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## Influence on the performance of broilers with the Garlic (*Allium sativum*) and Holy basil (*Ocimum sanctum*) leaf powder supplementation in the basal diet

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### Abstract

Present experiment was designed to evaluate the effect of supplementing different levels of garlic and holy basil leaf powder in the broilers diet on their growth performance and nutrient metabolizability during a period of 6 weeks. A total of 280-day-old commercial broiler chicks (Vencobb-400) were procured and randomly distributed into seven treatments, each treatment had four replicates with ten chicks in each replicate. Growth trial was conducted in a complete randomized design comprising seven dietary treatments. T<sub>1</sub> was served as control and fed a basal diet formulated as per BIS (2007) standards. T<sub>2</sub> and T<sub>3</sub> were fed with garlic powder @ 0.5, 1% feed, respectively. T<sub>4</sub> and T<sub>5</sub> were given with holy basil leaf powder @ 0.5, 1% feed, respectively. T<sub>6</sub> was fed with garlic powder and holy basil leaf powder @ 0.5% each. T<sub>7</sub> was treated with garlic powder and holy basil leaf powder @ 1.0% each.

The body weight gain was significantly ( $P<0.05$ ) higher in combination of garlic powder and holy basil leaf powder @ 0.5% each and 1.0% each supplemented groups as compared to rest of the treatment groups. Feed intake was not affected significantly. While, feed conversion ratio ( $P<0.05$ ) improved in T<sub>6</sub> (1.70) & T<sub>7</sub> (1.73) as compared to T<sub>1</sub> (2.09), T<sub>3</sub> (1.96) and T<sub>5</sub> (1.95). The dry matter metabolizability (%) was ( $P<0.05$ ) higher in T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> as compared to T<sub>1</sub> (control). The nitrogen retention per cent was significantly higher in T<sub>6</sub> as compared to control group. The gross energy metabolizability was significantly higher in T<sub>6</sub> and T<sub>7</sub> as compared to T<sub>1</sub>, T<sub>3</sub> and T<sub>5</sub>. Thus, the present study revealed that supplementation of garlic powder and holy basil leaf powder @ 0.5% each or 1.0% each in the broilers diet significantly improved body weight gain, feed conversion ratio and nutrient metabolizability without affecting feed intake.

**Keywords:** Garlic, holy basil, broiler, metabolizable, nitrogen retention

### Introduction

Growth and development of the commercial broiler farming in the country during the last decades has been spectacular. The poultry birds are continuously exposed to stressful conditions leading to serious economic losses. Scientific production and management has made considerable progress to make broiler farming fastest growing industry. There is a huge outcry both from the consumer society and health sector to ban antibiotic growth promoter (AGP) use in livestock and poultry feeds due to developing resistance and residue in meat (Sheoran *et al.*, 2015) [27]. Thus, there is a need to find out an alternative to AGP, such as enzymes inorganic acids, probiotics, prebiotics, herbs, immunostimulants and some other managerial practices (Banerjee, 1998) [3]. The main advantage of Non-Antibiotic Growth Promoters (NAGP) over Antibiotic Growth Promoter (AGP) is that they usually do not bear any risk regarding bacterial resistance or undesired residues in meat. Recently, WHO (2003) [35] recommended a global alliance on traditional medicine and developed guideline for the quality control of herbal drugs.

Garlic (*Allium sativum*) contains at least 33 sulfur compounds, several enzymes, 17 amino acids and minerals such as selenium (Newal *et al.*, 1996) [20]. The sulfur compounds are responsible both for garlic's pungent odor and many of its medicinal effects like lowering cholesterol level, protect against oxidative damage (Chowdhury *et al.*, 2002) [7]. Garlic has several beneficial effects on both human and animals having antimicrobial, antioxidant as well as antihypertensive properties (Sivam, 2001). Due to its antimicrobial property, garlic was considered to be one of the alternatives to antibiotics as growth promoters in animal industry (Ao *et al.*, 2011). Holy basil (*Ocimum sanctum*) contains eugenol (1-hydroxy 2-methoxy 4 allyl benzene) a phenolic compound and ursolic acid having pharmacological effects (Prakash, and Gupta, 2005) [35].

Some of the main chemical constituents of tulsi are: oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool (Kuhn *et al.*, 2007) [16]. The plant is reported to possess anti-infertility, anticancerous, antibacterial (Joshi *et al.*, 2009) [13], antidiabetic, antifungal, antimicrobial, hepatoprotective, cardioprotective, antiemetic, antioxidant (Subramanian *et al.*, 2005) [33], antispasmodic, analgesic, anti-ulcerogenic and ulcer healing properties, adaptogenic (Singh *et al.*, 2012) [29]. Its anti-inflammatory effect is due to dual inhibition of arachidonic acid metabolism by blocking both cyclooxygenase and lipoxygenase pathways (Singh *et al.*, 1996) [30]. The higher levels of flavanoids from Tulsi at higher level of inclusion might have been responsible for the improved antioxidant capacity in birds (Swathi *et al.* 2015) [34]. The purpose of this investigation was to study the effects of supplementing garlic and holy basil leaf powder on the performance of broilers.

### Materials and Methods

A total of 280-day-old commercial broiler chicks (Vencobb-400) were procured and randomly distributed into seven treatment groups of 40 chicks each. Each treatment groups was further subdivided into four replicates of ten chicks each. The herbs used in the study were purchased from local market. The experimental diets (Table 1) were formulated to meet the nutrient recommendations (BIS, 2007). Growth trial of 6 weeks was conducted in a complete randomized design comprising seven dietary treatments. T<sub>1</sub> was served as control and fed a basal diet formulated as per BIS (2007) standards. T<sub>2</sub> and T<sub>3</sub> were fed with garlic powder (GP) @ 0.5, 1% feed respectively. T<sub>4</sub> and T<sub>5</sub> were given with holy basil leaf powder (HBLP) @ 0.5, 1% feed respectively. T<sub>6</sub> was fed with garlic powder (GP) and holy basil leaf powder (HBLP) @ 0.5% each. T<sub>7</sub> was treated with garlic powder (GP) and holy basil leaf powder (HBLP) @ 1.0% each.

The chicks were kept hygienically on floor litter system in separate pens. All the birds were reared adopting uniform management conditions. The chicks were brooded at 35°C during the first week and thereafter the temperature was reduced by 3°C every week until the temperature reached 25±1°C. The birds were vaccinated against prevailing diseases adopting a standard protocol. Individual body weight of chicks was recorded at 0 day age and thereafter weekly. Total feed consumed, growth rate and feed conversion ratio (FCR) were calculated. A metabolism trial of seven days was conducted at the end of experiment to find out nutrient retention and energy metabolizability. Four birds from each treatment (one bird from each replicate) were randomly selected and transferred to individual metabolic cages. After three days of adaption period, a total collection of excreta was carried out for four days and feed consumption for each bird was recorded. The excreta on each polythene sheets were thoroughly mixed and homogenous samples were stored in plastic bottles in deep freeze. On the last day of collection, the excreta samples were kept at room temperature. All the diets were analyzed for proximate principles and also excreta samples for moisture and nitrogen contents (AOAC, 2007). The dried samples were kept for energy estimation.

The data were analyzed using completely randomized design (Snedecor and Cochran, 1994) and using general linear model procedure of statistical package for social sciences 20<sup>th</sup> version (SPSS) and comparison of means tested using Duncan's multiple range test (Duncan, 1955) [9] and significance was considered at  $P < 0.05$ .

**Table 1:** Ingredient (%) and chemical composition (% DM basis) of basal diet

Feed ingredient	Starter diet	Finisher diet
Maize (kg)	53	57
Soybean meal (kg)	19	16
Rice police (kg)	3	4
Ground nut cake (kg)	12	11
Fish meal (kg)	7	5
Soybean oil (kg)	4	5
Mineral mixture (kg)	2.0	2.0
*Feed additives (kg)	0.29	0.29
Chemical composition (% DM basis)		
Crude protein %	22.04	20.08
Crude fibre %	3.61	3.32
Ether extract %	8.38	8.98
Total ash %	6.18	5.86
**Metabolizable energy (Kcal/kg)	3056	3163

\*Feed additives include Vitamin Mixture-I-10 g, Vitamin, Amino acid and Ca mixture-II 20 g, Coccidiostat (Dinitro-0-Toluamide)-50 g, Choline chloride-50 g, Lysine-50 g, DL- methionine-80 g and Chlortetracycline -33.5g/100kg; \*\* Calculated values - BIS (2007)

### Result and Discussion

The average feed intake (g/bird) during different growth periods did not show any significant difference (Table 2). The above results are in agreement with the findings of Toghyani *et al.* (2011) [26] and Ao *et al.* (2011) they reported that supplementation of garlic powder have no significant ( $P < 0.05$ ) effect on feed intake of broilers. Similarly Singh *et al.* (2014) [28] also found non-significant effect of tulsi supplementation on feed intake. In contrary to our findings, Pourali *et al.* (2010) [22] have reported that supplementing garlic powder beyond 0.6% level enhanced repulsive odour and the taste of the diets, resulting decreased average daily feed intake. While, Tirupathi Reddy (2010) [25] found that a dietary combination of amla, tulsi and turmeric (0.25%, 0.5%) in broilers diet significantly increased the feed intake in broilers.

**Table 2:** Treatment means of feed intake (g/bird) during different growth periods

Treatments	Period (weeks)		
	0 to 2	0 to 4	0 to 6
T <sub>1</sub>	438.50±5.80	1648.50±13.55	3771.75±4.23
T <sub>2</sub>	435.00±18.73	1671.00 ±23.73	3713.25±11.94
T <sub>3</sub>	422.00±10.57	1657.25 ±59.36	3687.25±79.93
T <sub>4</sub>	434.75±14.25	1644.25 ±34.67	3645.75±61.90
T <sub>5</sub>	433.25±6.04	1638.50 ±22.79	3634.25±17.80
T <sub>6</sub>	420.75±10.44	1660.75 ±17.74	3627.50±6.64
T <sub>7</sub>	426.25±10.37	1676.50 ±34.39	3640.25±69.05

<sup>a,b,c</sup> The mean values in same column with different superscripts differ significantly ( $P < 0.05$ )

The significant ( $P < 0.05$ ) highest mean body weight gain was observed in combination of garlic powder and holy basil leaf powder @ 0.5% each and 1.0% each supplemented groups as compared to rest of the treatment groups (Table 3). There is an evidence in the literature that garlic significantly enhanced villus and goblet cell numbers in the duodenum, jejunum and ileum of birds. As a result of these intestinal morphological changes, the entire absorptive process in the birds is better activated. In this way nutrient absorption is enhanced with the resultant growth promoting effect (Tatara *et al.*, 2005; Masoud, 2006) [24, 18]. The improvement in weight gain of the birds using garlic in their rations may probably be due to the

fact that allicin (an antibiotic substance found in garlic), inhibits growth of intestinal bacteria such as *S. aureus* and *E. coli* and inhibit aflatoxin producing fungi (Meraj, 1998) [19]. Resultantly, when the load of these bacteria in the intestine is low, birds may absorb more nutrients, thus leading to the improvement in weight gain of the birds using rations supplemented with *Allium sativum*. The present increase in muscle weight may be due to the antioxidant property of holy basil plant which increases digestive enzymes and decreasing bacterial activities and thus result in body weight gain in broiler chicks (Khan *et al.*, 2009) [14]. After many research studies on animal and human being, Dixit *et al.*, (2005) [8] reported that fenugreek seed powder improved metabolism. Therefore, there is likelihood that improved metabolism has beneficial impact on weight gain of the studied muscles. Gomez *et al.*, (1998) [11] concluded that the improvement in live body weight in broilers may be due to antibacterial related to flavonoids in *Ocimum sanctum* that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver and muscle glycogen contents. The results are in close agreement with the findings of Kumar *et al.* (2010) [17] and Onyimonyi *et al.* (2012) [21] have observed significant improvements in growth of broilers fed with garlic supplement while, Gupta and Charan (2007) [12] and Khatun *et al.* (2013) [15] with holy basil supplement.

**Table 3:** Treatment means of body weight gain (g/bird) during different growth periods

Treatments	Period (weeks)		
	0 to 2	0 to 4	0 to 6
T <sub>1</sub>	236.50 <sub>a</sub> ±2.53	870.00 <sub>a</sub> ±16.29	1801.75 <sub>a</sub> ±1.79
T <sub>2</sub>	245.50 <sub>ab</sub> ±4.29	939.75 <sub>b</sub> ±11.50	1823.00 <sub>ab</sub> ±21.17
T <sub>3</sub>	251.00 <sub>b</sub> ±4.22	945.25 <sub>b</sub> ±13.84	1873.50 <sub>b</sub> ±9.13
T <sub>4</sub>	245.25 <sub>ab</sub> ±6.84	951.25 <sub>b</sub> ±22.66	1818.50 <sub>b</sub> ±11.92
T <sub>5</sub>	249.75 <sub>b</sub> ±1.54	860.25 <sub>bc</sub> ±15.80	1863.25 <sub>b</sub> ±8.41
T <sub>6</sub>	251.25 <sub>b</sub> ±2.68	1005.75 <sub>d</sub> ±3.09	2129.25 <sub>c</sub> ±22.83
T <sub>7</sub>	254.00 <sub>b</sub> ±1.41	995.25 <sub>cd</sub> ±5.82	2094.75 <sub>c</sub> ±32.93

<sup>a,b,c</sup> The mean values in same column with different superscripts differ significantly ( $P<0.05$ )

In present experiment feed conversion ratio (FCR) significantly improved in T<sub>6</sub> & T<sub>7</sub> as compared to T<sub>1</sub> (control), T<sub>3</sub> and T<sub>5</sub> (Table 4). This study clarified that, the birds fed rations supplemented with garlic and holy basil utilized their feed more efficiently than those feed ration without addition. These findings are in agreement with Fadlalla *et al.* (2010) [10] by garlic and Chaudhary *et al.* (2015) [6] by herbal mixture (*Curcuma longa*, *Emblica officinalis* and *Nigella sativa* powder) at 1% level in broiler diet resulted in better FCR. The improved FCR of the broilers may be attributed to the antibacterial properties of these supplements, which resulted in better absorption of the nutrients present in the gut and finally leading to improvement in feed conversion ratio. The gain in mean body weight due feed supplementation with

garlic powder and holy basil leaf powder either individually or their combination also resulted in improved FCR of broilers could be related to their promoting effects on metabolic processes of digestion and utilization of nutrients.

**Table 4:** Treatment means of feed conversion ratio (FCR) during different growth periods

Treatments	Period (weeks)		
	0 to 2	0 to 4	0 to 6
T <sub>1</sub>	1.85 <sub>b</sub> ±0.01	1.89 <sub>c</sub> ±0.04	2.09 <sub>c</sub> ±0.01
T <sub>2</sub>	1.77 <sub>ab</sub> ±0.06	1.77 <sub>b</sub> ±0.01	2.03 <sub>bc</sub> ±0.02
T <sub>3</sub>	1.68 <sub>a</sub> ±0.01	1.75 <sub>ab</sub> ±0.04	1.96 <sub>b</sub> ±0.03
T <sub>4</sub>	1.77 <sub>ab</sub> ±0.05	1.72 <sub>ab</sub> ±0.02	2.00 <sub>bc</sub> ±0.03
T <sub>5</sub>	1.73 <sub>ab</sub> ±0.01	1.70 <sub>ab</sub> ±0.02	1.95 <sub>b</sub> ±0.01
T <sub>6</sub>	1.67 <sub>a</sub> ±0.02	1.65 <sub>a</sub> ±0.01	1.70 <sub>a</sub> ±0.01
T <sub>7</sub>	1.67 <sub>a</sub> ±0.03	1.68 <sub>ab</sub> ±0.03	1.73 <sub>a</sub> ±0.04

<sup>a,b,c</sup> The mean values in same column with different superscripts differ significantly ( $P<0.05$ )

The dry matter (DM) metabolizability (%) was significantly ( $P<0.05$ ) higher in supplemented group of holy basil leaf powder @ 0.5%, combination of garlic powder and holy basil leaf powder @ 0.5% each or 1.0% each as compared to control group. The nitrogen retention per cent was significantly higher in the broiler fed diet supplemented with combination of 0.5% GP and 0.5% HBLP as compared to that of fed control diet (Table 5). The gross energy (GE) metabolizability was significantly higher in combination of garlic powder and holy basil leaf powder @ 0.5% each and 1.0% each supplemented group as compared to rest of the treatment groups (Table 6).

There is evidence in the literature that garlic significantly enhance the villus and goblet cell numbers in the duodenum, jejunum and ileum of birds. As a result of these intestinal morphological changes, the entire absorptive process in the birds is better activated. In this way nutrient absorption is enhanced with the resultant growth promoting effect (Tatara *et al.*, 2005; Masoud, 2006) [24, 18]. Garlic and holy basil supplementation also increased liver and muscle glycogen might have resulted in better metabolizability and nitrogen retention. These findings were in agreement with (Gomez *et al.*, 1998) [11].

**Table 5:** Treatment means of per cent dry matter metabolizability and nitrogen retention

Treatments	DM metabolizability (%)	Nitrogen retention (%)
T <sub>1</sub>	63.25 <sub>a</sub> ±1.10	62.00 <sub>a</sub> ±0.70
T <sub>2</sub>	65.00 <sub>ab</sub> ±0.70	62.75 <sub>ab</sub> ±0.47
T <sub>3</sub>	65.00 <sub>ab</sub> ±0.57	62.50 <sub>ab</sub> ±0.86
T <sub>4</sub>	64.75 <sub>ab</sub> ±0.85	62.50 <sub>ab</sub> ±0.28
T <sub>5</sub>	66.00 <sub>b</sub> ±0.70	62.50 <sub>ab</sub> ±0.50
T <sub>6</sub>	66.78 <sub>b</sub> ±0.62	64.00 <sub>b</sub> ±0.57
T <sub>7</sub>	66.75 <sub>b</sub> ±0.62	62.75 <sub>ab</sub> ±0.47

<sup>a,b,c</sup> The mean values in same column with different superscripts differ significantly ( $P<0.05$ )

**Table 6:** Mean values of metabolizable energy (kcal/kg) and per cent gross energy metabolizability in experimental birds under different dietary treatments

Treat-ment	GE of feed (kcal/kg)	GE of excreta (kcal/kg)	Apparent ME (kcal/kg)	Calculated ME (kcal/kg)	Nitrogen retention (g/kg feed × 8.22)	Nitrogen corrected ME (kcal/kg)	GE Meta bolizability (%)
T <sub>1</sub>	4812.00±3.33	1562.14 <sub>d</sub> ±3.50	3249.86 <sub>a</sub> ±2.69	3163.00	174.47 ±1.72	3075.39 <sub>a</sub> ±1.24	63.91 <sub>a</sub> ±0.03
T <sub>2</sub>	4811.18±1.73	1553.67 <sub>cd</sub> ±2.12	3257.51 <sub>ab</sub> ±3.77	3163.00	175.49 ±1.53	3082.02 <sub>ab</sub> ±3.63	64.05 <sub>ab</sub> ±0.05
T <sub>3</sub>	4812.68±1.50	1548.13 <sub>bc</sub> ±3.26	3264.55 <sub>bc</sub> ±4.75	3163.00	174.98 ±0.51	3089.57 <sub>bc</sub> ±4.50	64.19 <sub>b</sub> ±0.07

T <sub>4</sub>	4811.03±0.80	1554.32 <sup>cd</sup> ±1.43	3256.71 <sup>ab</sup> ±1.49	3163.00	176.31 ±1.47	3080.40 <sup>ab</sup> ±2.57	64.02 <sup>ab</sup> ±0.05
T <sub>5</sub>	4811.76±0.70	1547.24 <sup>bc</sup> ±5.75	3264.52 <sup>bc</sup> ±6.44	3163.00	175.33 ±1.79	3089.18 <sup>bc</sup> ±6.05	64.20 <sup>b</sup> ±0.11
T <sub>6</sub>	4811.38±1.94	1534.58 <sup>a</sup> ±1.76	3276.80 <sup>c</sup> ±3.52	3163.00	173.38 ±1.76	3103.42 <sup>d</sup> ±3.58	64.50 <sup>c</sup> ±0.05
T <sub>7</sub>	4812.55±1.39	1538.97 <sup>ab</sup> ±1.64	3273.58 <sup>c</sup> ±2.96	3163.00	174.29 ±1.89	3099.29 <sup>cd</sup> ±2.01	64.40 <sup>c</sup> ±0.03

<sup>a,b,c,d</sup> The mean values in same column with different superscripts differ significantly ( $P<0.05$ )

## Conclusion

It was concluded that supplementation with the combination of garlic and holy basil leaf powder in broilers diet improved body weight gain, feed conversion efficiency and nutrients metabolizability without affecting the feed intake.

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