RESEARCH ABSTRACT

ANIMAL SCIENCE

Title: Enhancing nutrient utilization of corn DDGS by feed enzymes in the pig intestine
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Scientific Abstract:

Price and availability of conventional feedstuffs like corn and wheat used in pig diets are widely variable due to the variation in production and ever-increasing demand. This is also because these grains are used in production of ethanol in large quantity. This situation has led to increase in cost of swine diets, affecting the competitiveness of the swine industry. Thus, there is a need for relatively cheap alternatives to the cereal grains. Distiller's dried grain with solubles (DDGS), a byproduct from the ethanol industry is available in U.S. in large quantities. It has a higher content of crude protein (CP), amino acids (AA), fat, fiber, and minerals than parent cereal grains. Inclusion of DDGS in swine diets has been shown to result in significant reduction in cost of swine feeds. Therefore, DDGS can likely serve as a partial alternative to cereal grains in swine diets. However, utilization of DDGS in formulation of swine diets might be limited due to its low digestibility. Non-starch polysaccharides (NSP) like arabinoxylans and mannans are present in high concentration in DDGS. These dietary fibers are not degraded by endogenous enzymes, increase the digesta viscosity and reduce the digestibility of nutrients. Thus, there is need for determining the reason of the lower digestibility of DDGS in pig intestine and way to enhance its utilization in the swine diets.

The overall objective of the study was to explore why the protein and fibers of DDGS are not well digested and to determine the appropriate strategy to enhance their digestion/utilization in the pig intestine. The specific objectives were to characterize the corn DDGS matrix for their nutritional configuration; to determine in vitro digestion and fermentation of corn DDGS without or with enzymes; and to determine ileal and total tract nutrient digestibility in weaner

pigs fed with or without enzyme-supplemented corn-DDGS-based diets.

A corn DDGS sample was analyzed for its nutrient profile along with individual monomers of NSP. Also, the fiber-starch-protein matrix structure of the DDGS was determined using confocal laser scanning microscopy. In vitro enzymatic (pepsin-pancreatin) digestion followed by in vitro gas production technique was used to simulate the digestion and microbial fermentation occurring in the gastrointestinal tract of pigs and to determine the digestibility and fermentability of DDGS in pig gastrointestinal tract. Also 3 different enzymatic treatments (xylanase, mannanse and a combination of xylanase and mannanse) and a control were used in the in vitro fermentation study to determine the effect of enzymes on DDGS utilization in the pig intestine.

An animal study with weaner pigs was conducted to validate the effect of enzymes on the utilization of DDGS in the pig intestine studied in vitro. For the animal study, four experimental diets were formulated consisting of corn, soybean meal and 15% corn DDGS [control, supplemental xylanase (0.01% of diet), mannanase (0.05% of diet), and xylanase + mannanase]. Thirty-two weaner pigs were used in randomized complete block design for a feeding trial of 20 days. Titanium dioxide was blended into the experimental diets (0.3%) as an indigestible marker on day 14. Fecal samples were collected for terminal 3 days to determine apparent total tract digestibility (ATTD). On day 20, digesta samples from ileum, jejunum and colon were collected to measure apparent ileal digestibility (AID), viscosity and pH.

Protein and starch content of the corn DDGS sample was 27.4% and 9.2%, respectively. The total NSP content of corn DDGS was 31.8%, of that 8.2% was soluble NSP. In vitro apparent ileal digestibility (AID) of DM and gross energy of corn DDGS was found to be 65.3% and 63.4%, respectively. The xylanase supplementation resulted in highest amount of gas production in vitro, which is reflection of fermentability of the fiber components of DDGS. It was also revealed by the matrix structure as seen under confocal laser scanning microscope. In vitro fermentation studies revealed that xylanase affected ($P<0.05$) the production of total short chain fatty acid and propionate, whereas, mannanase affected ($P<0.05$) production of butyrate.

There was no effect of supplemental enzymes on growth performance of piglets as 20 days might not have been sufficient to show an effect. Addition of xylanase reduced ($P<0.05$) the viscosity of jejunal digesta (2.1 to 1.5 centipoise), increased AID of total NSP, arabinoxylan and AID of gross energy. Supplementation of mannanase increased ($P <0.05$) the AID of mannans of DDGS but had no effect on AID of cellulose and protein as well as ATTD of gross energy and protein. In conclusion, supplemental enzymes in diets containing DDGS increases degradation of fibers, increases NSP digestibility, and decreases the viscosity of digesta. However, there is variation in the response of different enzymes; xylanase had the best effects

among tested enzymes. Hence, xylanase enzyme can be used to improve the utilization of corn DDGS in the diet of pigs.