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Effect of dietary oligosaccharides on faecal microbial loads and intestinal morphology of crossbred pigs

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Abstract

An experiment was conducted to assess the effect of dietary herbal oligosaccharides on the blood biochemical parameters, faecal microbial load and intestinal morphology of crossbred pigs. Twenty-four crossbred (Hampshire x Assam local) piglets of average body weight of 12 ± 0.81 kg and about 2 months of age were divided into four treatment groups viz C (basal diet only), T1 (basal diet with oligosaccharide @ 0.1%), T2 (basal diet with oligosaccharide @ 0.2%) and T3 (basal diet with oligosaccharide @ 0.3%). No significant ($P > 0.05$) difference was observed among the treatment groups in respect of total serum protein (g/dl) and blood haemoglobin (g). The faecal coliform count in the treated groups was significantly ($P < 0.01$) decreased than the control group. But, the number of lactobacilli was significantly increased in pigs fed 0.1% (T1) and 0.2% (T2) oligosaccharides compared with the control pigs ($P < 0.05$). There was no significant difference among the treatment groups in respect of total viable count. The villous height in the duodenum were significantly increased by the supplementation of oligosaccharides ($p < 0.01$). The result of this study revealed that the oligosaccharide supplementation in swine diet improves gut health by modulation of intestinal microflora and by increasing the intestinal villous height.

Keywords: Crossbred pigs, oligosaccharides, intestinal microflora and villous height

Introduction

Antibiotic growth promoters (AGPs) have been highly effective at keeping pigs healthy, producing more meat per kilogram of feed. However, the European Union ban on using antibiotic growth stimulators resulted in intensification of research on alternatives to AGPs that could maintain animal health and performance. Among the several bioactive molecules, prebiotic is the front runner as it acts through several physiological activities beginning from gut microflora modulation to cholesterol reduction, immune stimulation, enhanced mineral absorption, antioxidant activities etc. (Samanta *et al.* 2015) [1]. In swine nutrition, prebiotics seem to be functional component with beneficial effects on growth performance, gastrointestinal function, and health. Among food ingredients, non digestible carbohydrates (oligo and polysaccharides) some peptides and protein, certain lipids are candidate for prebiotics and oligosaccharides are the most significant among non digestible carbohydrates. Oligosaccharides have been used to enrich the beneficial microbial populations in livestock. It is well known that oligosaccharides are naturally occurring constituent in plants and vegetable, and the most common sources are onions, Jerusalem artichokes, bamboo shoots, chicory roots and bananas. Commercially available prebiotics are mostly fructooligosaccharides, isomaltoligosaccharides, galacto-oligosaccharides, trans galactooligosaccharides, inulin and oligofructose etc. The present study was conducted to evaluate the effect of Gut Motil AFI powder Indian Herbs Research & supply Co. Ltd) containing oligosaccharides prepared from selected natural herbs, on the blood biochemical parameters, faecal microbial load and intestinal morphology of crossbred (Hampshire x Local) pigs.

Materials and Methods

The experiment was carried out at the department of Animal Nutrition, College of Veterinary Science, AAU, Khanapara. The feeding trial was conducted at the farm of AICRP (MSP) on Pig, College of Veterinary Science, AAU, Khanapara, Guwahati. Twenty-four crossbred (Hampshire x Assam local) piglets of average body weight of 12 ± 0.81 and about 2 months of age were divided into four groups viz C (basal diet only), T1 (basal diet with oligosaccharide

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@ 0.1%), T2 (basal diet with oligosaccharide @ 0.2%) and T3 (basal diet with oligosaccharide @ 0.3%). Completely randomized design was followed for the experiment. The basal diet was prepared for grower and finisher pigs separately by using conventional feed ingredients viz maize, wheat bran, ground nut cake and soya bean meal as per BIS (2001) [2] specification of nutrient composition having 18.21 and 16.42 percent crude protein and 3.195 and 3.164 Mcal ME/kg in grower and finisher ration, respectively. The feeding trial was performed for a period of 182 days. The blood sample was collected from three animals of each group at '0' day (initial), 91 days (middle) and at the end of the experiment to estimate total serum protein and blood haemoglobin. Faecal sample was collected from three animals of each group at the end of the feeding trial to study the faecal microbial load. At the end of the entire experiment, Intestinal tissues were collected from three animals per treatment during slaughter for histological study. All the samples were subjected for Total Viable Count, *E. Coli* and Lactobacilli count by pour plate method described by Cruickshank *et al.* (1975) [3].

Results and Discussion

Detail results of the bacteriological investigation of the faecal samples collected from crossbred pigs of different experimental groups have been presented in the table 1. Statistically, there was no significant difference among the treatment groups in respect of total viable count. The faecal coliform count in the treated groups was significantly ($P<0.01$) decreased than the control group. But, the number of lactobacilli was significantly increased in pigs fed 0.1% (T1) and 0.2% (T2) oligosaccharides compared with the

control pigs ($P<0.05$). The results of present investigation are in good agreement with the reported results of Castillo *et al.* (2008) [4]; Liu *et al.* (2008) [5]; Zhao *et al.* (2014) [6]. In the present investigation, increased faecal lactobacilli and decreased *E. coli* in the treated groups might be due to increased amounts of various fatty acids (acetate, butyrate, propionate and lactate) produced by the fermentation of oligosaccharides which decreases the pH in the large intestine, making the microenvironment unsuitable growth of pathogenic bacteria like *E. coli*.

The differences in intestinal villi in the pigs of different experimental groups can be seen precisely from the Table 1 and Fig.1-4. The villous height were significantly ($p<0.01$) increased by the supplementation of oligosaccharides. The result of the present experiment are in accordance with the findings of Xu *et al.* (2002) [7]; Shim *et al.* (2005) [8] and Liu *et al.* (2008) [5]. The short chain fatty acid (SCFA) production due to oligosaccharide fermentation might be related to the development of intestinal villous and crypts in treated groups. Especially, the butyric acid has high potential to stimulate the growth of epithelial cells in the intestine of pigs by providing energy to the cells. There was no significant ($P>0.05$) difference among the groups in respect of initial and overall average values of blood protein in the post feeding period. The present finding is in good agreement with Rekiel *et al.* (2007) [9], Xu *et al.* (2005) [10]. The average values of blood haemoglobin (g/100ml) observed in pigs of different groups at the overall average values of post feeding period were presented in the Table.1 and found to be within reference level. Similar results also reported by Shim *et al.* (2005) [8] and Rekiel *et al.* (2007) [9].

Table 1: Effect of dietary oligosaccharides on faecal bacterial count (log10cfu/g), duodenal villi height (μm) and blood parameters in experimental pigs

Particulars	Treatment Groups			
	C	T ₁	T ₂	T ₃
Faecal bacterial count (log10cfu/g)				
E. coli	7.23 ^a ±0.17	6.26 ^b ±0.07	6.16 ^b ±0.06	6.31 ^b ±0.10
Lactobacilli	8.38 ^b ±0.16	8.77 ^a ±0.07	8.86 ^a ±0.08	8.71 ^{ab} ±0.07
TVC	9.21 ±0.08	9.18 ± 0.06	9.16 ±0.04	9.18 ±0.03
Duodenal villi height (μm)	428.87 ^d ±11.96	619.45 ^b ±9.92	690.35 ^a ±16.43	554.45 ^c ±17.15
Total serum protein value (g/dl)	7.38 ±0.08	7.39 ±0.11	7.37 ±0.03	7.35 ±0.17
Average blood haemoglobin value (gm%)	12.31 ±0.03	12.29 ±0.19	12.32 ±0.14	12.26 ±0.07

Means in a row bearing different superscripts differed significantly

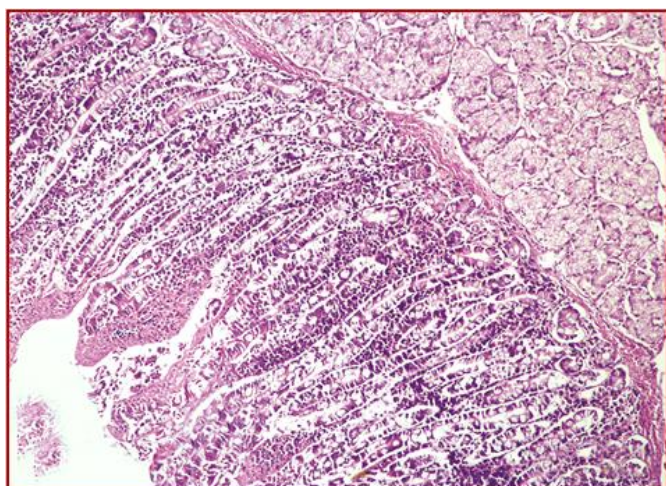


Fig 1: Photomicrograph of Section of Duodenum of Pig of T₁ Group Showing Increased Villous Height (X10)

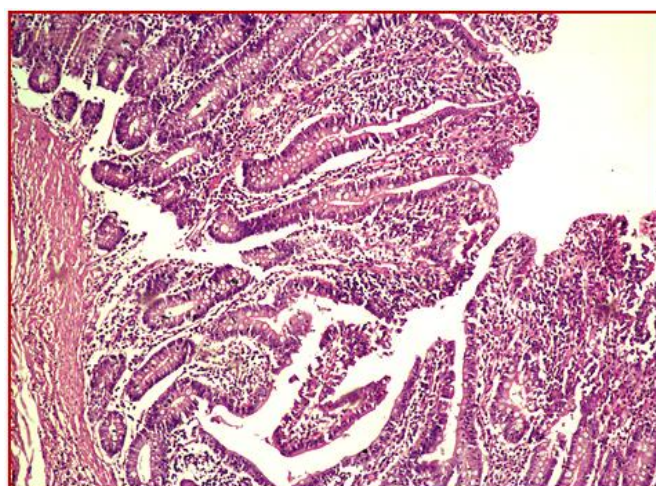


Fig 2: Photomicrograph of Section of Duodenum of Pig of T₂ Group Showing Increased Villous Height (X10)

Conclusion

The present study revealed that the Oligosaccharides supplementation depress the growth of intestinal pathogenic bacteria like *E. coli*, but makes suitable environment for beneficial bacteria like *Lactobacili* and the enterocytes to grow as evidenced by increased length and breadth of the villi and the best effect was observed for the supplementation at 0.2% level.

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