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Effect of Garlic Supplementation on Performance, Carcass Traits and Blood Profile of Broiler Chicken

A. Khaidem[1], R. Zuyie[1]* N. Haque[2] and V. K. Vidyarthi[1]

[1]Dept. of Livestock Production and Management, Nagaland University, SASRD, Medziphema Campus, Medziphema, Nagaland (797 106), India
[2]ICAR-NRC on Mithun, Division of Animal Nutrition, Jharnapani, Medziphema, Nagaland (797 106), India

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Corresponding Author

R. Zuyie

e-mail: ninot09@yahoo.co.in

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Abstract

An experiment was conducted to evaluate the feeding of garlic (*Allium sativum* L.) powder on the performance and blood profile of broiler chicken. A total of 120 day old Cobb-400 strains of broiler were distributed into four treatments groups with 30 birds in each treatment having five replicates of 6 birds each. The birds were reared in cages and were fed with diet supplemented with 0%, 0.25%, 0.50% and 0.75% of garlic powder. Feed and water was provided ad libitum and the experiment lasted for 42 days. The results had revealed that there was no significant (p>0.05) difference in body weight, gain in weight, feed intake and feed conversion efficiency, performance index, dressing percentage, carcass and organ weights due to different levels of garlic though the values were observed to be numerically better in garlic treated groups. Dietary supplementation of garlic had significant (p<0.05) effect on WBC and RBC and the values were observed to be maximum at the highest level of garlic (0.75%) and the least in control group (0%). Haemoglobin and differential white blood cells count were unaffected by garlic treatment. Economic analysis had shown that the groups fed with 0.25% and 0.05% garlic had the least cost of production and highest net profit kg^{-1} gain in weight. It was concluded that supplementation of garlic up to 0.75% did not have any adverse effect on the performance of broilers and garlic supplementation resulted in higher net return. The experiment was conducted as per CRD and the data was analysed using single way ANOVA.

Keywords: Broiler, garlic powder, performance, blood profile, economics

1. Introduction

Feed represents the major part of cost in poultry production. Rise in feed cost, availability, consumer's awareness and preference determines its production and profitability. There is an increased consumers concern over drug residues in meat and bacterial resistance (Demir et al., 2003 and Issa and Omar, 2012), environmental contamination and general health. As a result, poultry scientists today are challenged to find out new alternatives particularly to the synthetic growth promoters and to opt for natural feed supplements (Iji et al., 2001). Hence, the need to develop ideal, safe and cost effective feed that will virtually meet all aspects of production and reproduction has been an utmost concern in order to increase the efficiency and utilization of available feed and to minimize the cost of production per unit and produce quality product. Guo

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et al. (2000); Demir et al. (2003) and El- Faham et al. (2014) have reported that the herbal natural feed additives such as oregano, du-sacch, quiponin, garlic, ginger, black pepper and thyme etc. have positive effect on the performance of broilers and could be potentially used as an alternatives to an antibiotic growth promoter in broiler production.

Garlic (*Allium sativum*), a member of allium family (liliaceace) is a well known spice which contains bioactive substances like sulfur compounds such as allin, allicin and diallylsulfide, ajoene, S-allyl cysteine and diallyltrisulfide that act as antibacterial, antifungal, antiparasitic, antiviral, antioxidant and antithrombotic (Mikaili et al., 2013; Puvaca et al., 2014), vitamins, minerals and flavonoids (Pekowska and Skupien, 2009). Garlic has been found to demonstrate antimicrobial activity (Adibmoradi et al., 2006) and improve productive performance, feed conversion ratio, lower mortality, better performance index and dressing per cent of broiler chicks (Demir et al., 2003; Hamodi and Al-Hamdany 2006; Banuree et al., 2009; Broszka et al., 2015 and El-katcha et al., 2016), reduction in cost of production and higher gross profit (Borgohain et al., 2017). Similiarly, significant changes in blood haematological parameters and its biochemical constituents due to the bioactive compounds of garlic have been proved by several researchers. Numerous studies have reported increased red blood cells, total white blood cells, haemoglobin, high density lipoprotein and a reduction in cholesterol, triglycerides and low density lipoprotein (Fadlalla et al., 2010; Ahmed, 2012; Issa and Omar 2012; Oleforuh-Okoleh et al.,2015; Samanthi et al., 2015 and El-katcha et al., 2016 and Adebiyi et al., 2017). Hence, the beneficial properties of garlic effecting the performance, blood profile and immune status, supports its use through nutritional manipulation of both human and farm animal (Sallam et al., 2004).

Majority of the farmers in Nagaland practice traditional system of poultry farming where the birds are reared with zero or meagre inputs. Broiler farming is a profitable venture (Sikder et al., 2012) which is not only gaining popularity in the state but also able to meet the high demand for meat. As a result, maintaining of small units of broiler as family business particularly in semi-urban areas is on the rise. However, small scale commercial rearing of broiler by family household is being limited by factors such as high feed cost and disease outbreaks. Garlic is a widely used spice in every kitchen in the state and in traditional medicines for human as well as for animals. Considering the benefits of garlic on the performance, feed utilization, blood profile and its possible use as an alternative to antibiotic growth promoters, the present study was conceived to study its effects on the performance, carcass traits and blood profile of broilers under the agro-climatic condition of Nagaland.

2. Materials and Methods

2.1. Study site and period

The experiment was conducted in the poultry unit of the Instructional Animal Farm of the Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland. The farm is located at 93.20^0 E to 95.15^0E longitude and latitude between 25.6^0N at an elevation of 310 meter above mean sea level (MSL). The study was conducted from April to May during the year 2017.

2.2. Experimental design, birds and diets

A total of one hundred and twenty, day old, straight-run, commercial broiler chicks of Cobb-400 strain from a single hatch were procured from a reputed hatchery. The experiment was conducted as per completely Randomized Block design. The experimental birds (120 numbers) were randomly divided into four (4) different groups (designated as T_1, T_2, T_3 and T_4) with thirty (30) chicks in each group having five replicates of six (6) chicks each**.** The chicks were fed with standard broiler starter from 0-3 weeks of age followed by broiler finisher from 4-6 weeks of age and subjected to four dietary levels of garlic. Group T_1 served as control which was provided with basal diet while the group T_2, T_3 and T_4 were provided with basal diet supplemented with garlic powder @ 0.25%, 0.50% and 0.75%, respectively. Good quality garlic was purchased from local market for preparation of garlic powder which was oven dried and grounded into fine powder and used.

2.3. Management of stock and experimental procedure

The experimental birds were reared under standard management practices. After 21 days of battery brooding, the birds were transferred to rearing cages in the finisher house. The chicks were fed with standard broiler starter from 0-3 weeks of age followed by broiler finisher from 4-6 weeks of age.The feeding trial was conducted for six weeks and the feed as well as drinking water were provided ad libitum to the birds during the entire experimental period. The initial body weight of the birds was recorded at the start of the experiment and thereafter it was recorded at weekly interval. Daily feed offered and thereafter the left over feed collected the following day was recorded to determine the feed intake of the birds. Feed conversion efficiency was calculated by dividing weight gain by feed intake. Livability percentage was calculated by subtracting the mortality percentage from 100. Performance index (PI) was calculated by adopting the formula of Sapcota et al. (2014). At the end of the experiment, four birds from each treatment group was randomly selected, weighed and sacrificed by humane method to determine the carcass yield, dressing percentage and organ weight. Dressing percentage was calculated using the formula dressed weight divided by live weight multiplied by 100. Average weight of the organs (heart, liver, spleen and gizzard) was recorded as per the four respective groups. The economics of feeding garlic powder was calculated on the basis of the overall cost of inputs. Final live weight and gain in weight of the bird was considered for calculating the

gross return per bird and net profit per gain in weight.

2.4. Analysis of blood

Blood sample (2 ml) was collected in heparin tubes from three birds treatment wise via wing vein for haematological and biochemical studies. The number of RBC and WBC was counted as per the method described by Sastry (1985). Haemoglobin concentration was estimated by Cyanmethemoglobin method and expressed in g/dl. Packed cell volume (PCV) was calculated by using the formula Hb (g dl^{-1}) = 0.304*PCV + 0.461 (Velguth et al., 2010). Differential white blood cells count was determined by examining whole blood smears and expressed in percentage. The count includes relative percentages of Lymphocytes, Heterophiles, monocytes, Basophiles and Eosinophils.

2.5. Statistical analysis

Data was subjected to one-way analysis of variance (ANOVA) using SPSS (version 16.0) and the means were separated using Duncan's multiple range test of the same software used for comparisons. The overall level of statistical significance was defined as $p<0.05$.

3. Results and Discussion

3.1. Growth performance

The results presented in Table 1 revealed that the garlic treated groups showed slightly higher final body weight and total weight gain as compared to the control group however as per statistical analysis there is no significant difference due to various levels of garlic on the above parameters.

Table 1: Effect of garlic supplementation on growth performance and feed efficiency of broiler chicks

Parameters	Dietary garlic supplementation (%)			
	Control (T_1)	0.25 (T_2)	0.50 (T_3)	0.75 (T_4)
Final body weight (g $bird^{-1}$)	2189.5±28.62	2262.9±58.15	2269.6±27.89	2314.63±63.55
Total weight gain (g $bird^{-1}$)	356.48±28.62	369±58.15	369.78±27.89	377.28±3.98
Total FI (g)	3862.46±53.23	3952.83±35.92	3890.46±27.15	4001.86±53.14
FCE (gain:feed)	0.606±0.0053	0.619±0.0107	0.626±0.0092	0.621±0.0089
Livability (%)	100	100	100	100
Average PI	266.956±4.931	279.015±12.060	285.177±7.873	288.272±12.293

Hence, addition of garlic did not show any negative effect. These results are in agreement with Issa and Omar (2012) who reported that broilers fed with diet supplemented with garlic powder at 0.2 and 0.4% did not show any significant effects on body weight and weight gain. However, these findings disagree with Mahmood et al. (2009) who reported that the supplementation of 0.5% garlic in the broiler ration significantly ($p<0.05$) improved the weight gain of the birds and achieved the highest live weight.

3.2. Feed intake and FCE

Feed intake and feed conversion efficiency was found to be non significant (Table 1) though the values were observed to be higher in garlic supplemented group. This observation corroborated the findings of Adebiyi et al. (2017) who reported that there was no significant difference in feed intake and feed conversion ratio in broilers fed with 1%, 2% and 3% raw and dried garlic. On the contrary, the results of the present study disagree with El- Amin (2011) and Borgohain et al. (2017) who reported that inclusion of garlic powder resulted in increased ($p<0.05$) feed intake and achieved the best efficiency of feed utilization. Variation in the findings could be due to several factors such as the level of garlic used, type and composition of feed, strain of bird and agro-climatic condition etc.

3.3. Livability and performance index

Irrespective of the treatment, the mortality percentage of broiler birds from day old to six weeks of age was 0%. Hence, livability (Table 1) was recorded to be 100% in all the groups which might be attributed to favourable climatic condition, good quality feed and proper management practices. It was also indicative that supplementation of garlic did not have adverse effect on the survivability of the birds.

Non-significant effect of garlic was observed for average performance index as presented in Table 1 though higher values are observed in groups fed with garlic based diet. Similiar to the present findings, Borgohain et al. (2017) had also reported that inclusion of garlic powder at the rate of 0.5, 1.0 and 1.5% resulted in highest broiler performance efficiency index (BPEI) and 100% livability.

3.4. Carcass traits

The average dressing percentage, carcass yield and the organ weights were unaffected by garlic powder (Table 2) which is in line with the findings reported by Mahmood et al. (2009) and Samanthi et al. (2015) who observed that basal feed with or without garlic powder failed to produce positive effects on carcass yield in terms of dressing percentage and relative giblet weight (heart, gizzard, liver and spleen).

3.5. Haematological parameters

The average values of haemoglobin, total white blood cells, red blood cells, packed cell volume and differential white blood cells count in birds of different groups is presented in Table 3. The values for haemoglobin and packed cells

Table 2: Effect of garlic supplementation on dressing percentage, carcass yield and organs weight (g bird^{-1}) of broiler birds

Group	Dressing %	Carcass weight (g)	Organ weight (g)			
			Heart	Liver	Gizzard	Spleen
T_1	72.22	2203.5	15.55	88.62	45.10	5.75
T_2	73.57	2638	16.87	88.14	45.83	8.86
T_3	74.03	2573	17.43	97.80	41.61	8.65
T_4	73.19	2400.5	18.33	88.65	48.96	8.24

Table 3: Effect of garlic supplementation on blood profile of broiler chicken

Treatment	Haemoglobin (g dl^{-1})	Total white blood cells (thousand mm^{-3})	Total red blood cells (Million mm^{-3})	Packed cells volume (%)	Differential white blood cells count(%)				
					Mono.	Baso.	Hetero.	Eosino.	Lympho.
T_1	9.98±0.18	18.0^{c}±5.67	2.56^{c}±.03	32.35±0.62	1.00±0.58	0	30±2.08	0	69±2.52
T_2	9.92±0.35	22.3^{b}±7.73	2.89^{b}±.04	32.18±1.15	1.39±0.88	0	27±2.08	0	71±2.96
T_3	9.99±0.41	24.3^{b}±7.96	2.68^{c}±.05	32.43±1.35	1.03±0.33	0	28±3.28	0	71±3.21
T_4	9.77±0.19	32.0^{a}±9.44	3.03^{a}±.06	31.67±0.609	1.00±0.67	0	23±2.03	0	75±1.45

^{a,b,c}Means bearing different superscripts within the column differ significantly (p<0.05)

volume did not differ from the control group however, there was significant (p<0.05) effect of garlic supplementation on WBC and RBC particularly at 0.75% of garlic in the diet. The differential white blood count cells including monocytes, basophils, heterophils, eosinophils and lymphocytes were unaffected by addition of garlic. Similiar findings was reported by Ahmed (2012) who observed that haemoglobin estimation at 2% of garlic did not show significant difference from control group and garlic supplementation at 3 and 5% did not have significant effect (p>0.05) on the differential count of white blood cells including neutrophils, basophils eosinophils, monocytes and lymphocytes (El- Amin, 2011, Elagib et al., 2013). Conversely, Ari et al. (2012) and Oleforuh-Okoleh et al. (2015) reported significant increase in haemoglobin concentration and packed cell volume. Variation in the results might be due to levels and form of garlic used, seasons, type of feed and its composition, strain differences etc.The present investigation showed that garlic did have adverse effect on the blood parameters within the tested doses but suggested a positive influence particularly in RBC and WBC which was in agreement with Fadlalla et al. (2010) and Toghyani et al. (2011) who reported a significant (p<0.05) increased in white blood cells and red blood cells count, respectively in birds fed with garlic as compared to the control group. This study supported the findings of Tariq et al. (1988) and Mikaili et al. (2013) that the organo sulfur volatile compounds contribute to the effective bioactive properties of garlic which includes allicin, diallyl disulphide, S- allyl cysteine and diallyl trisulfide.

3.6. Economic efficiency of feeding garlic

The results obtained on the economic efficiency of feeding garlic in broiler chicken presented in Table 4 shows that the least and the highest cost of production kg^{-1} gain was

Table 4: Effect of garlic supplementation on the economic efficiency of broiler production

Items	Treatment Groups			
	T_1	T_2	T_3	T_4
Cost of broiler (₹ bird^{-1})	40.00	40.00	40.00	40.00
Cost of feed (₹ bird^{-1})	123.52	126.40	124.48	128.03
Miscellaneous cost (₹ bird^{-1})	20.88	22.81	24.77	26.881
Cost of production (₹ bird^{-1})	184.4	189.21	189.25	194.911
Average final Weight of broiler (kg^{-1})	2.189	2.262	2.269	2.314
Average total gain in weight kg^{-1}	2.138	2.214	2.218	2.263
Cost of production kg^{-1} gain (₹)	86.248	85.460	83.324	86.129
Receipt through sale of broiler @ ₹ 130 kg^{-1} live weight	284.57	295.06	294.97	300.82
Sale of gunny bags @ ₹ 10 bag^{-1}	1.10	1.12	1.10	1.14
Total receipt (₹) bird^{-1}	285.57	295.06	294.97	300.82
Profit bird^{-1} (₹)	101.27	105.97	106.82	107.049
Net profit kg^{-1} gain in weight (₹)	47.366	47.863	48.160	47.300

recorded in group fed with 0.5% garlic and the control group, respectively. Garlic supplementation resulted in higher net profit kg^{-1} weight gain which apparently is due to better feed efficiency. Addition of garlic at 0.5% resulted in highest net profit kg^{-1} gain in weight. Similar findings had earlier been reported by Singh et al. (2015) who observed increased returns due to garlic supplementation and advocated its use for better profitability.

4. Conclusion

Addition of garlic upto 0.75% did not have adverse effect on the body weight, gain in weight, feed efficiency and performance index as compared to control. However, positive effect of garlic was observed in the blood parameters particularly for WBC, RBC and lymphocytes. In terms of economy, addition of garlic at 0.25 to 0.50% resulted in least cost of production kg^{-1} gain and higher net return.

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