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Pork CRC Research Summary

1B-102 - Processing methods for improving the utilisation of cereal grains by pigs

Principal Investigator:

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Background:

Maximising the energy available for pig growth from grain-based feeds is at the heart of efforts to enhance the economic efficiency and international competitiveness of the Australian pork industry. This project identified the grain and processing factors that influence energy availability in pigs, and demonstrated a processing route to improve FCR.

Methodology:

1. Identifying the reason grain energy is not fully available in the small intestine
2. Developing a panel of laboratory assays to characterize feeds and digestibility
3. Identifying the factors that determine *in vitro* digestibility
4. Characterising animal performance for feeds predicted to differ in digestibility
5. Identifying, through a comprehensive literature review, potential methods for manipulating feed intake

Key Findings:

1. Grain energy is not fully available in the small intestine due to slowly-digested large particles of grain and fermentation of grains within the small intestine.
2. Assays developed and applied include:
 - a) A robust *in vitro* digestibility method using a commercial glucometer
 - b) Mathematical models to quantify digestion kinetics
 - c) Differential scanning calorimetry to quantify starch gelatinization
 - d) Rapid Visco Analysis to characterize hydration and swelling properties
 - e) Fermentation kinetics *in vitro*, to characterize fermentability of ingredients
3. **Digestion rate is more affected by milling and heat processing than grain type:**
 - a) Large particles are more slowly digested in proportion to their size squared
 - b) Heat processing partially gelatinizes starch & increases large particle digestion
4. **Removing large particles (by sieving and re-grinding) from mash feeds improves FCR for both sorghum (11%) and barley (8%).** Effects for steam-pelleted feed are less (sorghum 5%; barley 3%) but still positive. FCR of re-ground sorghum or barley mash is at least as good as for conventional steam-pelleted feed.
5. Critical factors determining feed intake are the control of the rates of passage and digestion, with hormone and energy status signals integrated in the hypothalamus.

Conclusions:

- Processing outweighs raw material effects in determining grain digestion rates
- Feeds without large (>1mm) particles are most rapidly digested and give low FCR
- Heat processing consistently enhances digestion rates *in vitro*, but if large particles are avoided, the advantage in terms of animal performance may be limited
- Potential use of indigestible fibre in the right proportion and specific undigested nutrients at the ileum to either increase or decrease feed intake

Potential Users of Information (including value assessment):

Grain processors and pig producers to select grain/process conditions for e.g. reduced FCR