Soluble and Insoluble Non-Starch Polysaccharides on Nutrient Digestibility and Ileal Bacteria Populations in Grower Pigs

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Summary

Soluble (SOL) and insoluble (INSOL) NSP may influence gut bacteria populations, reflecting changes in fermentable material in the gut. Effects of purified (SOL, guar gum; INSOL, cellulose) NSP fractions on ileal bacteria populations and energy digestibility were studied. Pigs surgically fitted with an ileal T-cannula were fed four experimental diets (14% cornstarch basal [control]; 7% SOL NSP [SOL]; 7% INSOL NSP [INSOL]; and 7% SOL+7% INSOL NSP [SOL+INSOL]). Diets were fed for 13 d, ileal digesta was collected under CO_2, and bacteria were cultured on selective media. Overall, NSP increased bacteria counts except for Bifidobacteria. Compared to control, addition of soluble and insoluble NSP reduced energy digestibility from 73 to 39% in the ileum, but only marginally across the total tract. Increasing dietary purified soluble and insoluble NSP reduces nutrient digestibility and subsequently, increases the amount of fermentable dry matter in the small intestine, thereby providing further substrate for ileal bacteria proliferation in grower pigs.

Introduction

Several factors influence microbial growth and its metabolic turnover. Apart from body temperature, which provides optimal growth condition, microbial growth depends on the presence of substrate to be metabolized. The substrate further depends on the number of meals, the composition, structure and technological treatment of the diets, and endogenous digestion processes. Digestion process in the upper part of the gut, digesta flow rate and retention time may influence gut microbial processes. Dietary fibre is usually an integral part of swine diets. An increase in dietary fibre is directly related to a reduction in the amount of available nutrients and energy for the pig. The decrease in nutrient digestibility will increase the amount of undigested organic matter present in the ileum, and subsequently influence ileal microflora populations.

Experimental Procedure

Twelve grower pigs fitted with an ileal T-cannula were used in a two-period

Figure 1. Fibre fractions on energy digestibility

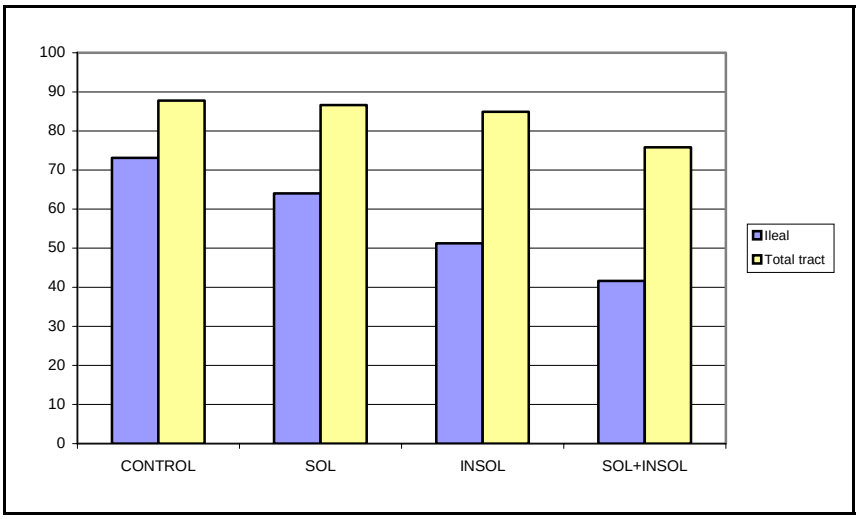

Figure 2. Fibre fractions on crude protein digestibility

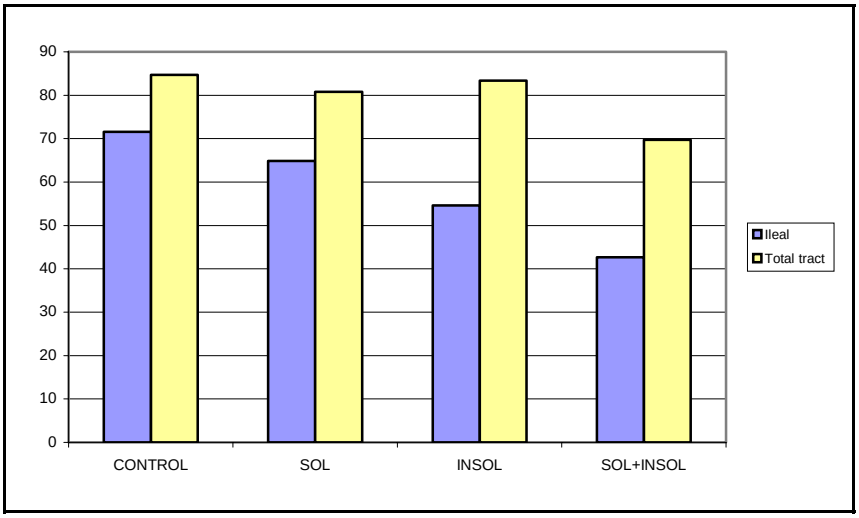

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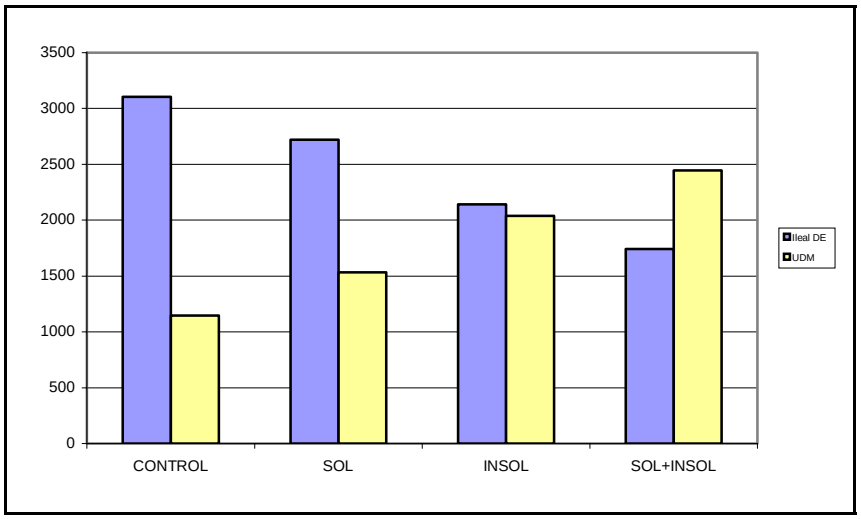
Figure 3. Fibre fractions on ilieal DE and UDM



change-over design, providing 6 pigs per treatment. Pigs were fed experimental diet for 18 d, a 2-d faecal sampling and a 3-d digesta collection for microbial and nutrients digestibility assays. Experimental diets were; 1) corn-soybean meal diet with 14% cornstarch, as a purified carbohydrate source (**control**); 2) control diet with 7% soluble NSP (**SOL**); 3) control diet with 7% insoluble NSP (**INSOL**); and 4) control with 7% soluble + 7% insoluble NSP (**SOL+INSOL**), with purified NSP fraction replacing cornstarch at a 1:1 ratio. The control diet was formulated to 3.5 Mcal DE /kg and 2.4 g Dlys/Mcal DE, and diets were fed at 3 x maintenance based on the control diet.

Results and Discussion

Addition of soluble and insoluble NSP reduced ileal and total-tract energy and crude protein digestibility (Fig. 1 and 2). The ileal DE content decreased with addition of soluble and insoluble NSP, while the amount of undigested organic matter available for microbial fermentation increased with addition of SOL and INSOL NSP (Fig. 3). Lactobacilli, Clostridia, Enterococci and Enterobacteria populations were highest for pigs fed SOL + INSOL compared to pigs fed the control diet (Table 1).

Table 1. Effect of fibre fractions on ilieal bacteria populations

Bacteria, log_{10} cfu/g digesta	Control	SOL	INSOL	SOL+INSOL	SEM
Total anaerobes	7.87[a]	8.12[ab]	8.00[ab]	9.02[b]	0.27
Total aerobes	7.69[a]	8.16[ab]	7.74[a]	8.91[b]	0.30
Lactobacilli	7.58[ab]	8.07[ab]	7.43[a]	8.68[b]	0.34
Bifidobacteria	7.04	7.89	7.12	7.70	0.29
Clostridia	6.75[a]	7.39[ab]	6.43[b]	7.89[b]	0.39
Enterococci	7.39 [a]	7.55[ab]	7.57[ab]	8.63[b]	0.33
Enterobacteria	7.12[a]	7.13[a]	7.46[ab]	8.61[ab]	0.27

SOL = soluble, INSOL = insoluble, SEM = standard error of the mean
[ab]Means within a row with different superscript letter differ (P < 0.05).

Decreased in protein and energy digestibility was due to replacing high digestible carbohydrate with poorly degradable NSP, indicating increased availability of protein and energy in the ileum for the microbes, thereby creating a fertile environment for bacterial to colonize and proliferate readily. In addition, the increase in ileal bacteria populations may be related to increased viscosity associated with adding soluble and insoluble NSP to the diet. High viscosity reduces the interaction between substrate and digestive enzyme, and may reduce the effective absorption of nutrients and subsequently increased organic matter for microbial growth.

Implications

Supplementing high NSP containing diets with NSP degrading enzyme may enhance fibre degradation in the ileum and subsequently improved nutrient digestion and absorption. Also, gut microbial population can be altered by