4B-107: Processing methods of grains - Extension

Project Leader : Dr Peter Sopade, University of Queensland

Background

Previous research within the Pork CRC has demonstrated that 2-4 MJ/kg of energy in cereal grains is not digested in the small intestine, but fermented in the hind-gut with considerable loss of energy to the pig. Material flowing from the small intestine was shown to consist of intact, large grain particles. Enzyme diffusion rates and therefore digestion rates were found to decrease with the square of particle size, with a 2-fold increase in particle size resulting in a 4-fold decrease in digestion rate. Enzyme diffusion rates were also affected by cereal type, with rates being approximately half for sorghum compared with barley particles of the same size.

Conventional hammer-milling of cereal grains results in a significant proportion of large particles. Hence, sieving off and re-milling large particles was shown to increase the efficiency of feed use by 12-22% in weaner pigs and by 8-11% in grower pigs. The higher values were for sorghum and the lower values for barley.

Methodology

Grain particle size distribution was surveyed in several commercial feed mills and home mixers to determine the effects of mill type on particle size variability and proportion of large particles in commercial pig feeds. An *in vitro* assay was developed to determine the rate of protein digestion in a range of protein meals including field peas, meat meal, soybean meal, sunflower meal and sorghum.

Key Findings/Conclusions

There were large variations in cereal grain particle size distribution between mills. Most mills produced a substantial proportion of ground grains that had particles estimated to be too large for complete digestion in the small intestine of pigs. Hammer mills produced the widest distribution in particle size, whereas roller mills produced the lowest variation in particle size. Roller mills produced the greatest proportion of large particles. Disc mills tended to produce more fine particles than other mills, but size distribution depended greatly on the gap between discs.

An *in vitro* protein assay was successfully developed. The rate and extent of protein digestion was affected by protein source (greatest for meat meal and least for field peas) and also particle size. Protein digestion rate was also inversely related to the square of particle size, but this relationship did not always apply to the mean sample size as it depended on the actual particle size distribution.

A prototype for a cheap, easy to use hand held sieving device was developed and tested at commercial enterprises. A spreadsheet applicable for smart phones and tablets was developed to guide feed millers in the correct direction to improve the particle size distribution of milled products.

Further research is required to better define the threshold maximum particle size for complete digestion in the small intestines for different cereal grains and protein sources.

Potential Users of Information (including value assessment)

Commercial feed millers and piggery home mixers are already enthusiastic about using the manual sieving devise, because of the large improvements in feed conversion efficiency related to the proportion of large particles in feed mixtures.