

INTERACTIVE EFFECT OF PREBIOTIC (OLIGOFRUCTOSE) AND PROBIOTIC (SACCHAROMYCES) FEED ADDITIVES ON NUTRIENT UTILIZATION, GROWTH, FEED CONVERSION AND FAECAL MICROBIOTA POPULATION IN PIGS

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ABSTRACT

Prebiotics and probiotics are safe alternative feed additives to in-feed antibiotics in piggery. The combined effect of prebiotic and probiotic has been sparsely studied in pigs. This paper depicts the synergistic effect of prebiotic, fructo-oligosaccharides (FOS) and probiotic, *Saccharomyces cerevisiae* (Sc) on nutrient digestibility, growth, feed conversion efficiency, and faecal microbiota population in 24 weanling Large White Yorkshire x Desi (local) crossbred male pigs with 75% exotic inheritance in the year 2012. The pigs were divided into four groups at random with equal number in each group. Group I pigs were given basal diet alone that served as the control (T₁). Group II pigs were given 1% FOS along with the basal diet (T₂). Group III pigs were given 0.1% Sc (dried yeast) along with the basal diet (T₃). Group IV pigs were given a combination of FOS and Sc, at the earlier mentioned doses for group II and group III animals, respectively (T₄). The results revealed that digestibility coefficient (%) of OM (83.5±0.75) and CP (81.0±1.13), number of days required to attain market weight i.e. 35 kg (71.5±3.86 days), and feed conversion efficiency (2.9±0.14 kg) in T₄ pigs were significantly (P≤0.05) better than in T₁ and T₂ animals. The differences between T₃ and T₄ groups with respect to body weight and FCE were non-significant (P≥0.05). Evaluation of faecal microbiota revealed that the total bacterial count (274.6±39.73), Coliforms (230.6±40.42), and *Salmonella* (305.8±67.25) were significantly (P≤0.05) lower, and *Lactobacilli* (570.4±83.05) were significantly (P≤0.05) higher in T₄ group than the other three groups. This study tends to conclude that the synergy of prebiotic (FOS) and probiotic (Sc) enhanced nutrient digestibility (OM, CP), and stimulated the growth of the benefactor microorganism, *Lactobacilli* with concurrent depression in the growth of potentially harmful pathogens like Coliforms and *Salmonella*, symbolizing better gut health of the host. Probiotic endorsed better growth and FCE than prebiotic under independent administration.

KEY WORDS

Faecal microbiota, Fructooligosaccharides, Pig, *Saccharomyces cerevisiae*

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INTRODUCTION

In pig production, supplementation of in-feed antibiotics is widely practiced around weaning to promote the pace of growth, so as to achieve higher market weight at a short interval of time. But, it endangers the gastrointestinal tract (GIT) environment at its critical period of development, and may potentially result in the development of antibiotic resistance in the host bacteria.

There has been increasing pressure on pig producers to adopt alternative strategies, to eliminate or reduce the use of antibiotics in feed. Among the proposed alternatives, *Saccharomyces cerevisiae* (yeast) is a widely used probiotic feed additive in animal production system, and has been found to promote growth in monogastric domestic animals like pig (Bontempo *et al.*, 2006). Besides, it confers protection against incoming pathogenic microorganisms (Walter, 2008). Its biggest handicap is its elimination from the gastrointestinal tract after cessation of dosing, as it cannot colonize the digestive tract (Auclair, 2001).

Prebiotic like fructooligosaccharide is a non-digestible oligosaccharide that serves as substrate for the nourishment of benefactor microorganisms like *Lactobacillus* and *Bifidobacter*, besides suppression of

potentially harmful pathogens like *Clostridium perfringens* in the intestinal tract of the host (Bornet *et al.*, 2002).

A combination of prebiotic and probiotic can be ameliorative for animal production system. There have been scant studies in this regard in monogastric domestic animals, particularly in pigs. The objective of the present study was to investigate the effect of feeding fructooligosaccharide and *Saccharomyces cerevisiae* (dried yeast), alone or in combination on nutrient utilization, growth, feed conversion efficiency, and faecal microbiota population in growing Large White Yorkshire x Desi crossbred (75% exotic inheritance) pigs.

MATERIALS AND METHODS

This experiment was carried out on Large White Yorkshire x Desi crossbred pigs with 75% exotic inheritance at the university pig farm at Tirupati in the year 2012 on 24 weanling male pigs with an average body weight of 15.8 ± 1.07 kg. The pigs were housed in individual pens, and were fed on a basal diet *ad libitum*, formulated as per NRC (1998) with unlimited access to clean drinking water. They were dewormed before the onset of the experiment. The probiotic, *Saccharomyces cerevisiae* (Sc) and prebiotic, Fructooligosaccharide (FOS) were used in the experiment.

The ingredients of the basal diet was, maize (58%), soybean meal (22%), de-oiled rice bran (17%), mineral mixture (2%), and salt (1%). The chemical composition of the diet, viz., DM, OM, CP, TA, EE, CF, and NFE was 91.9, 89.6, 16.9, 10.4, 2.2, 10.7, and 59.8 percent, respectively.

The pigs included in the experiment were divided into four groups at random, with equal number of pigs in each group. Group I pigs were given basal diet alone (T_1) that served as the control. Group II pigs were given a prebiotic feed additive (1% FOS) along with the basal diet (T_2). Group III pigs were given a probiotic feed additive (0.1% Sc, dried yeast) along with the basal diet (T_3). Group IV pigs were given a combination of prebiotic (FOS) and probiotic (Sc) feed additives, as per the earlier mentioned doses for group II and group III animals, respectively (T_4). The daily feed consumption of the pigs based on the amount of feed offered, and the left over was recorded, along with the body weights at weekly intervals in all the four groups. The faecal bacterial load (counts) were recorded every fortnight from the faecal samples (1-2 g) obtained directly from the rectum under sterile conditions. The experiment was continued for 21 weeks.

One digestion trial was conducted on the animals at about 25 kg body weight under each treatment. The pigs were individually placed in metabolic cages. Group-specific feeds were offered to each group. They had free access to clean drinking water. The pigs were acclimatized to the cages for 3 days, followed by a collection period of 5 days. During the collection period, faeces were collected daily from each pig. The daily feed intake, left over feed, and faeces voided by the animals were recorded. An aliquot of 1/10th of the total faeces voided was preserved for further laboratory analysis.

The diet and faecal samples were analyzed for proximate composition as per AOAC (1995). The data were subjected to one-way classification of analysis of variance (Snedecor and Cochran, 1994) and the means were tested by least significant difference.

RESULTS AND DISCUSSION

Digestibility Coefficient: The digestibility coefficient (%) of nutrients, in pigs of different treatment groups are depicted in Table-1. There were significant ($P \leq 0.05$) differences between the treatment groups with respect to OM and CP. The OM (83.5 ± 0.75) and CP (81.0 ± 1.13) percents were significantly ($P \leq 0.05$) higher in T_4 group

Table-1. Digestibility coefficient (%) of nutrients in different treatment groups.

Factor	T ₁	T ₂	T ₃	T ₄
Dry matter	77.4 ± 1.26	77.2 ± 2.20	80.2 ± 2.31	79.7 ± 2.32
Organic matter *	75.1 ± 2.86 ^b	77.5 ± 2.24 ^b	82.5 ± 2.00 ^b	83.5 ± 0.75 ^a
Crude protein *	74.9 ± 0.86 ^b	77.5 ± 2.24 ^b	80.2 ± 1.30 ^b	81.0 ± 1.13 ^a
Crude fibre	34.2 ± 1.28	42.4 ± 5.34	35.2 ± 0.63	40.7 ± 6.18
Ether extract	73.4 ± 1.53	75.6 ± 1.94	73.6 ± 2.18	77.6 ± 2.72
NFE	81.9 ± 1.59	80.0 ± 1.56	82.5 ± 2.00	83.2 ± 0.71

Note: (1) The figures are presented as Mean ± SEM. (2) Values in a row not sharing common superscripts differ significantly* ($P \leq 0.05$).

than in other three groups, while there were no differences ($P \geq 0.05$) among T₁, T₂, and T₃. Earlier studies have indicated improvement in total tract apparent digestibility in broilers, on diets supplemented with oligosaccharides (Huang *et al.*, 2005; Li *et al.*, 2007).

Growth and Feed Conversion Efficiency:

The growth and feed conversion efficiency of pigs in different treatment groups are depicted in Table-2. There were significant ($P \leq 0.05$) differences between the treatment groups with respect to the number of days taken to reach the target weight (35 kg) and feed conversion efficiency (kg). It was found that T₃ and T₄ animals grew faster ($P \leq 0.05$) and were more efficient in feed conversion ($P \leq 0.05$) than T₁ and T₂ animals. The differences between T₁ and T₂ animals in one hand, and T₃ and T₄ animals on the other hand were statistically non-significant ($P \geq 0.05$).

These results are in agreement with Estrada *et al.* (2001), where in, they reported positive growth response in weaned piglets, supplemented with prebiotic (0.5% FOS) and probiotic (*Bifidobacterium longum*) combination. It could also be due to increased total tract apparent digestibility of major nutrients (CP and OM) in T₃ and T₄ animals (Table-1). Previous studies have also shown improvement in feed intake in broilers, fed with a diet containing Chito-Oligosaccharides (Huang *et al.*, 2005; Li *et al.*, 2007). Moreover, yeast cells contain the cell-wall-oligosaccharides, peptides, and amino acids which may stimulate appetite and improve feed intake (Gao *et al.*, 2008). Further, yeast protein contains nucleotides that stimulate the development of GI tract, resulting in improved appetite (Silva *et al.*, 2009).

Table-2. Growth and Feed conversion efficiency in different treatment groups.

Factor	T ₁	T ₂	T ₃	T ₄
Initial body wt. (kg)	15.4±1.05	15.5±1.13	15.5±1.03	14.6±0.83
Final body wt. (kg)	35.3±0.31	35.5±0.30	35.5±0.36	35.8±0.24
Total body wt. (kg)	20.0±0.90	20.0±1.15	20.0±1.17	21.2±0.78
No. of days *	84.0±2.46 ^a	80.3±3.01 ^b	71.0±3.80 ^c	71.5±3.86 ^c
Av. Daily Gain (g)	237.2±10.27	248.8±11.49	292.3±19.12	303.3±23.32
FCE (kg)*	3.7±0.23 ^a	3.7±0.32 ^a	3.0±0.21 ^b	2.9±0.14 ^b
Av. daily feed intake (g)	997.8±37.33	985.7±44.35	991.0±55.97	981.0±41.15

Note: (1) The figures are presented as Mean±SEM. (2) Values in a row not sharing common superscripts differ significantly* ($P \leq 0.05$).

Table-3. Average faecal bacterial population in different treatment groups.

Factor	T ₁	T ₂	T ₃	T ₄
Total Count *	737.2±60.13 ^a	450.2±78.40 ^b	425.9±36.13 ^b	274.6±39.73 ^c
Coliforms *	839.0±96.00 ^a	656.7±85.77 ^{ab}	620.9±40.57 ^b	230.6±40.42 ^c
<i>Salmonella</i> *	719.2±37.88 ^a	557.3±60.34 ^b	530.2±51.23 ^b	305.8±67.25 ^c
<i>Staphylococci</i> *	57.0±5.29 ^a	37.3±4.09 ^{ab}	44.8±7.90 ^b	24.5±7.23 ^b
<i>Lactobacilli</i> *	219.0±29.08 ^a	276.6±32.50 ^{ab}	365.9±51.14 ^b	570.4±83.05 ^c

Note: (1) The figures are presented as Mean±SEM. (2) Values in a row not sharing common superscripts differ significantly* ($P \leq 0.05$).

Faecal microbiota: The average faecal bacterial count of pigs in different treatment groups are given in Table-3. There were significant ($P \leq 0.05$) differences between the treatment groups with respect to the total counts of Coliforms, *Salmonella*, *Staphylococci*, and *Lactobacilli* bacteria in faeces.

The total bacterial count (274.6±39.73), Coliforms (230.6±40.42), and *Salmonella* (305.8±67.25) were significantly ($P \leq 0.05$) lower, and *Lactobacilli* (570.4±83.05) were

significantly ($P \leq 0.05$) higher in T₄ group than the other three groups. Blomberg *et al.* (1993) have reported high concentration of *Lactobacillus* in pigs, and Li *et al.* (2007) have reported low concentration of Coliforms in chickens fed on FOS supplemented diets. Our result confirmed the report of Bomba *et al.* (2002), who had observed significant increase in *Lactobacillus* spp., and *Bifidobacterium* spp. counts, and significant decrease in *Clostridium* and *Enterobacterium* counts in the faeces of the weanling piglets,

who were administered *Lactobacillus paracasei* (probiotic) in combination with FOS (prebiotic).

CONCLUSION

Our study revealed that combined administration of probiotic (*Saccharomyces cerevisiae*) and prebiotic (FOS) enhanced nutrient digestibility (OM, CP), and gut health, by promoting the growth of *Lactobacilli* and diminishing the growth of potentially harmful pathogens like Coliforms and *Salmonella*.

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