigs in phase 2 and 3 diets. We observed a linear decrease in body weight (BW) as pigs consumed more HP-DDGS. This decrease in ADG was the result of significant decrease in ADFI, presumably due to a disproportionate increase in Leucine intake.

doi:10.1093/tas/txy101

Gut microbiome is implicated in numerous benefits to humans and animals. However, the metabolic mediators of gut microbiome are still unknown. In this project, we evaluated the impact of antibiotic growth promoter (Tylosin) on gut microbiome and metabolome of commercially raised pigs. Interestingly, pigs consuming Tylosin had greater fecal concentration of hyodeoxycholic acid and this increase was associated to changes in microbes of the Clostridia family.

https://doi.org/10.3389/fvets.2018.00196

Currently, 40% of all food produced is still wasted. While feeding food waste to livestock is not new, there is the necessity to provide accurate nutritional evaluation that enables food waste recycling entrepreneurs to evaluate the value of their products. Likewise, it is necessary to characterize the variability in nutritional composition among sources and other time. We observed that food waste generated upstream of in the supply chain had greater nutritional value and less variability than food waste generated post-consumer. Current equations from the NRC reasonably well evaluate the nutritional value of food waste.

Fung et al. (2018) Transl Anim Sci 3:143-152
https://doi.org/10.1093/tas/txy114