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Effects of Garlic (*Allium sativum*) Supplementation on Growth Performance, Carcass Characteristics and Economics of Broilers

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ABSTRACT

One hundred and eighty (n=180) day old white commercial broiler chicks (Cobb 400) were randomly divided into three groups to study the effects of garlic supplementation on growth performance. Dietary treatments were control (T_1- basal diet only), garlic powder supplemented at 0.1% (T_2) and 0.5 % (T_3). Daily feed intake, weekly body weight and residue left any were recorded to calculate the feed conversion ratio. At the end of experiment six birds from each group were sacrificed to determine the carcass characteristics. Results revealed that dietary supplementation of 0.1% garlic powder (T_2) significantly ($P<0.01$) improved body weight, body weight gain, feed intake and FCR as compared to birds supplemented with 0.5 % garlic powder (T_3) and control (T_1). Dietary supplementation of 0.1% garlic (T_2) resulted in significant ($P<0.05$) improvement in dressed yield as compared to T_3 and T_1. On the other hand, comparable ($P>0.05$) effect was observed on shrinkage loss, blood loss, feather loss, eviscerated yield and relative weight of giblet. Mortality (%) in T_1, T_2 and T_3 was 3.33, 0.00 and 1.67, respectively. Total feed cost, total cost/kg live weight and total cost/kg meat was reduced ($P<0.05$) in 0.1% garlic (T_2) as compared to 0.5 % garlic (T_3) supplemented birds or control (T_1). Thus, dietary supplementation of 0.1 % garlic had beneficial effect on growth performance, dressed yield and cost of production.

Keywords: Broilers, garlic, growth, FCR, economics

Antimicrobial compounds are commonly included in poultry ration for promotion of growth and control of diseases. The European Union has banned feed grade antibiotic growth promoters because of the risk of possible drug resistance in human pathogenic bacteria and only two antimicrobial growth promoters are planned to remain in use (Shane, 2001). Feeds containing no chemical additives are increasingly used in poultry nutrition. For this reason, herbs and natural feed additives i.e. garlic, fenugreek, thyme, etc. are being investigated as natural sources biologically important substances (Demir *et al.* 2003). Garlic (*Allium sativum*) is well known as a spice and herbal medicine belongs to family *Liliaceae* and the genus *Allium*. Garlic contains at least 33 sulfur compounds (Alliin, Diallyl sulfides and Allicin), several enzymes, 17 amino acids and minerals such as selenium (Newall *et al.* 1996) which are responsible for antibacterial (Cavallito and Bailey,

Table 1. Composition of basal diet used during starting (0-3 wk) and finishing (4-6 wk) phase

Ingredients	Starter (%)	Finisher (%)
Yellow maize	56.6	60.4
Soybean meal	36.5	34
Rapeseed meal	3.5	2.5
Limestone powder	0.9	0.9
Dicalcium phosphate	1.7	1.45
Common salt	0.3	0.3
DL-Methionine	0.11	0.07
Constant*	0.415	0.415
Total	100.03	100.04
Nutrient composition (As fed basis)		
ME, kcal/kg***	2867.8	2905.7
Crude Protein, %**	22.13	20.89
Lysine,%***	1.27	1.15
Methionine,%***	0.52	0.46
Calcium,%***	0.92	0.86
Phosphorus, %***	0.45	0.40
Ether extract,%**	4.76	4.64
Crude fiber,%**	3.5	3.4
Total ash,%**	3.38	3.22

** Analyzed values as fed basis

***calculated values as fed basis

*Constant includes trace mineral premix 0.1, vitamin premixes 0.215, toxin binder 0.05 and coccidiostat 0.05 %. Trace mineral premix supplied Mg-300, Mn-55, I-0.4, Fe-56, Zn-30 and Cu- 4 mg/kg diet. The vitamin premixes supplied vitamin A 8250 IU, vitamin D_3 1200 ICU; vitamin K 1 mg; vitamin E 40 IU, vitamin B_1 2 mg, vitamin B_2 4 mg, vitamin B_{12} 10 mcg; niacin 60 mg; pantothenic acid 10 mg and choline chloride 500 mg/kg diet.

1994), antifungal (Bradely, 1992), antiviral (Ankari and Mirelman, 1999), antioxidant (Prasad *et al.* 2009), anti parasitic, antithrombotic, anti cancerous and vasodilator characteristics (Canogullari *et al.* 2010). The sulphur compounds of garlic are responsible for garlic's pungent odour and many of its medicinal effects like lowering cholesterol level (Chowdhury *et al.* 2002). Positive effects of garlic on growth rate, feed conversion ratio (FCR), carcass characteristics and mortality rate have been studied earlier (Demir *et al.* 2003; Lewis *et al.* 2003; Tollba and Hassan, 2003). Thus, the present study was designed to observe the potential of incorporating different levels of garlic as a phytogenic growth promoter in commercial broilers.

MATERIALS AND METHODS

Location of study

The research work was conducted for six weeks at private poultry farm of Dangia village, Dantiwada taluka, Banaskantha district of Gujarat, India.

Birds and experimental diets

One hundred and eighty (n=180) day old commercial

Table 2. Growth performance of broilers fed different levels of garlic

Parameters	Treatments			P Value
	T_1	T_2	T_3	
IBW (g)	42.28±0.31	42.27±0.32	42.18±0.33	NS
FBW (g)	2013.69±6.89[a]	2097.02±5.86[c]	2039.95±3.77[b]	0.001***
BWG (g)	1971.50±6.92[a]	2054.70±5.77[c]	1997.70±3.68[b]	0.001***
FI (g)	3461.10±36.69[a]	3615.70±8.82[b]	3514.70±50.46[ab]	0.041*
FCR	1.82±0.01[b]	1.76±0.01[a]	1.79±0.01[ab]	0.017*

Means with different superscripts in a row differ significantly.
*(P < 0.05) ** (P < 0.01) *** (P < 0.001) NS- non-significant
IBW: Initial body weight, FBW: Final body weight, BWG: Body weight gain, FI: Feed intake, FCR: Feed conversion ratio

broiler chicks (strain 'Cobb-400') were randomly distributed into three groups with 4 replicates of 15 birds in each group. Dietary treatments were T_1: Basal diet without garlic powder supplementation (Control), T_2: Basal diet with garlic powder supplementation 1 g/kg of feed and T_3: Basal diet with garlic powder supplementation 5 g/kg of feed. Garlic bulb was procured from local market then powdered in an electrical grinder and stored in air tight container at room temperature for use. The basal diets were formulated as per the standards of NRC (1994) from available feed ingredients with compositions given in Table 1. The proximate analysis of experimental diets was carried out at as per AOAC (1995).

Housing and management

Birds were reared in deep litter system under uniform and standard managemental conditions. All the experimental chicks were properly vaccinated against various diseases like new castle disease, infectious bursal disease etc.

Sampling and analytical methods

Body weight of the individual experimental chicks were recorded in the morning before feeding with the help of digital weighing balance at day old and thereafter at weekly interval till six weeks of age. Feed consumption was measured by weighed quantity of feed offered to each group and at the end of week feed left over was weighed and recorded. On the basis of that average weekly feed intake and FCR was calculated. At the end of experiment, six birds from each treatment were randomly selected and slaughtered. The dressed weight of each bird was obtained separately by complete bleeding and removal of feathers, head, neck, shanks and viscera. Heart, liver, gizzard and spleen were also weighed individually and their percentages in relation to body weight were calculated. Mortality was recorded as and when occurred. Mortality rate (%) was calculated from the records of dead birds up to end of the study against total number of birds. Relative economics was calculated by subtracting the cost of feeding from the output of bird sold at ₹ 70 per kg live weight. Garlic used for experimental feeding was purchased at ₹ 60 per kg.

Statistical analysis

All the recorded and calculated data were subjected to statistical analysis by applying "factorial and completely randomized design" (FCRD) employing one-way analysis of variance as per Snedecor and Cochran (1994). A p-value of <0.05 was considered a significant difference among groups and the comparison of means was made using Duncan multiple range test (DMRT) described by Duncan (1955).

RESULTS AND DISCUSSION

Body weight

Average initial body weight (IBW) and corresponding final body weight (FBW) of broiler chicks are presented in Table 2. Body weight of birds was significantly (P<0.001) higher in T_2 as compared to T_3 and T_1. Mahmood *et al.* (2009) and Aji *et al.* (2011) also supported that garlic supplementation significantly improved body weight. While Rahimi *et al.* (2011) reported that garlic

Table 3. Carcass parameters (%) of broilers fed different levels of garlic

Parameters (%)	Treatments			P Value
	T_1	T_2	T_3	
Shrinkage loss	4.61±0.05	4.65±0.10	4.59±0.08	NS
Blood loss	2.91±0.07	3.05±0.05	2.95±0.04	NS
Feather loss	4.83±0.07	4.75±0.06	4.88±0.07	NS
Eviscerated yield	69.55±0.12	69.96±0.09	69.60±0.16	NS
Dressed yield	$74.71±0.12^{a}$	$75.17±0.10^{b}$	$74.78±0.16^{ab}$	0.05*
Heart	0.50±0.01	0.52±0.00	0.51±0.00	NS
Liver	2.50±0.01	2.52±0.01	2.50±0.01	NS
Gizzard	2.16±0.03	2.18±0.02	2.17±0.01	NS
Giblet	5.16±0.03	5.21±0.02	5.17±0.02	NS
Mortality	3.33	0.00	1.67	NS

Means with different superscripts in a row differ significantly.
*(P < 0.05) ** (P < 0.01) *** (P < 0.001) NS- non-significant

supplementation had no significant effect on body weight.

Body weight gain

Total body weight gain was significantly (P<0.001) higher in birds supplemented with 0.1 % garlic as compared to 0.5% garlic supplementation and control (Table 2). Earlier studies have reported mixed responses in body weight gain to garlic supplementation. Mansoub (2011), Stanacev *et al.* (2011) and Suriya *et al.* (2012) reported that garlic supplementation significantly improved body weight gain. In present study, better weight gain in garlic fed birds might be due to the action of allicin (an antibiotic substance found in garlic) which inhibits the growth of pathogenic bacteria by interfering with bacterial cell metabolism (Ghosh *et al.* 2010). Resultantly, when the load of these bacteria in the intestine is low birds may absorb more nutrients leading to improved in weight gain (Reeds *et al.* 1993). Apart from this, garlic also enhances pancreatic enzymes activity (Ramakrishna *et al.* 2003) and activates the digestive process which improves absorption of nutrients and ultimately the growth.

Feed intake

Total feed intake was significantly (P<0.05) better in birds receiving 0.1 % garlic (T_2) as compared to birds that are receiving either 0.5 % garlic (T_3) or control (Table 2). Slight reduction in feed intake at higher doses might be due to increasing repulsive odour and taste of garlic (Pourali *et al.* 2010). Javandel *et al.* (2008) reported that feed consumption was significantly higher in birds fed diets with lower concentration of garlic 0.125 and 0.25 % as compared to higher level 0.5, 1 and 2 %. Similar findings were also reported by Mansoub and Myandoab (2011). In contrast, Rahimi *et al.* (2011) reported non-significant effect of garlic supplementation on feed intake in broilers.

Feed conversion ratio

The better feed conversion ratio (P<0.01) was observed in birds that are receiving 0.1 % garlic (T_2) as compared to those birds receiving either 0.5 % garlic (T_3) or control (Table 2). Results of the present study were in line with previous findings of Fadlalla *et al.* (2010) and Suriya *et al.* (2012). On the other hand, Aji *et al.* (2011) reported non-significant effect of garlic on feed conversion ratio. In present study better FCR in garlic supplemented group might be due to control of growth and colonization of various pathogenic microorganisms in the gut resulting into enhanced efficiency of utilization of feed (Ankri and Mirelman, 1999 and Bedford 2000). Thus, better FCR in garlic fed birds may be due to nutrient sparing effect of garlic.

Carcass characteristics

Various carcass parameters are presented in Table 3.

Table 4. Economics of feeding different levels of garlic

Parameters	Treatments			P Value
	T_1	T_2	T_3	
Feed cost (₹)/kg live broiler	48.03±0.40[b]	46.74±0.20[a]	47.92±0.24[b]	0.022*
Total cost (₹)/kg live broiler	67.34±0.45[b]	65.90±0.22[a]	67.22±0.27[b]	0.023*
Total cost (₹)/kg meat	90.51±0.60[b]	87.67±0.29[a]	89.90±0.36[b]	0.003**
Total cost (₹) of production/broiler	134.20±0.97	135.65±0.27	135.35±0.49	NS

Means with different superscripts in a row differ significantly.
*(P < 0.05) ** (P < 0.01) *** (P < 0.001) NS- non-significant

Significantly (P<0.05) higher dressing percentage was observed in T_2 as compared T_3 and T_1. However, shrinkage loss, blood loss, feather loss, eviscerated yield, relative weight of heart, liver, gizzard and giblet remained comparable (P>0.05) among different dietary treatment groups. Ashayerizadeh *et al.* (2009) and also reported significant (P<0.05) increase in dressing percentage on garlic supplementation. In contrast to present findings, Aji *et al.* (2011) reported non-significant effect of garlic supplementation on dressing percentage in broilers.

Mortality

Out of 180 chicks reared only 3 chicks were died during entire experiment period indicating that the mortality (%) was well within the normal limit. Total mortality (%) was 1.67 in all the treatment groups with 3.33, 0.00 and 1.67 in T_1, T_2 and T_3 experimental groups, respectively. The results of the present study were supported by the earlier findings of Fadlalla *et al.* (2010). In present study, lower mortality in garlic fed birds may be due to antimicrobial action of garlic (Ankri and Mirelman, 1999).

Economics of feeding

Economics of garlic supplementation at various levels is presented table 4. The cost of feeding, total cost of production for 1 kg live weight and cost of production for 1 kg meat was significantly (P<0.05) lower in T_2 to T_3 and T_1. Lowered cost of production in garlic supplemented group is mainly because of better feed conversion ratio due to garlic's growth promoting effect. In contrary to present findings, Aji *et al.* (2011) reported increased feed cost when birds were supplemented with garlic as compared to control.

CONCLUSION

It could be concluded that 0.1 % garlic supplemented group had significantly higher growth rate and better economic benefit than 0.5 % garlic supplemented group and control. Garlic at 0.1 % is an economical alternative to antibiotic growth promoters and can be easily made and adopted by the poultry farmers.

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