

Effect of Dietary Supplementation of Garlic (*Allium Sativum*) Powder as Herbal Feed Additives on Growth Performance in Broilers

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Abstract

It is conceivable that herbal agents could serve as safer alternatives as growth promoters due to their suitability and preference, lower cost of production, reduced risks of toxicity and minimum health hazards. Interestingly recent biological trials of certain herbal formulations in India as growth promoter have shown encouraging results and some of the reports have demonstrated improvement with respect to weight gain, feed efficiency, lowered mortality, increased immunity and increased livability in broiler chicken. Garlic seems to have potential to be used as an alternative to antibiotics and to improve production performance of broilers. Thus, an attempt was made to find out effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additives on acceptability, growth performance, mortality carcass traits and economics of broiler production.

To conduct the study a total of one hundred and eighty, day old broiler chicks of Cobb-400 strain were divided into three treatment groups with 4 replicates of 15 chicks in each using completely randomized design (CRD). All experimental chicks were randomly assigned to 12 pens. There was one control group (T₁) fed on basal diet without any supplement and two treatment groups supplemented with 0.1 % garlic powder (T₂) and 0.5 % garlic powder (T₃). Garlic powder was mixed with control diet as per the proportion. The experiment was carried out for 6 weeks by dividing into two phases starter (0-3 wk) and finisher (4-6 wk). Feed intake and growth performance, were studied. Feed intake, body weight, body weight gain were recorded weekly. Average feed intake in gram/chick/week was calculated by dividing the total amount of feed by the number of chicks in the particular pen on particular week. The weekly average body weight gain was calculated by difference between the body weight of current and earlier weeks.

The body weight of birds was higher (P<0.001) in garlic supplemented birds as compared to without supplemented control, with better weight in 0.1 % garlic powder (T₂) supplemented birds as compared to 0.5 % garlic powder (T₃) supplemented birds. Body weight gain was differ significantly at the end of 1st, 2nd, 3rd, 4th week of age with better gain in 0.1 % garlic powder supplemented birds as compared to without supplemented control and 0.5 % garlic powder supplemented birds. The body weight gain of 6th week differ significantly (P<0.001) with better gain in 0.1 % garlic powder supplemented birds followed by 0.5 % garlic supplemented birds and subsequently without supplemented control.

The overall body weight gain was higher (P<0.001) in 0.1 % garlic supplemented birds subsequently by 0.5 % garlic supplemented birds as compared to without supplemented control. The total feed intake (0-6 wk) was significantly (P<0.05) superior in birds supplemented with 0.1 % garlic (T₂) as compared to birds that were supplemented with 0.5 % garlic (T₃) and without supplementation (T₁). Dietary supplementation of garlic @ 0.1 % in broiler diet had beneficial effect on body weight gain, feed intake, feed conversion ratio and dressed yield. Dietary supplementation of 0.1% garlic had beneficial effect in broilers for improving performance and also serves as one of the potential alternative to antibiotic growth promoter as well as reducing the cost of production in commercial broiler farming.

Keywords: Farming; Industry, Weight Gain; Supplementation; Herbal Promoters.

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Introduction

Poultry industry is one of the fastest expanding segments of agro-livestock sector in India. The potential of poultry farming as a viable industry is reflected in the amazing growth of the agriculture sector during last three decades and the same has not been recorded in any other agriculture sector. Poultry occupies an important place in Indian economy contributing more than ₹ 11,000 crores to the national gross domestic products. India ranks 3rd and 5th with respect to production of egg and meat respectively in the world (BAHS, 2010). The per capita availability of poultry meat is 2.15 kg/annum which is very less as against the recommendation of 11 kg meat/annum given by National Institute of Nutrition (Prabhakaran, 2012). Now a day, the efficiency of poultry to convert the feed into meat plays a key role in economics of broiler industry. Therefore, it is highly essential to improve feed efficiency of poultry to produce meat economically and also food safety is more seriously considered than before. On the other hand, economy of food production is also a factor that cannot be ignored. A huge amount of antibiotics have been used to control diseases and improve performances in livestock. However, due to growing concerns about antibiotic resistance and the potential for a ban for antibiotic growth promoters in many countries in the world, there is an increasing interest in finding alternatives to antibiotics in poultry production.

Feed additives are commonly described as non-nutrient substances that accelerate growth, efficiency of feed utilization, beneficial for health or metabolism of the animals (Church and Pond, 1988). The additives that hold great promise in the feeding of poultry comprise of antibiotics, coccidiostats, antioxidants, enzymes, hormones, probiotics, buffers, organic acids, mould inhibitors, herbal products, synthetic micronutrients etc. Antimicrobial compounds produced by microorganisms have been used in poultry rations as growth promoters for many years (Church and Pond, 1988; Barragry and Powers, 1994).

Herbal feed additives are usually defined as products derived from plants and added to animal feed as alternatives to antibiotics, growth promoter, fattening agent to increase productivity, improving the quality of feed and animal hygiene conditions thereby to improve the quality of produced food. Feed additives produced from plants have often a significant antibacterial effect, thereby suppressing pathogenic microflora in the gastrointestinal tract of animals and thus reducing mortality during the

fattening period, especially during stress (Schone *et al.*, 2006). Plant additives are added into feedstuff as they improve the taste and smell of feed and thus improve intake and growth of animals (Windisch *et al.*, 2008). Several herbal additives contain substances which increase the production of digestive juices (saliva, gastric juices, pancreatic and intestinal secretion) and thereby enhance appetite and digestion (Barreto *et al.*, 2008). There are many herbal additives which have shown promising results as alternative to antibiotics as well as improvement in production performance of broilers. Few of such herbal additives include garlic, fenugreek, thyme, oregano etc.

Garlic (*Allium sativum*) has been used as a spice and a native medicine since long ago (Rivlin, 2001). Garlic belongs to family *Liliaceae* and the genus *Allium*. Bioactive components of garlic like sulfur containing compounds (Alliin, Diallylsulfides and Allicin) are responsible for its some of the specific characteristics (Amagase *et al.*, 2001). It has been indicated that these compounds have antibacterial, antifungal, anti parasitic, antiviral, antioxidant, antithrombotic, anti cancerous and vasodilator characteristics. Garlic powder as a natural growth promoter can be a potential alternative for common artificial growth promoters like antibiotics and in this respect, it can improve growth rate, feed conversion ratio (FCR), carcass characteristics and decrease mortality rate in broiler chickens (Demir *et al.*, 2003; Lewis *et al.*, 2003; Tollba and Hassan, 2003). Garlic has been found to lower serum and liver cholesterol (Qureshi *et al.*, 1983), inhibit bacterial growth (Cavallito and Bailey, 1994), inhibit platelet growth and reduce oxidative stress (Horie *et al.*, 1992).

The mechanism of action of garlic as a growth promoter is yet to be fully elucidated. In this backdrop, the investigation was planned to study the effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additives on acceptability, growth performance, carcass traits and economics of production in broilers.

Materials and Methods

The experiment was carried out from day old age up to 6 weeks of age from 8th September 2013 to 20th October 2013 at private poultry farm at Dangia village in Dantiwada taluka of Banaskantha district nearby area of College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat) and the laboratory work was carried out in the

Department of Animal Nutrition of the College.

Treatments And Feeding Standard

Experimental Materials

Total of one hundred and eighty unsexed day old commercial broiler chicks of same strain (Cobb-400) and hatch were procured from sunrise hatchery, Mumnavas (Dist: Banaskantha) were used. Experimental chicks were divided into three treatment groups with 4 replicates of 15 chicks each using completely randomized design (CRD). Chicks were randomly assigned to 12 pens. The day old chicks were weighed individually with standard electronic weighing balance and it was taken as initial body weight of chicks.

Garlic (*Allium sativum*) powder was used as a herbal feed additive and garlic bulb was procured from local market then powdered in an electrical grinder air dried and stored in air tight container at room temperature for use.

The experimental design consisted of three dietary treatments as follow:

T₁ = Basal diet without garlic supplementation (Control)

T₂ = Basal diet + garlic supplementation @ 0.1% of feed

T₃ = Basal diet + garlic supplementation @ 0.5% of feed

The detailed plan of various treatments is shown in Table 1. The basal diet was formulated and made available from commercial feed mill in mash form and considered as control. The broiler chicks were fed in two phases viz. starter (0-21 days) and finisher (22-42 days). Feed and water were offered *ad-libitum* to each group throughout experimental period. The details regarding the proportions of feed ingredients used for manufacturing of basal diet and calculated nutrient composition of basal diet are given in Table 1 All the treatment feeds were fortified with adequate vitamins, coccidiostats and other supplements.

Table 1: Treatments and number of broiler chicks assigned randomly to various experimental groups.

Group	Treatments	Replicates			
		R ₁	R ₂	R ₃	R ₄
T ₁	Control diet	15	15	15	15
T ₂	Control diet supplemented with 0.1 % garlic powder	15	15	15	15
T ₃	Control diet supplemented with 0.5 % garlic powder	15	15	15	15

Garlic powder was mixed with control diet as per the proportion mentioned in treatments for the particular group and offered to birds. The proximate analyses of the experimental feeds were carried out as per AOAC (1999).

** 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 D₃ 1200 ICU; vitamin K 1 mg; vitamin E 40 IU, vitamin B₁ 2 mg, vitamin B₂ 4 mg, vitamin B₁₂ 10 mcg; niacin 60 mg; pantothenic acid 10 mg and choline chloride 500 mg/kg diet.

Proximate Analysis of Experimental Diets

Proximate analysis of starter and finisher feed was carried out for various proximate principles by standard analytical procedures of AOAC (1999) at Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (Gujarat).

Management of Birds

Housing management

A feeding trial of 6 weeks was carried out with the chicks divided into various experimental groups. All the experimental birds

Table 2: Ingredients and nutrient composition of basal diet used during starting (0-3 wk) and finishing (4-6wk) phase

Ingredients (kg/ 100kg)	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

Ingredients and nutrient composition of basal diet is given in Table 2. were reared in deep litter system of housing under same environmental condition. An ideal and identical floor, feeding and watering space was allotted to experimental birds. Experimental groups were divided into 12 (twelve) pen by wire net partitioning.

Feeding and watering management

All groups were provided with individual feeder and waterer. Feed was offered *ad-libitum* in weighed quantity once in a day for first two weeks and then twice a day for rest of experimental period. The feeders were not filled more than two third during first two weeks period, so as to minimize the wastage of feed. Manual turning and mixing of feed was done frequently four to five times in a day. Clean, fresh

wholesome drinking water was made available to all experimental birds *ad libitum* throughout the experimental period.

Observations Recorded

The following observations related to the objective of the study were recorded regularly for the individual birds as per the schedule described below:

Body weight

Accurate body weight of the individual experimental chicks were recorded in the morning hours before feeding with the help of digital weighing balance at day old age and thereafter at weekly interval till six weeks of age.

Body weight gain

Broiler chicks were weighed individually at weekly interval up to six weeks of age and the data for average weekly body weight gain was obtained by calculating differences between the average live body weight of previous week from that of current week for each treatment groups and recorded in grams (g).

Feed intake

The daily weighed quantity of feed offered to each experimental group under the study was recorded. At the end of week left over feed were collected, weighed and recorded. The difference between the weight of feed offered during period of seven days and the feed left over on the last day for each treatment was calculated to know the average feed intake for each treatment groups. Average feed intake in gram/week was calculated by dividing the total amount of feed consumed by the number of chicks in the particular pen for particular week.

Statistical Analysis

The data pertaining to various parameters were analyzed statically by the methods of Snedecor and Cochran (1994). The significant mean differences were tested as per Duncan’s multiple range test (DMRT) described by Duncan (1955).

criticism and has raised global concern as some reports revealed their ill effects among which are development of microbial resistance to the pathogens and their potential harmful effects on human health (Rahmatnejad *et al.*, 2009). These shortcomings led to the search for alternative substances like probiotics, prebiotics and medicinal plants as natural feed additives which can be used in poultry diets to enhance the performance and immune response of birds (Rahmatnejad *et al.*, 2009). In this regard garlic powder seems to have potential to be used as growth promoter as an alternative to antibiotics.

The present study was carried out to know the effect of dietary supplementation of garlic (*Allium sativum*) powder as herbal feed additive on performance of broilers.

Body Weight (BW)

The body weight of individual broiler chicks were recorded initially and at the end of every week during entire period of 6 weeks, as the changes in body weight is very reliable measure of performance of chicks subjected to various treatments. Weekly body weight of broilers under different treatments groups are presented in Table 3.

The average body weight of selected broiler chicks at day old age were 42.28 ± 0.31, 42.27 ± 0.32 and 42.18 ± 0.33 g under treatment group T₁, T₂ and T₃, respectively. The corresponding average final body weight at the end of six weeks were 2013.69 ± 6.89, 2097.02 ± 5.86 and 2039.95 ± 3.77 g in the T₁, T₂ and T₃ experimental groups, respectively.

Weeks

Treatments

T₂

Day

Results and Discussion

42.28 ± 0.31 42.27 ± 0.32

Old

Supplementing animal feeds with antibiotic based growth promoters is presently facing serious

1st 166.00 ± 1.39^a 173.45 ± 1.28^b 166.83 ± 1.20^a

Table 3: Weekly body weight (g/bird/week) of broilers under different treatment groups.

2nd 403.79 ± 2.21^a 418.93 ± 1.86^b 405.58 ± 1.67^a

3rd 738.48 ± 3.21^a 768.55 ± 3.09^b 741.78 ± 3.69^a

4th 1172.16 ± 3.95^a 1215.97 ± 3.54^b 1180.56 ± 3.72^a

5th 1598.34 ± 6.31^a 1634.67 ± 3.68^b 1607.58 ± 3.75^a

6th 2013.69 ± 6.89^a 2097.02 ± 5.86^c 2039.95 ± 3.77^b

Note: Values superscripted with different letter in the same row differ significantly. NS: Non-significant.

The body weight of birds was higher ($P < 0.001$) in garlic supplemented birds as compared to without supplemented control birds. When the diet of birds were supplemented with 0.1 % garlic powder (T_2) resulted in higher ($P < 0.001$) body weight as compared to birds fed with 0.5 % garlic powder (T_3). The present findings were in line with earlier work of, Mahmood *et al.* (2009) and Aji *et al.* (2011). In contrary to our findings, Rahimi *et al.* (2011) reported that garlic supplementation had no significant effect on body weight.

Body Weight Gain (BWG)

The biological response of growth was also

interpreted in terms of body weight gain. Weekly body weight gain of broilers under different treatment groups are presented in Table 4 and Overall (0-6 wk) body weight gain (g/bird) of broilers in under different treatment groups in Table 5.

At the end of 1st, 2nd, 3rd and 4th week of age birds fed with 0.1 % garlic had significant effect on body weight gain as compared to without supplemented control and 0.5 % garlic fed birds. The comparable effect was observed on 5th week body weight gain while the body weight gain of 6th week differ significantly ($P < 0.001$) with better gain in 0.1 % garlic powder fed birds followed by 0.5 % garlic fed birds and without supplemented control (T_1).

The overall body weight gain for 0-6 weeks of age

Table 4: Weekly body weight gain (g/bird/week) of broilers under different treatment groups.

Note: Values superscripted with different letter in the same row differ significantly. NS: Non-significant.

Table 5: Overall (0-6 wk) body weight gain (g/bird) of broilers under different treatment groups.

Replications	Treatments				
	T ₁	T ₂	T ₃		
Mean ±SE	1971.50 ± 6.92 ^a	2054.70 ± 5.77 ^c	1997.70 ± 3.68 ^b		
ANOVA					
Sources of variation	SS	D.F	MSS	'F' Value	Significance
Between groups	214664.54	2	107332.27	57.92	0.001
Within groups	322425.39	174	1853.02		
Total	537089.93	176			

were 1971.50 ± 6.92 , 2054.70 ± 5.77 and 1997.70 ± 3.68 g in treatment T₁, T₂ and T₃, respectively. The overall body weight gain was higher (P<0.001) in 0.1 % garlic (T₂) fed birds followed by 0.5 % garlic (T₃) fed birds as compared to without supplemented control (T₁). Earlier studies have reported mixed responses in body weight gain to garlic supplementation. Our findings were corroborated with earlier findings of Pourali *et al.* 2010; Mansoub, 2011; Stanacev *et al.* 2011 and Suriya *et al.* 2012. On the other hand, non-significant effect of garlic supplementation was reported by Fadlalla *et al.* 2010; Mansoub and Nezhady, 2011 and Rahimi *et al.* 2011. In present study better weight gain in garlic fed birds may be due to the action of allicin, an organosulfur compound which inhibits the growth of pathogenic bacteria and aflatoxin producing fungi leading to improved gut environment (Reeds *et al.*, 1993; Meraj, 1998 and Cullen *et al.*, 2005) and also due to promoting effect of allicin on intestinal flora, thereby improving digestion and enhancing the utilization

of energy, leading to improved growth (Lewis *et al.* 2003).

Feed Intake (Fi)

The most important factor affecting the profitability in broiler farming is feed cost which constitutes a major component of expenditure and may contribute about 70 to 75 % of total cost of broiler production. Weekly feed intake of broilers under different treatment groups are presented in Table 6.

The average feed consumed by birds for first week of age in T₁, T₂ and T₃ experimental groups were 171.06 ± 2.52 , 176.33 ± 0.40 and 171.59 ± 3.72 g respectively. The dietary supplementation of garlic powder did not bring any significant effect on feed intake during 1st, 2nd, 4th and 5th week of age. However, when birds were supplemented with 0.1 % of garlic increase in feed intake during 3rd and 6th week of age.

The overall (0-6 wk) feed intake was $3461.10 \pm$

Table 6: Weekly feed intake (g/bird/week) of broilers under different treatment groups.

Weeks	Treatments		
	T ₁	T ₂	T ₃
1 st	171.06 ± 2.52	176.33 ± 0.40	171.59 ± 3.72
2 nd	342.58 ± 1.39	350.39 ± 2.05	342.55 ± 7.62
3 rd	$542.07^a \pm 10.59$	$571.92^b \pm 1.60$	$550.65^{ab} \pm 6.99$
4 th	760.60 ± 4.91	768.72 ± 2.76	771.27 ± 11.74
5 th	794.79 ± 12.66	803.93 ± 10.46	807.00 ± 10.07

Note: Values superscripted with different letter in the same row differ significantly. NS-Non-significant.

6th 36.69 , 3615.70 ± 8.82 and 3514.70 ± 50.46 g/bird in T₁, T₂ and T₃, respectively as shown in Table 7.. The total feed intake (0-6 week) was significantly (P<0.05) better in birds receiving 0.1 % garlic (T₂) powder as compared to birds that are receiving either 0.5 % garlic (T₃) or without supplementation (T₁).

Findings of the present study were in line with earlier findings of Javandel *et al.* (2008). They 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 many workers. Isa (2011); Mansoub and Myandoab (2011); Mansoub and Nezhady (2011). In contrast to our

findings Choi *et al.* (2010); Fadlalla *et al.* (2010); Onu (2010); Raeesi *et al.* (2010); Aji *et al.* (2011); Mansoub (2011) and Rahimi *et al.* (2011) reported non-significant effect of garlic supplementation on feed intake in broilers.

Conclusion

Dietary supplementation of garlic @0.1 % in broiler diet had beneficial effect on body weight gain and feed intake. Better survivability was observed in 0.1 % garlic supplemented birds as compared to 0.5 % garlic supplemented birds or without supplemented

Table 7: Overall (0-6 wk) feed intake (g/bird) of broilers under different treatment groups.

Replications	Treatments		
	T ₁	T ₂	T ₃
Mean	3461.10	3615.70	3514.70
±SE	±36.69 ^a	±8.82 ^b	±50.46 ^{ab}

ANOVA					
Sources of variation	SS	D.F	MSS	'F' Value	Significance
Between groups	49318	2	24658.79	4.658	0.041
Within groups	47645	9	5293.91		
Total	96963	11			

control. Dietary supplementation of 0.1% garlic had beneficial effect in broilers for improving performance and also serves as one of the potential alternative to antibiotic growth promoter as well as reducing the cost of production in commercial broiler farming. Though the findings of the study are concrete and encouraging but further detail investigations are required to determine the effect of garlic supplementation on performance and welfare of broiler chickens under various agro-climatic conditions.

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