EFFECTS OF β-GLUCAN AND NON-STARCH POLYSACCHARIDES ON ILEAL AND FAECAL ENERGY, NITROGEN, ILEAL APPARENT AND TRUE AMINO ACID DIGESTIBILITY IN THE GROWING PIG

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Abstract

It is generally accepted that soluble non-starch polysaccharides (NSP) in cereals such as barley have a negative influence on the digestibility of energy, nitrogen, and amino acids in broiler chickens. However, the evidence in growing pigs for a similar effect of barley NSP on nutrient digestibility is less convincing. A major reason for this is that detailed investigations into the effect of barley NSP, predominantly β-glucan, have not been conducted. Therefore, the overall aim of this study was to elucidate the effect of NSP from a cohort of Australian barleys on the ileal and faecal digestibility of energy, nitrogen, and amino acids in growing pigs.

This study was a collaborative project with the South Australian Research and Development Institute (SARDI). Eleven Australian barley varieties (including a control barley) were fed as the sole source of protein and energy to Landrace X Large White male pigs (35-55kg) fitted with a T-piece PVC cannula. Celite® was added as the indigestible marker. All diets were cold-press pelleted. Test diets were given to pigs based on a Latin Square design for five days prior to a two day collection period. An enzymically-hydrolysed casein (EHC) diet was fed to pigs for quantitative determination of endogenous amino acid flows at the terminal ileum. Ileal nitrogen, energy, apparent and true amino acid digestibilities were determined with reference to the marker. Faecal nitrogen and energy digestibilities were determined in six of the barley diets that were examined in New Zealand. An experiment with five barley varieties and one control barley was conducted in South Australia, and the same experimental protocol was followed at Massey University.

The range in nutrient composition of Australian barley varieties was 7.6-14.2% CP, 12-21% NDF, 3-6% ADF, 0.5-1.5% Lignin, 2-4% total β-glucan, 0.21-0.34% soluble β-glucan, and 6-12% total amino acids on a dry matter basis. The six barleys that were examined in New Zealand were analysed for NSP and contained 11-17% total NSP, 7-11% insoluble NSP, and 2-7% soluble NSP. The contents of total NSP, soluble NSP, and soluble β-glucan were significantly correlated to CP content in barley ($p<0.01$, $p<0.001$, $p<0.05$, $p<0.01$, respectively).

The ileal and faecal energy digestibilities of the barleys ranged from 53.6 to 71.0% and from 79.2 to 82.5%, respectively. Ileal and faecal nitrogen digestibilities ranged from 52.5 to 76.0% and from 64.3% to 75.6%, respectively. The mean apparent and

true amino acid digestibilities were 69.7% and 84.1%, respectively. The mean endogenous Lysine flow determined under conditions of EHC/Ultrafiltration was 472μg/g dry matter intake.

Correlation analysis between the chemical composition of the barleys and nutrient digestibility found significant positive relationships between ileal nitrogen digestibility and crude protein content ($p<0.05$), soluble β-glucan ($p<0.05$), soluble NSP ($p<0.05$), and faecal nitrogen digestibility ($p<0.05$). Ileal energy digestibility was negatively correlated to insoluble NSP ($p<0.05$). No correlation was found between the chemical composition of barley and faecal nitrogen digestibility, while faecal energy digestibility was negatively correlated with NDF, ADF, and hemicellulose ($p<0.05$). The apparent ileal digestibility of essential amino acids was positively ($p<0.05 - 0.01$) correlated to ileal nitrogen digestibility, whereas no relationship ($p>0.05$) was found between true digestibility of essential amino acids and chemical composition of barley.

Mathematical investigations found that the ileal ($r^2=0.66$) and faecal energy digestibility ($r^2=0.73$) could be predicted from the concentration of insoluble NSP and hemicellulose contents of barleys, respectively. Ileal nitrogen digestibility ($r^2=0.80$) could be predicted from the concentration of CP and faecal nitrogen digestibility. Also, apparent ileal digestible lysine content ($r^2=0.99$) could be predicted from faecal nitrogen digestibility along with the content of lysine in the barley.

The anti-nutritive effects of NSP of Australian barleys were not observed in apparent ileal and faecal digestibilities of energy, nitrogen, and amino acids. However, a consistent tendency of the negative influence ($p<0.05 - p>0.05$) of NSP to true amino acid digestibility was demonstrated.

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