Research Article

Influence of Dietary Supplementation of Certain Probiotics on Growth Performance of Pigs

Mada Bhaskar[1]*, Vasili Ashok[2], K. Aswani kumar[3], K. Adhilaxmamma[4] and A. Ravi[5]

[1]Dept. of Veterinary Clinical Complex, SVVU, Tirupati, Andhra Pradesh, India.
[2]Dept. of Veterinary Biochemistry, SVVU, Tirupati, Andra Pradesh, India.
[3]Dept. of Veterinary Biochemistry, SVVU, Tirupati, Andhra Pradesh, India.
[4]CVSc Tirupati, SVVU, Andhra Pradesh, India.
[5]SVVU, Andhra Pradesh, India.

Abstract

The present study was undertaken to evaluate the effect of probiotics (*Lactobacillus acidophilus* and *Saccharomyces* cerevisiae) individually and in combination on feed intake, body weight gain, feed conversion ratio in growing pigs. Twenty four pigs (75% LWY x 25% DESI), 170 days of age, weighing about 36.1±0.6 kg body weight (BW) were selected and randomly divided into 4 groups of 6 pigs per pen. They were fed with different diets: Basal diet (T1), Basal diet + *Lactobacillus acidophilus* (T2), Basal diet + *Saccharomyces cerevisa*e (T3) and Basal diet + *Lactobacillus acidophilus* + *Saccharomyces cerevis*ae (T4), In this experiment body weights were measured in fortnight intervals for a period of 60 days. At the end of the experimental period significant ($p<0.05$) difference in average daily gain (ADG) and average daily feed intake (ADFI) were observed among various experimental diets T2, T3 and T4 compared with control diet (T1). Pigs fed with combination of probiotics (T4) showed greatest significant ($p<0.05$) increase in ADG and ADFI at the end of the experimental period compared to other treatment diets (T2 and T3) and control diet (T1). The current study demonstrates that the mixture of bacteria and yeast viz., *L. acidophilus* and *S. cerevisiae* has the potential to be used as a probiotic dietary supplement in growing pigs.

Keywords: Growth Performance; Lactobacillus; Saccharomyces; Probiotics; Pigs

***Correspondence**
Author: Mada Bhaskar
Email: drmadabachi5@gmail.com

Introduction

Pork is a very important source of animal protein. It is the most widely consumed meat in the world accounting for 38% of meat production worldwide. Pork is nutritionally rich and palatable human food containing 17% protein and 24% fat. The antibiotics were earlier used as efficient growth promoters in pork production but their use is now condemned due to the adverse effects of antibiotic residues in food products in the development of resistant bacteria. Probiotics, which are live microbial feed supplements, have received attention as suitable alternatives to antibiotics to promote growth in the pig industry. They selectively stimulate the composition, growth and activity of gut microflora thus ultimately improving the growth performance of the animal.

Materials and Methods

The Experimental protocols describing the management and care of animals were reviewed and approved by the animal ethical committee of Sri Venkateswara Veterinary University, Tirupati.

Source of probiotic

The probiotics used in T2, T3 and T4 diets Viz., *Lactobacillus acidophilus* and *Saccharomyces cerevisiae* were procured from AVA BIOTECH, Hyderabad as gratis.

Experimental design and diets

Animals of growth trial were categorized into four groups with three dietary treatments consisting of six pigs in each group. The first group is the control group (T1) fed on a basal diet. In the remaining three groups basal diet was supplemented with probiotic organisms through water as described below during the experimental period of 60 days.

Table 1 Experimental design

Groups	Diets	Number of Animals
Group-I (T1)	Basal diet	6
Group-II (T2)	Basal diet +*Lactobacillus acidophilus*, (1x 10^9 CFU/g) at 0.1%	6
Group-III (T3)	Basal diet + *Saccharomyces cerevisiae*,(1x 10^9CFU/g) at 0.1%	6
Group- IV (T4)	Basal diet + *Lactobacillus acidophilus* (1x 10^9 CFU/g) at 0.1% + *Saccharomyces cerevisiae*, (1x 10^9 CFU/g) at 0.1%	6

Table 2 Ingredients and chemical composition of basal diet

Ingredients	Kg/100 Kg
Maize	60.0
Soybean meal	24.0
DORB	14.0
Mineral mixture (Agrimin)	1.4*
Salt	0.5
Lysine	0.1
Total	100
Chemical composition	%
Dry matter	92.5
Organic matter	91.2
Crude protein	18.2
Crude fibre	7.9
Ether extract	2.6
Nitrogen free extract	62.5
Total carbohydrates	70.3
Total Ash	8.9
Acid insoluble ash	5.4
Calcium	0.74
Phosphorous	1.35
DE kcal/kg	3100
*composition of mineral mixture for kg: cobolt-150 mg, copper-1200 mg, iodine-325 mg, iron-5000 mg, magnesium-6000 mg, manganese-1500 mg, potassium-100 mg, sodium-5.9 mg, sulphur-0.922%, zinc-9600 mg, DL-methionine-1920 mg, L-lysine-4400 mg, calcium-24% and phosphorous- 12%.	

Methods

During the experimental period of 60 days, feed intake, body weight gains and feed conversion ratio were recorded at fortnight intervals. Feed intake was recorded daily during the trial in order to calculate the average daily gain (ADG), average daily feed intake (ADFI), and feed conversion ratio (FCR).

Statistical analysis

The data were analyzed using General Linear Model procedure of statistical package for social sciences (SPSS) 15th version and comparison of means was tested using Duncan's multiple range test [1] and significance was considered at 1% and 5% level of significance ($P<0.01$ and $P<0.05$).

Results

Body weights

Among all the treatments, T4 has highest overall body weight gain of 26.55 ± 0.16 kg while T2 and T3 had 24.83 ± 0.10 and 25.18 ± 0.38kgs respectively. There was significant ($P<0.05$) difference in overall body weight gains of treatment T4 (26.55 ± 0.16 kg) compared to treatment T1 (control) with overall body weight gain of 23.17 ± 0.28 kg were presented in Table 3.

Average daily feed intake

Among all the treatments, animals in T4 have highest overall average daily feed intake of 1025 ± 11.23, while T2 and T3 had 993.3 ± 19.43 and 951.3 ± 18.41respectively. There was significant (P<0.05) difference in overall average daily feed intake of treatments T2 and T4 (993.3 ± 19.43 and 1025 ± 11.23) compared to treatment T1 (control) which showed overall average daily feed intake of 913.3 ± 17.13 were presented in Table 4.

Table 3 Effect of supplementation of different probiotics on body weights (kg) of growing pigs

DAYS	Treatments			
	T1	T2	T3	T4
0	36.0^{a}± 1.37	36.17^{a}±1.11	36.0^{a}±1.06	36.33^{a}± 1.31
15	41.17^{a}± 1.64	42.33^{ab} ±0.88	41.83^{ab}±1.08	43.00^{b}± 1.37
30	47.00^{a} ± 1.98	48.33^{ab}±1.02	47.87^{ab}±1.13	49.33^{b}±1.45
45	53.17^{a}± 1.83	54.83^{ab}±0.98	53.75^{ab}±1.13	55.67^{b}±1.23
60	59.17^{a}± 1.64	61.00^{ab}±1.21	61.18^{ab}±0.68	62.88^{b} ±1.15
Overall weight gain	23.17^{a} ± 0.28	24.83^{ab}±0.10	25.18^{ab}±0.38	26.55^{b}±0.16

^{ab}Means bearing different superscripts in a row differ significantly *(p<0.05)

Table 4 Effect of supplementation of different probiotics on average daily feed intake (g/d) in growing pigs

DAYS	Treatments			
	T1	T2	T3	T4
0-15	690^{a} ± 18.13	790^{b}± 14.02	780^{b} ± 13.93	820^{b} ± 17.45
16-30	780^{a} ± 13.08	830^{ab}± 16.73	822^{ab}± 17.11	870^{b} ± 16.77
31-45	920^{a}± 11.55	990^{b}± 18.12	942^{ab}± 18.50	1010^{b} ± 12.55
46 -60	1040^{a} ± 14.48	1160^{b}± 13.12	1090^{a}± 12.36	1195^{b}± 10.14
Overall	913.3^{a}± 17.13	993.3^{b}± 19.43	951.3^{ab}±18.41	1025^{b}± 11.23

^{ab}Means bearing different superscripts in a row differ significantly *(p<0.05)

Average daily gain

There was significant (P<0.05) difference in overall average daily gain of treatment T4 (422.67 ± 20.15) compared to treatment T1 which showed an overall average daily gain of 386.17 ± 14.59 were presented in Table 5.

Feed conversion ratio

Whereas the feed conversion ratio of growing pigs in treatments T2, T3 and T4 at overall experiment were 2.40 ± 0.06, 2.27 ± 0.02 and 2.32 ± 0.09 respectively. The overall feed conversion ratio was in the range of 2.27 ± 0.02 to 2.40 ± 0.06 across treatments and was not significantly different were presented in Table 6.

Table 5 Effect of supplementation of different probiotics on average daily gain (g/d) in growing pigs

DAYS	Treatments			
	T1	T2	T3	T4
0-15	344.67^{a} ±16.90	410.67^{b}±20.97	388.67^{b}±19.97	444.67^{b}±18.50
16-30	388.67^{a} ±26.80	400.00^{a} ±19.73	402.67^{a} ±22.69	422.00^{a}±16.74
31-45	411.33^{a}±15.58	433.33^{b} ±18.78	392.00^{a} ±21.60	422.67^{b}±20.15
46-60	400.00^{a}±19.20	411.33^{a}±21.15	495.33^{b} ±24.36	480.67^{b}±22.44
Overall	386.17^{a}±14.59	413.83^{ab}±17.00	419.67^{ab} ±21.40	442.50^{b}± 13.77

^{ab}Means bearing different superscripts in a row differ significantly *(p<0.05)

Table 6 Effect of supplementation of different probiotics on feed conversion ratio in growing pigs

DAYS	Treatments			
	T1	T2	T3	T4
0 -15	2.00±0.02	1.92±0.03	2.01±0.08	1.84±0.11
16-30	2.01±0.01	2.08±0.06	2.04±0.07	2.06±0.08
31-45	2.24±0.08	2.28±0.04	2.40±0.05	2.39±0.06
46-60	2.60±0.07	2.82±0.02	2.20±0.04	2.49±0.04
Overall	2.37±0.10	2.40±0.06	2.27±0.02	2.32±0.09

n=6

Discussion

Effect of dietary supplementation of probiotics on growth

The overall body weight gain was 23.17 ± 0.28 kg in T1 group compared to 26.55 ± 0.16 kg in T4 group. There was significant (P<0.05) increase in body weight gain of treatments T2, T3 and T4 when compared with control highest being in T4 indicating beneficial role of probiotics in weight gain. From the data it was also clear that feeding pigs with Basal diet + *Lactobacillus acidophilus* (1x 10^9 CFU/gm) at 0.1% + *Saccharomyces cerevisiae*, (1x 10^9 CFU/gm) at 0.1% gave better weight gain.

[2] also observed significant increase in body weight gain with supplementation of *Saccharomyces cerevisiae* (3-5 x 10^6 cfu/g) and *Lactobacillus acidophilus* (2-3 x 10^9 cfu/g) in the diet of post weaning piglets aged 28 days for a period of 140 days.

The annual report of AICRP on pigs [3] pertaining to the growth performance of 75% Large White Yorkshire crossbred pigs (21st generation I, II and III crop) revealed mean body weight of 34.46 ± 0.12 at 5 months age and 60.24 ± 0.19 at 7 months age and the mean overall post weaning growth rate (g/d) was 290.86 ± 1.33. Whereas in 2017-18 (22nd generation, I crop), the mean body weight was 35.53 ± 0.26 at 5 months age.

Effect of dietary supplementation of probiotics on average daily feed intake

There was significant (P<0.05) difference in overall average daily feed intake of treatments T2 and T4 (993.3 ± 19.43 and 1025 ± 11.23) compared to treatment T1 (control) indicating the increased digestibility of nutrients in diet which may be due to increased enzyme activity in the intestine due to probiotics.

The results of average daily feed intake reported in our study are in accordance with the findings of support the finding of [4], reported that pigs fed diets with lactobacilli complex (*L. acidophilus*, 4 × 10^6cfu/g; *L. plantarum*, 2 × 10^6cfu/g; and *L. plantarum*, 7 × 10^6 cfu/g) had higher ADFI from day 1 to 14. Those studies showed that *L. acidophilus* or lactobacilli complex had beneficial effects on growth performance in weaning pigs. The addition of lactic acid complexes comprising combinations of strains *Enterococcus faecium* 6H2 (3 x 10^8 CFU g -1 versus control 5 x 10^8 CFU g -1), *Lactobacillus acidophilus* C3 (4 x 10^6 CFU g-1 versus control 6 x10^6 CFU g -1), *Pediococcus pentosaceus* D7 (3 x 10^6 CFU g-1 versus control 5 x 10^6 CFU g-1), *Lactobacillus plantarum* 1K8 (2 x 10^6 CFU g-1 versus control 4 x 10^6 CFU g -1) and *Lactobacillus plantarum* 3K2 (7 X 10^6 CFU g-1 versus control 9 x 10^6 CFU g-1) improved daily feed intake of pigs significantly (p<0.01) as compared to the control.

Effect of dietary supplementation of probiotics on average daily gain

There was significant (P<0.05) difference in overall average daily gain of treatment T4 (442.50 ± 13.77) compared to treatment T1 which showed an overall average daily gain of 386.17 ± 14.59.

Performance of 75% Large White Yorkshire crossbred pigs (21st generation I, II and III crop) in terms of post weaning growth rate (g/d) was 290.86 ± 1.33. Annual report of AICRP on pigs[5]. However much higher growth rates were observed in the present study in the growing pigs of all the treatments which could be because of the supplementation of diet with probiotics in groups T2, T3 and T4.

Our findings are in accordance with that of [6] obtained similar results having significantly higher ADG (P < 0.05) with supplementation of probiotics in the basal diet of 28 days old post weaned piglets during the experimental period of 20 weeks. The ADGs were 523.73 g in *Saccharomyces cervisiae* group, 520.04 g in *Lactobacillus acidophillus* compared with 451.04 g in control group.

The results of [7] showed significant increase (P < 0.05) of ADG (0.77 kg/d) in growing pigs treated with a mixture of *Bacillus subtilis*, *Saccharomyces boulardi* and Lactic Acid Bacteria (LAB) complex when compared to control (0.73 kg/d) whereas no significant effect was observed when treated with *Bacillus subtilis* alone or a combination of *Bacillus subtilis* and *Saccharomyces boulardi*.

[8] studied the effect of *Enterococcus faecium* supplementation in the basal diet of growing pigs on ADG and the results are in agreement with the present study depicting significant increase (P < 0.05) in the value from 697 g/d in probiotic treated group when compared to 632 g/day in control group during the experimental period of 6 weeks. The effect of probiotic supplementation on ADG was more prominent with high energy and nutrient density diets in contrast to low energy and nutrient density diets.

[9] reported that dietary supplementation with 0.1% or 0.2% of *L. acidophilus* had higher ADG from day 1 to 28. The inclusion of *L. acidophilus* led to a higher ADG compared to those fed non-supplemented diet during day 15–42 and day 1–42 [10].

Effect of dietary supplementation of probiotics on feed conversion ratio

Feed conversion rate is a ratio or rate measuring of the efficiency with which the bodies of livestock convert animal feed into the desired output. The overall feed conversion ratio was in the range of 2.27 ± 0.02 to 2.40 ± 0.06 across treatments and was not significantly different (Table 6) in the present study. Age is most important determinant of FCR and in general FCR gradually increases (gets worse) as the pig grows older.

According the annual report of AICRP on pigs[11] the performance of 75% Large White Yorkshire crossbred pigs (22^{nd} generation I crop) overall feed conversion efficiency was 2.98±0.58.

[12] obtained similar results. The FCRs at the end of 18 weeks trial in 24 weeks aged growing pigs were 0.277 and 0.236 in probiotic and control groups respectively. The feeding of probiotic had no significant influence at the end of the experiment conducted for the duration of 18 weeks.

The effect of *Bacillus subtilis* endospore and *Clostridium butyricum* endospore complex supplementation in high energy and high nutrient density diets of growing pigs for a period of 10 weeks had no significant difference in FCR (0.401) compared to non probiotic supplemented group (0.390) [13]. [14] showed no significant difference in FCR with growing-finishing pig diets supplemented with *Bacillus subtilis* (2.50), *Bacillus subtilis* with *Saccharomyces boulardi* (2.47) and the mixture of *Bacillus subtilis*, *Saccharomyces boulardi* and LAB (2.41) compared to control (2.56) during the experimental trial of 75 days.

The values of FCR obtained in the present study are in accordance with those of other researchers and the results are in agreement with them implicating non- significant effect of probiotics on FCR.

Conclusion

In present study a significant ($P<0.05$) difference in average daily gain (ADG) and average daily feed intake (ADFI) and without any significant difference in feed conversion ratio (FCR) were observed among various experimental diets T2, T3 and T4 compared with the control diet (T1). Among the treated groups, pigs fed with probiotics in combination (T4) showed significant ($p<0.05$) increase in ADG and ADFI when compared with other probiotic diets (T2 and T3) and control diet (T1).

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