varying from 18.57% to 46.02%. The greatest reduction in invasion (approximately 80%) was associated with isolates of Lb. salivarius and Lb. murinus. Interestingly, Lb. acidophilus 4, which performed well in the previous assays, was the least effective at preventing Salmonella invasion.

Conclusions: The results of the present study support the potential use of some porcine intestinal LAB as probiotics for the reduction of Salmonella carriage in the pig GIT.

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References:


Effects of commercial feed additives on Porcine intestinal microflora


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Summary: The objective of this study was to assess the effects of commercially available feed additives on the gut microflora of finishing pigs. Pigs received either a barley-based control diet, or an experimental diet supplemented with mannanoligosaccharide (BioMOS™), fumaric acid, or a commercially available acid/salt mixture (Bact-A-Cid™) for four weeks prior to slaughter. Dietary supplementation with fumaric acid (20 g/kg) resulted in the greatest effects on gut microflora composition. Following 28 days of treatment, faecal coliforms and lactobacilli numbers were reduced in the fumaric acid-fed animals (P<0.05). In addition, there was a ten-fold reduction in lactobacilli in the caecum and colon due to fumaric acid treatment (P<0.05). The data indicate that supplementation with fumaric acid caused a desirable change in coliform numbers. However, given that Lactobacillus are considered beneficial microorganisms in the mammalian intestine, the reduction in lactobacilli counts as a result of fumaric acid supplementation warrants further investigation.

Keywords: pigs, gastrointestinal tract, bacteria, acid, mannanoligosaccharide

Introduction: A possible means of controlling carcass contamination with salmonellae and reducing consequent public health concerns, is to reduce intestinal carriage of the organism in finishing pigs by incorporation of additives into the feed. Reduced numbers of pathogenic bacteria in weanling pigs supplemented with organic acids and salts (Canibe et al., 2001; Tsiloyiannis et al., 2001) has been attributed to reduced pH and dissociation of acid molecules in the cell cytoplasm. Dietary supplementation with mannanoligosaccharide (MOS) or D-mannose has been shown to effectively reduce colonisation by Salmonella Typhimurium in broiler chicks (Spring et al., 2000), and Escherichia coli K88 in piglets (White et al., 2002) by reduced adherence of pathogenic bacteria to epithelial cells.
However, relatively few studies have been performed using acidifiers or MOS in pigs during the latter stages of production. The objective of this study was to compare the effects of such feed additives on the faecal and gastrointestinal microbiology of finishing pigs.

**Materials and Methods:** Female pigs were selected at 75 kg, blocked on weight, and assigned to one of four treatments in a randomised complete block design as follows: T1. Control diet (800 g/kg barley), T2. Control diet + 1.5 g/kg BioMOS' (Alltech), T3. Control diet + 3 g/kg Bact-A-Cid' (Agil Products) and T4. Control diet + 20 g/kg fumaric acid. There were a total of eight pigs per treatment. Faecal samples were taken prior to treatment and after 7, 14, 21 and 28 days on trial. The pH values of the samples were recorded. Samples were then diluted 1:10 in maximum recovery diluent (MRD) containing glycerol (40 % (v/v)), and stored at -20 ∞C pending microbiological analysis. At the end of the four-week feeding period, pigs were slaughtered, and gastrointestinal contents were sampled from the pyloric region of the lower ileum, caecum, and ascending colon. Intestinal samples were treated in the same manner as faeces. Microbiological analysis was conducted on faecal and intestinal samples as follows. Coliforms were enumerated on violet red bile agar following incubation at 37 ∞C for 24 h. Bifidobacteria and lactobacilli were enumerated on de Man, Rogosa & Sharpe agar containing 0.05 % (w/v) cysteine hydrochloride and mupirocin (200 mg/ml) and Lactobacillus selective agar, respectively, following anaerobic incubation at 37 ∞C for 72 h. The General Linear Model procedure of SAS was used to analyse the data, and Duncan’s Multiple Range Test was used for separation of means.

**Results:** Results for microbiological analysis of faecal and intestinal samples are shown in Table 1. Faecal coliforms were significantly reduced (P<0.05) by fumaric acid supplementation after 28 days compared with control animals. A significant reduction (P<0.05) in faecal lactobacilli was also seen with fumaric acid after 7 days (data not shown), and this effect remained throughout the trial. At slaughter there was a numerical trend towards lower coliform numbers in the caecum and colon as a result of fumaric acid treatment compared with control animals (P>0.05). In addition, there was a 10-fold reduction in Lactobacillus counts in the caecum and colon of fumaric acid-fed animals compared with all other treatments (P<0.05). Bifidobacteria in intestinal samples remained largely unchanged by treatment. However, a reduction in numbers was observed in the ileum with Bact-A-Cid' supplementation (P<0.05) (data not shown). No differences in pH of intestinal or faecal samples were found (data not shown).

**Discussion:** Our study found that MOS supplementation of finisher pig diets resulted in no significant alterations in faecal or gastrointestinal pH or microbial populations compared with other treatments.
(P>0.05). This agrees with previous results obtained on feeding MOS to weaner pigs (Mathew et al., 1998). It is, however, in contrast to studies performed by White et al. (2002) who found that piglets supplemented with brewers dried yeast as a source of MOS had lower numbers of total coliforms. MOS has also been shown to act as effective antimicrobial agent in experimental infection studies, where animals were challenged with S. Typhimurium, a species known to be mannose-sensitive (Oyofo et al., 1989; Spring et al., 2000). MOS affects gut microflora through the adsorption of bacteria (Spring et al., 2000), and it is likely that the lack of effect of MOS supplementation observed in the present study may be due to a lack of mannose-specific receptors on the cell surface of the species examined (lactobacilli, bifidobacteria, coliform). However, further studies are required to establish the effectiveness of MOS supplementation in reducing carriage of food-borne pathogens in finishing pigs.

Our study found that faecal, but not intestinal coliforms were reduced as a result of fumaric acid treatment (P<0.05). Apart from the effects on health (i.e. reduced diarrhoea), the inclusion of acids and/or salts to the feed/water of finishing pigs may provide a means of reducing carcass contamination at slaughter by reducing levels of intestinal carriage of enteropathogens (van der Wolf et al., 2001). However, the reduction in coliform observed in the present study was also accompanied by a decrease in both faecal and intestinal lactobacilli (P<0.05). Lactobacilli are considered a beneficial intestinal bacterial species, and so the implications of this finding are unknown. It has previously been suggested that this reduction in lactic acid bacteria is due to negative effects on lactic acid fermentation by fumaric acid. An alternative acid such as lactic acid may, therefore be more suitable for the enhancement of Lactobacillus populations (van Winsen et al., 2001).

Conclusions: Fumaric acid supplementation resulted in the greatest modifications in gut microflora, including reduced coliform and lactobacilli numbers. However, these reductions in microbial populations were mainly observed for Lactobacillus spp., bacteria considered potentially beneficial to the animal. Apart from fumaric acid, little evidence of a significant effect on intestinal pH or gut microflora of finishing pigs was observed when diets were supplemented with the additives used. This is likely to be due, in part, to the age and health status of the pigs used in the study.

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References:


