Effect of cooking and fermentation of a pig diet on gut environment and digestibility in growing pigs

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Abstract

The effect of pre-feeding treatment of a pig diet on gut environment and digestibility was studied in a double 3×3 Latin-square experiment using growing castrated PVTC cannulated male pigs. The diets were based on local feed resources and were fed raw (R), cooked (C) or naturally fermented (F). There were no differences (P>0.05) in pH and butyric acid concentration of ileal digesta between diets. However, on diet F concentrations of acetic, lactic and propionic acid in ileal digesta were higher (P<0.05) than on diets R and C. The relative proportions of individual organic acids in ileal digesta were not a reflection of the fermentation profile found in diet F. The ileal apparent digestibility of crude protein, crude fiber and NDF were higher (P<0.05) on diet F than on diets R and C. The total tract apparent digestibility of crude protein was higher (P<0.05) on diet F diet than on diets R and C, while there were no differences in total tract apparent digestibility between diets for any other dietary component. In conclusion, when compared with a pig diet in the raw form, fermentation influenced the gut environment and improved the digestibility of some dietary component, while cooking prior to feeding had no measurable effects.

Keywords: Fibre; Organic acids; Pigs; Fermentation

1. Introduction

In Vietnam, due to the high cost of commercial feed, farmers use agricultural products and by-products available at farm level as the main source of feed for pigs. Processing of feed plays an important role in pig production, especially on small-scale farms. Normally, farmers in central Vietnam use cooked instead of raw feed for their pigs, which results in high inputs of labor and fuel, and reduced profits.

Fermentation of food for human consumption has a long tradition in south-east Asian countries, but this technology has yet limited application in the animal production sector. It has been shown that fermented diets may improve growth performance (Scholten et al., 1999) and health (van Winsen et al., 2001) in pigs in comparison with non-fermented diets. Pedersen and Lindberg (2003) found an improvement in the in vitro digestibility of organic matter (OM) and crude protein (CP) due to fermentation. However, limited information is available on the effect of feed fermentation on in vivo digestibility of dietary components.
This study was conducted to determine the effect of cooking and fermentation of a pig diet composed of local feed resources on gut environment and digestibility in growing pigs.

2. Materials and methods

2.1. Animals and experimental design

Six (Large White × Mong Cai) castrated male pigs from the same litter with an initial body weight of 29.8 (± 2.3) kg were fitted with post-valve T-caecum cannulas (van Leeuwen et al., 1991) and used in a double 3 × 3 Latin-square. Each experimental period comprised of 20 days with 12 days for adaptation, followed by 5 days for faeces and 3 days for ileal digesta collection. Pigs were kept individually in cages (1.6 × 0.8 m) which were roofed, had concrete floors and were equipped with water nipples and feed troughs.

2.2. Diets and chemical analysis

The diets (125 g CP and 195 g NDF per kg dry matter (DM)) were based on (g/kg) rice bran (550), maize meal (140), cassava root meal (200), fish meal (100), a mineral–vitamin premix (5) and Cr2O3 (5), and were fed raw (R), cooked (C) or naturally fermented (F). Diet C was prepared every day by mixing the feed with boiled water at a ratio of 1:2, which was followed by boiling and stirring with a cane for 10 minutes. The cooked diet was then allowed to cool prior to feeding and was kept stored during the day in a plastic container covered with a lid. Diet F was prepared in a 15-liter tank and was mixed with warm water (35–40 °C) at a ratio of 1:1. After 72 h of fermentation (room temperature 30–35 °C) in a plastic container covered with a lid, the fermented feed was given to the pigs. Daily feed allowance was 4% of body weight for each individual animal. The pigs were fed two times per day at 07.00 and 18.00 h. Food refusals were recorded daily and were used for correction the feed intake data. Chromium oxide was used as a digesta flow marker and was added at 5 g/kg DM of diet.

Feed, digesta and faeces were dried at 40 °C for 48 h, milled through a 1 mm screen and subjected to chemical analysis as described by Le Van An et al. (2004).

2.3. Statistical analysis

The data were subjected to analysis of variance according to the General Linear Models procedure of the MINITAB Reference Manual Release 14. Tukey pairwise comparisons were used to determine differences between treatment means at \( P < 0.05 \).

3. Results

The DM content (g/kg) in diets R, C and F was 900, 268 and 434, respectively. The pH was lower in diet F than in diets R and C (4.1 vs. 6.1). Diet R contained no organic acids (OA) and only traces were recovered from diet C (0.1 mol/kg DM). In contrast, diet F contained 2.4 mol OA/kg DM, with molar proportions of acetic, lactic and butyric acid corresponding to 0.53, 0.38 and 0.08, respectively. The concentration of propionic acid in diet F was negligible and below detection limits.

Pigs fed diet F had higher concentrations of acetic, lactic and propionic acid, and total organic acids in ileal digesta \( (P < 0.05) \) than pigs fed diets R and C (Table 1), while there were no differences \( (P > 0.05) \) between diets in pH and butyric acid concentration.

The ileal apparent digestibility of CP, crude fiber and NDF were higher \( (P < 0.05) \) on diet F than on diets R and C. The total tract apparent digestibility of CP was higher
(P<0.05) on diet F diet than on the other diets, while there were no differences in total tract apparent digestibility between diets for any other dietary component (Table 2).

4. Discussion

Short chain OA’s are the main end product of microbiotal fermentation in the gastrointestinal (GI) tract of the pig (Jensen, 2001). The concentration of OA in digesta increases along the GI-tract, with lactic acid dominating in the proximal parts and acetic acid in the distal parts (Bach Knudsen et al., 1991; Jensen, 2001). However, the relative proportions of individual OA in ileal digesta may differ in response to dietary properties (Jensen, 2001; Högberg and Lindberg, 2006). In the current study, pH in ileal digesta was unaffected by diet pre-feeding treatment while the concentration of acetic, lactic and propionic acid in ileal digesta was higher on the fermented than on the cooked non-fermented feed. However, the relative proportions of individual OA in ileal digesta was not a reflection of that found in the fermented feed. This suggests that the gut environment and the microbial population were affected by fermentation but not by cooking.

Cooking of the pig diet did not affect any of the digestibility parameters, while fermentation improved the ileal digestibility of dietary fiber fractions and CP. The latter was in agreement with earlier studies and may be due to the impact of microbial activities during fermentation on the diet prior to feeding, in particular affecting the dietary fiber fraction (Pedersen and Lindberg, 2003).

5. Conclusion

When compared with a pig diet in the raw form, fermentation influenced the gut environment and improved the digestibility of some dietary component, while cooking prior to feeding had no measurable effects.

References


