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## Comparative studies on probiotic, prebiotic, synbiotic and garlic supplementation on growth performance of broilers

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### Abstract

The present experiment was conducted to investigate the effect of dietary supplementations of Probiotic, Prebiotic, Synbiotic and Garlic on growth performance, feed consumption, FCR, carcass traits and mortality percentage in broiler chickens up to six weeks of age. Three hundred seventy-five (375) straight run Vencobb broiler chickens were selected for the study and randomly assigned to five dietary treatment groups, Group T<sub>0</sub>-(Control), T<sub>1</sub>-0.01% Probiotic (100g/ton). T<sub>2</sub>-0.025% Prebiotic (250g/ton). T<sub>3</sub>-0.05% Synbiotic (500g/ton) and T<sub>4</sub>-0.30% Garlic powder (3kg/ton), fed along with standard broiler ration. At 6<sup>th</sup> week of age, the highest weekly body weight gain was observed in Garlic supplemented group followed by Synbiotic, Probiotic, Prebiotic and standard broiler ration group, respectively.

**Keywords:** Carcass traits, feed additives, garlic, growth performance, mortality, prebiotic, probiotic, synbiotic

### Introduction

Over recent decades the poultry industry has made tremendous adjustments to meet the increasing demand for inexpensive and safe supply of meat and eggs. Over the past three decades, the poultry sector has been growing at more than 5 percent per annum and its share in world meat production increased from 15 percent three decades ago to 30 percent currently (FAO, 2006) [18]. Poultry industry has been transformed into a strong, dynamic agro-based farming activity (Rama Rao and Sharma, 2007) [12]. Various kinds of feed additives that can be used as growth promoters are now available in the market at reasonable prices such as probiotic, prebiotic, synbiotic, etc.

Probiotics has been defined as "live or dead microbial culture which beneficially affects the host by improving its intestinal microbial balance". The term probiotic stems from the Greek and means 'in favour of life' its antonym is antibiotic which means 'against life' (Coppola and Turnes, 2004) [2]. Prebiotics has been defined as non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and activity of one or more limited number of bacteria in the colon and thus improves host health (Panda *et al.*, 2007) [10]. Synbiotic is a synergistic combination of probiotic and prebiotic or feeding probiotic microorganism together with prebiotic substances (Panda *et al.*, 2007) [10]. There would be an improvement of the intestinal environment for the process of digestion and absorption of nutrients (Pelicano *et al.*, 2004) [11]. Garlic (*Allium sativum*) flavour of the ages, for centuries garlic was valued as a medicinal herb, it has been recognized for both its culinary qualities and variety of medicinal properties. *viz*; antibiotic, antifungal, antiseptic, antioxidant, Cholesterol reduction, lowering LDL and increasing HDL, natural anticoagulant and antihypertensive etc. Garlic meal is an antibiotics alternative growth promoter (Gary and Biing, 2000) [4]. All these four additives, more or less, serves the same purpose of maintaining gut health, directly or indirectly.

Considering the importance of these supplementation, The present study was designed with the inclusion of Probiotics, Prebiotics, Synbiotics and Garlics as feed additives to study their effect on the growth performance of broiler chickens.

### Material and Methods

The present study was conducted at Department of Livestock Production and Management, College of Veterinary and Animal Sciences, Parbhani, Maharashtra, India during the period of 42 days from May to June 2007.

The 375-day old straight run Vencobb strain chicks were selected and randomly distributed in Treatment groups as; T<sub>0</sub>-(Control-without feed additive), T<sub>1</sub>-0.01 percent probiotic (100g/ton feed), T<sub>2</sub>-0.025 percent Prebiotic (250g/ton feed), T<sub>3</sub>-0.05 percent Synbiotic (500g/ ton feed) and T<sub>4</sub>-0.30 percent Garlic powder (3kg/ton feed), respectively with three replication of 25 chicks in each group. The standard broiler ration as starter and finisher ration with crude protein 22.973 and 19.981 percent, and metabolizable energy 2883.59 and 2974.69 (Kcal/kg), respectively was fed to all the Broilers. The parameters under study were growth performance, feed intake, feed conversion ratio (FCR), carcass characteristics and mortality of the broiler birds during the experiment. The experimental data of the birds was recorded up to 6 weeks (42 days) of age on daily basis and presented at weekly intervals. The analysis of generated data was done using Complete Randomized Design (Panse and Sukhatme, 1967).

## Results and Discussion

The data on the Growth performance, Feed consumption, feed conversion ratio (FCR), Carcass characteristic and mortality percentage is discussed as below

### Growth Performance

The effects of dietary supplementations of probiotic, prebiotic, synbiotic and garlic on growth performance are summarized in Table 1. At 6<sup>th</sup> week of age the weekly body weight of T<sub>0</sub>(control), T<sub>1</sub>(Probiotic), T<sub>2</sub>(Prebiotic), T<sub>3</sub>(Synbiotic) and T<sub>4</sub>(Garlic) were 1768.0, 1905.9, 1873.9, 1958.4 and 2021.9g, respectively. It was observed that the T<sub>4</sub>(Garlic) supplemented birds showed highly significant ( $p < 0.01$ ) weekly body weight gain up to the 6<sup>th</sup> weeks of age, followed by T<sub>3</sub>(synbiotic), T<sub>1</sub>(probiotic), T<sub>2</sub>(prebiotic) and T<sub>0</sub>(control) birds. At the end of the experiment it was statistically observed that the feed additive supplemented groups showed better feed efficiency as compared control group supplemented only with standard broiler ration.

**Table 1:** Weekly body weight (g) gain in Probiotic, Prebiotic, Synbiotic and Garlic treated groups.

Treatments	Age	Age (in weeks) (Mean ± S.E.)					
		1	2	3	4	5	6
T <sub>0</sub>		155.96±3.53 <sup>a</sup>	392.96±9.37 <sup>a</sup>	695.96±17.28 <sup>a</sup>	1043.0±19.26 <sup>a</sup>	1400.0±27.81 <sup>a</sup>	1768.0±35.79 <sup>a</sup>
T <sub>1</sub>		161.58±3.71 <sup>ab</sup>	418.58±10.66 <sup>ab</sup>	757.25±20.15 <sup>ab</sup>	1125.9±20.87 <sup>b</sup>	1489.2±32.88 <sup>ab</sup>	1905.9±39.16 <sup>b</sup>
T <sub>2</sub>		163.22±3.76 <sup>ab</sup>	425.89±9.79 <sup>b</sup>	749.89±18.94 <sup>ab</sup>	1108.2±19.96 <sup>b</sup>	1485.9±29.74 <sup>ab</sup>	1873.9±37.34 <sup>ab</sup>
T <sub>3</sub>		160.71±3.72 <sup>ab</sup>	429.71±10.29 <sup>b</sup>	796.38±19.62 <sup>bc</sup>	1136.4±21.62 <sup>b</sup>	1538.4±30.58 <sup>bc</sup>	1958.4±37.92 <sup>bc</sup>
T <sub>4</sub>		168.93±3.78 <sup>b</sup>	450.60±11.00 <sup>b</sup>	836.26±19.13 <sup>c</sup>	1170.3±21.68 <sup>b</sup>	1594.9±31.72 <sup>c</sup>	2021.9±38.31 <sup>c</sup>
'F' value		1.60 <sup>NS</sup>	4.14 <sup>*</sup>	7.66 <sup>**</sup>	5.18 <sup>*</sup>	5.57 <sup>*</sup>	6.73 <sup>**</sup>

Means bearing different superscripts (<sup>a,b</sup>) differ significantly ( $*p < 0.05$ ), ( $**p < 0.01$ ) in a column

These results are in agreement with earlier studies of Maiorka *et al.* (2001)<sup>[7]</sup> and Flemming *et al.* (2004)<sup>[3]</sup> recorded that the effect of the inclusion of prebiotic, probiotic, cell wall, yeast cultures (synbiotic) and different oligosaccharides improves the body weight gain and shown significant effects with supplementation of feed additives over unsupplemented groups. The dietary garlic supplemented group had slightly better ( $p > 0.05$ ) weight gain and final live weight than those on the control diet (Ademola *et al.* 2004)<sup>[1]</sup>. Maiorka *et al.* (2001)<sup>[7]</sup> observed lowest live weight gain in broilers whose diet was not supplemented by any additive.

### Feed consumption

The data of comparative cumulative feed consumption in all the groups is presented in Table 2. At the age of 6<sup>th</sup> week the weekly cumulative feed consumption in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were 3439.70, 3430.70, 3371.70, 3476.30 and 3493.30 g, respectively. The highest weekly cumulative feed consumption was observed in T<sub>4</sub> followed by T<sub>3</sub>, T<sub>0</sub>, T<sub>1</sub> and T<sub>2</sub> at 6 week of age. Feed intake of broilers did not differ significantly between experimental groups throughout the experiment.

**Table 2:** Weekly Cumulative feed consumption (g) in Probiotic, Prebiotic, Synbiotic and Garlic treated groups.

Treatments	Age	Age (in weeks) (Mean ± S.E.)					
		1	2	3	4	5	6
T <sub>0</sub>		169.67±3.06	517.67±10.78	1053.30±20.87	1719.00±27.94	2533.70±37.16	3439.70±47.12
T <sub>1</sub>		174.00±3.19	520.33±11.82	1044.70±21.95	1714.70±30.79	2525.30±40.38	3430.70±49.66
T <sub>2</sub>		163.67±3.12	494.67±12.67	1031.00±22.64	1691.00±31.24	2473.00±40.17	3371.70±49.97
T <sub>3</sub>		173.00±3.28	518.67±13.48	1066.30±22.83	1734.70±31.56	2551.00±40.16	3476.30±50.31
T <sub>4</sub>		179.00±3.21	530.67±14.34	1085.3±23.72	1753.00±32.11	2579.30±41.54	3493.30±50.47
'F' value		3.18 <sup>NS</sup>	1.09 <sup>NS</sup>	0.85 <sup>NS</sup>	0.56 <sup>NS</sup>	0.96 <sup>NS</sup>	0.94 <sup>NS</sup>

These results are in agreement with Yadav *et al.* (1994)<sup>[17]</sup>, Megharaja *et al.* (1996)<sup>[8]</sup>, Flemming *et al.* (2004)<sup>[3]</sup>, Kannan *et al.* (2005)<sup>[5]</sup>, Sartori *et al.* (2005)<sup>[14]</sup> observed slightly higher feed intake feed additives supplemented Groups but the difference was found non-significant with un supplemented groups. Ademola *et al.* (2004)<sup>[1]</sup> had found slightly better ( $p > 0.05$ ) average feed intake in Garlic and Ginger supplemented broiler birds than those in non-supplemented group.

### Feed conversion ratio (FCR)

The data of comparative cumulative feed conversion ratio

(FCR) of broilers is presented in Table 3. At 6 week the weekly FCR of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were 1.994, 1.841, 1.841, 1.817 and 1.766 g, respectively. The weekly FCR did not differ significantly between treatment groups for most of the weeks but shown significant ( $p < 0.05$ ) difference at 3<sup>rd</sup> and 6<sup>th</sup> weeks of age. The lowest cumulative feed conversion ratio was observed in groups T<sub>4</sub> followed by T<sub>3</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>0</sub> treatment groups, respectively at the weeks. The mean weekly cumulative feed conversion ratio of T<sub>4</sub> was significantly lowest at 6<sup>th</sup> week of age.

**Table 3:** Weekly cumulative feed conversion ratio (FCR) (g) in Probiotic, Prebiotic, Synbiotic and Garlic treated groups.

Age Treatments	Age (weeks) (Mean ± S.E.)					
	1	2	3	4	5	6
T <sub>0</sub>	1.498±0.039	1.479±0.041	1.613±0.044 <sup>b</sup>	1.719±0.036	1.867±0.041	1.994±0.037 <sup>b</sup>
T <sub>1</sub>	1.462±0.042	1.384±0.043	1.461±0.047 <sup>a</sup>	1.582±0.037	1.745±0.046	1.841±0.040 <sup>a</sup>
T <sub>2</sub>	1.372±0.046	1.294±0.044	1.459±0.051 <sup>a</sup>	1.588±0.038	1.714±0.045	1.841±0.039 <sup>a</sup>
T <sub>3</sub>	1.479±0.041	1.346±0.046	1.422±0.050 <sup>a</sup>	1.588±0.038	1.710±0.043	1.817±0.040 <sup>a</sup>
T <sub>4</sub>	1.421±0.048	1.302±0.046	1.368±0.049 <sup>a</sup>	1.555±0.037	1.662±0.042	1.766±0.039 <sup>a</sup>
'F' value	1.355 <sup>NS</sup>	2.904 <sup>NS</sup>	3.602 <sup>*</sup>	2.899 <sup>NS</sup>	3.232 <sup>NS</sup>	4.678 <sup>*</sup>

Means bearing different superscripts (<sup>a,b</sup>) differ significantly ( $p < 0.05$ ) in a column.

The studies of Taklimi *et al.* (1996) [16] on Live yeast supplementation, Singh and Sharma (1996) [15] on lactobacillus supplementation, and Sartori *et al.* (2005) [14] also recorded improved feed conversion efficiency in birds fed with 1 percent garlic powder along with control diet are in concurrence with our findings that feed efficiency improved significantly ( $p < 0.01$ ) in broilers. Maiorka *et al.* (2001) [7] observed better feed conversion with synbiotic followed by antibiotics, prebiotics and probiotics treated broilers, and least in control Group. Kannan *et al.* (2005) [5] reported that dietary

supplementation of probiotic and antibiotic (singly or in combination) improved feed efficiency significantly ( $p < 0.01$ ) as compared to control.

#### Carcass characteristics

The birds were randomly slaughtered at 6 weeks of age and the mean of carcass traits are summarized in Table 4. The edible carcass yield, breast yield, wing yield, thigh yield, drumstick yield, giblet yield, neck yield showed highly significant ( $p < 0.01$ ) difference within the groups.

**Table 4:** Carcass traits of broilers with comparative feeding of Probiotic, Prebiotic, Synbiotic and Garlic at 6<sup>th</sup> week of age

Treatments	Carcass traits	Edible carcass yield (%) (Mean ± S.E.)	Breast yield (%) (Mean ± S.E.)	Wing yield (%) (Mean ± S.E.)	Thigh yield (%) (Mean ± S.E.)	Drumstick yield (%) (Mean ± S.E.)	Giblet yield (%) (Mean ± S.E.)	Neck yield (%) (Mean ± S.E.)
T <sub>0</sub>		72.65±0.045 <sup>a</sup>	24.45±0.066 <sup>a</sup>	13.20±0.032 <sup>a</sup>	14.13±0.037 <sup>a</sup>	16.70±0.055 <sup>a</sup>	7.32±0.054 <sup>a</sup>	7.44±0.061 <sup>a</sup>
T <sub>1</sub>		74.25±0.046 <sup>c</sup>	25.31±0.067 <sup>c</sup>	13.80±0.033 <sup>c</sup>	4.47±0.040 <sup>bc</sup>	17.35±0.049 <sup>b</sup>	8.50±0.052 <sup>c</sup>	8.59±0.065 <sup>c</sup>
T <sub>2</sub>		73.84±0.047 <sup>b</sup>	24.89±0.071 <sup>b</sup>	13.50±0.033 <sup>b</sup>	14.37±0.041 <sup>b</sup>	17.24±0.058 <sup>b</sup>	7.90±0.057 <sup>b</sup>	7.98±0.066 <sup>b</sup>
T <sub>3</sub>		74.62±0.046 <sup>c</sup>	25.56±0.072 <sup>c</sup>	14.41±0.034 <sup>c</sup>	14.57±0.041 <sup>c</sup>	17.80±0.052 <sup>c</sup>	8.76±0.055 <sup>c</sup>	8.79±0.059 <sup>c</sup>
T <sub>4</sub>		74.80±0.048 <sup>c</sup>	25.89±0.068 <sup>c</sup>	14.69±0.034 <sup>c</sup>	14.79±0.040 <sup>c</sup>	18.40±0.056 <sup>c</sup>	8.97±0.052 <sup>c</sup>	8.79±0.061 <sup>c</sup>
'F' value		332.94 <sup>**</sup>	65.28 <sup>**</sup>	338.20 <sup>**</sup>	38.623 <sup>**</sup>	134.94 <sup>**</sup>	151.74 <sup>**</sup>	89.813 <sup>**</sup>

Means bearing different superscripts (<sup>a, b</sup>) differ significantly ( $**p < 0.01$ ) in a column.

These findings are partially in agreement with findings of Santosh kumar *et al.* (2003) [13] The results of the present study indicated that the mean percentage of organ vs body weight ratio with respect to live, spleen, kidneys thymus and bursa of fabricius exhibited a significant ( $p < 0.05$ ) increase in probiotic supplemented group as compared to control. Ademola *et al.* (2004) [11] recorded that supplements caused significant differences in the average weights (g) of shank ( $p < 0.01$ ), wings, drumstick, lung, liver ( $p < 0.05$ ) and weight (%) of wings and lungs when expressed on relative basis, were significantly ( $p < 0.05$ ) affected by the dietary supplementation. In contrast with our findings, Muzaffer Denli *et al.* (2003) [9] found that liver weight, intestinal pH and abdominal fat weight were not affected significantly by supplementation of probiotic, antibiotic and organic acid treatments ( $p > 0.05$ ) to the broilers. Lokhande *et al.* (2005) [6] evaluated carcass studies and revealed statistically non-significant differences in the edible carcass yield, liver, heart, gizzard and abdominal fat pad weight percentage within the Treatment and Control Group. The results of the present study has showed that there were highly significant differences in carcass traits by feeding probiotic, prebiotic, synbiotic and garlic in the broiler ration which helped to improve nutrient digestibility thereby resulting into higher body weight and carcass yield percentages.

#### Mortality percentage

The mortality percentage during the study period is presented in table no. 5, which showed higher percentage of mortality in Control group followed by Prebiotic, Probiotic and Garlic, and was absent in Synbiotic supplemented group.

**Table 5:** Mortality percentage of broilers fed with Probiotic, Prebiotic, Synbiotic and Garlic upto 6 weeks of age

Groups	Percentage (n)
T <sub>0</sub> (n=75)	8.00% (6)
T <sub>1</sub> (n=75)	1.33% (1)
T <sub>2</sub> (n=75)	5.33% (4)
T <sub>3</sub> (n=75)	0.00% (0)
T <sub>4</sub> (n=75)	1.33% (1)

The higher mortality in control group is indicative that the birds may not be resistant to disease and environmental fluctuations as compared to birds fed with different feed additives which resulted into improving the intestinal micro flora by increasing beneficial microorganisms and reducing the pathogenic microorganisms.

#### Conclusion

The results of this study showed that dietary inclusion of probiotics, prebiotics, synbiotics and garlic improves the growth performance compare to slandered broiler ration feeding. It is concluded that the use of garlic and synergistic effect of synbiotic may be used as a feed supplement in improving the weekly body weight gain of broilers instead of using probiotic or prebiotic alone as a feed additive.

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