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Growth Performance and Nutrient Utilization of Male Broiler Chicken as Affected by Feed Restriction with or without Garlic Supplementation

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ABSTRACT

One hundred and twenty, day old male broiler chicks were randomly distributed into 5 treatments each having 4 replicates with 6 birds in each replicate. Diets were formulated as per ICAR (2013) specifications and were fed in 3 phases. Treatment T_1 served as control. The other treatments comprised: $T_2 = T_1$ with feed restriction (10-12 h) at 8-17 days of age (DOA) with garlic supplementation, $T_3 = T_1$ with feed restriction at 8-17 DOA (10-12 h) without garlic supplementation, $T_4 = T_1$ with feed restriction at 18-27 DOA (10-12 h) with garlic supplementation, $T_5 = T_1$ with feed restriction at 18-27 DOA (10-12 h) without garlic supplementation. Early feed restriction (8-17 DOA) with or without garlic supplementation reduced ($P<0.05$) the average body weight gain and feed intake at 2nd week of age. Garlic supplementation and late feed restriction from 18-27 DOA reduced ($P<0.05$) the average body weight gain and feed intake at 4th week of age. There was no significant effect on feed conversion ratio (FCR) of early and late feed restriction with or without garlic supplementation expect at 5th week of age where FCR was observed to be better ($P<0.05$) in T_2 and T_4 as compared to control. There was no significant difference in protein efficiency ratio and calorie efficiency ratio among the groups. Early and late feed restrictions with garlic supplementation (T_2 and T_4) had higher ($P<0.05$) digestibility of crude protein and organic matter. It was concluded that garlic supplementation irrespective of restriction period (early or late) improved the FCR at the 5th week of age, crude protein digestibility and organic matter digestibility.

Key words: Feed restriction, Garlic supplementation, Male broiler chicken, Nutrient digestibility

INTRODUCTION

Poultry industry is supporting the nutrient supply of the huge population of the world. Broilers make up a large part of this industry with chicken meat accounting for 86% of the world poultry meat. Indian poultry sector has been growing @ 8-10% annually with broiler meat volumes growing @ of 10% due to increased domestic consumption (Panigrahy *et al.,* 2016). If feed is offered *ad lib.*, broilers consume feed 2-3 times above maintenance requirements. This enhanced growth due to *ad lib*. feeding is unfortunately accompanied by certain ill effects like high metabolic rate, high mortality, increased body fat, metabolic and skeletal defects (Zubair and Leeson, 1996). Feed restriction is a method of feeding in which the time or duration or amount of feed is limited. Plavnik and Hurwitz (1988) observed that the timing, severity and duration of restriction had significant effect on the subsequent ability of broilers to recover from a growth defect. Early feed restriction programs used to reduce abdominal and carcass fat in broiler chickens rely on the event called compensatory growth. Male broilers have a greater ability to exhibit compensatory growth following a period of under nutrition than females (McMurty *et al.,* 1988; Plavnik and Hurwitz, 1990 and 1991). Feed restriction strategy in broilers can improve feed efficiency, reduce feed cost and mortality along with the production of quality meat at cheaper rates. So, feed restriction strategies have been introduced at 8-17 days of age (DOA) and 18-27 DOA to reduce these metabolic problems and hence improve economy of broiler production.

Antibiotics as feed supplement are under serious criticism due to their ill effects like development of microbial resistance to the pathogens and their potential harmful effects on human health (Rahmatnejad *et al.,* 2009). At present, there is increasing pressure to reduce or eliminate the use of antibiotics in poultry feed due to the negative human health issue of antibiotic resistance. In garlic (*Allium sativum*), major active ingredients like allicin, ajoene, dialkyl polysulphides,

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s-allylcysteine *etc.* may be responsible for the various properties of garlic (Canogullari *et al.,* 2010). Allicin rapidly decomposes to several volatile organosulphur compounds which possibly reduce low density lipoprotein, triglyceride and cholesterol in serum (Alder *et al.,* 2003). Garlic as natural growth promoter can improve growth rate, feed conversion ratio and carcass characteristics (Tollba and Hassan, 2003; Makwana *et al.,* 2015). Supplementation of garlic powder @ 1.5% gave best response in terms of growth performance (Singh *et al.,* 2015). This study was, therefore, conducted to assess the effect of feed restriction along with garlic supplementation @ 1.5% on growth performance and nutrient digestibility in male broiler chicken.

MATERIALS AND METHODS

The study was conducted at the poultry farm and poultry nutrition laboratory of the Department of Animal Nutrition, GADVASU, Ludhiana, Punjab. One hundred and twenty male, day old meat type chicks (IBL-80) were procured from GADVASU hatchery and distributed randomly into 5 groups having 24 birds per treatment with 4 replicates having 6 chicks in each replicate representing different treatments *viz.,* T_1 - Control male group fed *ad lib.* as per ICAR (2013) specification *i.e.* starter diet (0-14 DOA) *i.e.* 22% CP and 3000 Kcal/kg ME, grower diet (14-21 DOA) *i.e.* 21.5% CP and 3050 Kcal/kg ME and finisher diet (21-35 DOA) *i.e.* 19.5% CP and 3100 Kcal/kg ME. The other treatments comprised: $T_2 = T_1$ with feed restriction (10-12 h) at 8-17 DOA (10-12 h) with garlic supplementation, $T_3 = T_1$ with feed restriction at 8-17 DOA (10-12 h) without garlic supplementation, $T_4 = T_1$ with feed restriction at 18-27 DOA (10-12 h) with garlic supplementation, $T_5 = T_1$ with feed restriction at 18-27 DOA (10-12 h) without garlic supplementation.

Six broilers diets were formulated for the study for weekly observations. The percent ingredient composition of all the phases was kept as per ICAR (2013) specifications (Table 1). Each diet was fed to quadruplicate group of chicks having 6 birds in each replicate during all the phases of growth. The feeders were removed from 10-12 h during 8 p.m. to 8 a.m. (next day) to apply feed restriction.

A metabolic trial was conducted at the end of experiment. Four birds with comparable body weight were selected from each treatment and were housed in battery brooders. There were 2 replicates of each treatment having 2 birds in each replicate. Birds were fed the same treatment ration for five days as in growth study to provide them adaptation time in the metabolic cages. After adaptation period of five days, the measured quantity of feed for next three consecutive days was offered to each replicate both in the morning and evening. The residual feed left was removed on 4th day and weighed to record the actual consumption of feed for each replicate. Three days total collection method was used for faeces. The sample of faeces were ground and analyzed for various proximate parameters (AOAC, 2005).

The data were subjected to statistical analysis using one way ANOVA in Software Package for Social Sciences (SPSS, version 22.0) to test the difference between various treatments. The treatment means were compared by Duncan's Multiple Ranged Test (Duncan, 1995) at 5% level of significance.

RESULTS AND DISCUSSION

There was no significant difference in average body weight gain at 1st week of age. But early feed restriction with or without garlic supplementation (T_2 and T_3) reduced ($P<0.05$) the average body weight gain at 2nd week of age (Table 2). Garlic supplementations in early (T_2) and late (T_4) feed restricted groups had no significant effect on average body weight gain as compared to their non-garlic supplemented T_3 and T_5 treatments. However, numerically higher value was observed due to garlic supplementation in corresponding feed restricted treatments at different weeks of age. There was no significant effect of garlic supplementation and feed restriction at 3rd and 5th week of age. But, garlic supplementation and late feed restriction (T_4 and T_5) from 18-27 days of age reduced ($P<0.05$) the average body weight gain at 4th week of age. Similarly, significantly ($P<0.05$) reduced average

Table 1. Ingredient composition (%) of experimental diets

Phase	Ingredient (kg/100 kg)	Treatment				
		T_1	T_2	T_3	T_4	T_5
Starter	Maize	54.85	54.35	54.85	54.35	54.85
	Soybean meal	33.5	33.5	33.5	33.5	33.5
	Groundnut extraction	4.5	4.0	4.5	4.0	4.5
	De-oiled rice bran	1.0	0.5	1.0	0.5	1.0
	Garlic	-	1.5	-	1.5	-
	Oil	2.5	2.5	2.5	2.5	2.5
	Di-calcium phosphate	1.5	1.5	1.5	1.5	1.5
	Limestone powder	1.5	1.5	1.5	1.5	1.5
	Methionine (g)	150	150	150	150	150
	Salt (g)	300	300	300	300	300
	Additives*(g)	200	200	200	200	200
	Total (kg)	100	100	100	100	100
Grower	Maize	57.0	57.0	57.0	57.0	57.0
	Soybean Meal	27.0	27.0	27.0	27.0	27.0
	Groundnut extraction	4.0	4.0	4.0	4.0	4.0
	De-oiled rice bran	5.0	3.5	5.0	3.5	5.0
	Garlic	-	1.5	-	1.5	-
	Oil	3.5	3.5	3.5	3.5	3.5
	Di-calcium phosphate	1.9	1.9	1.9	1.9	1.9
	Limestone powder	1.0	1.0	1.0	1.0	1.0
	Methionine (g)	100	100	100	100	100
	Salt (g)	300	300	300	300	300
	Additives*(g)	200	200	200	200	200
	Total (Kg)	100	100	100	100	100
Finisher	Maize	57.0	57.0	57.0	57.0	57.0
	Soybean meal	27.0	27.0	27.0	27.0	27.0
	Groundnut extraction	4.0	4.0	4.0	4.0	4.0
	De-oiled rice bran	5.0	3.5	5.0	3.5	5.0
	Garlic	-	1.5	-	1.5	-
	Oil	3.5	3.5	3.5	3.5	3.5
	Di-calcium phosphate	1.9	1.9	1.9	1.9	1.9
	Limestone powder	1.0	1.0	1.0	1.0	1.0
	Methionine (g)	100	100	100	100	100
	Salt (g)	300	300	300	300	300
	Additives*(g)	200	200	200	200	200
	Total (kg)	100	100	100	100	100

*Additives include Vit A 8,25,000 IU, Vit D_3 1,20,000 IU/, Vit K 100 mg, Riboflavin 500 mg, Thiamine 80 mg, Pyridoxine 160 mg, Vit E 800 mg, Cyanocobalamine 100 mcg, Niacin 1200 mg, Calcium pantothenate 80 mg, Manganese sulphate 25 g, Ferrous sulphate 10 g, Copper sulphate 500mg, Zinc oxide 8g Potassium Iodide 100 mg, Coccidiostat 60g

body weight gain due to early feed restriction was reported by other workers (Omosebi *et al.,* 2014; Malpotra *et al.,* 2017; Sidhu *et al.,* 2017). But, various other studies reported that there was no significant difference in the final body weight due to feed restrictions (Saber *et al.,* 2011; Jahanpour *et al.,* 2015). Moreover, Khetani *et al*. (2009) did not find any compensatory growth in the feed restricted groups. In contrast, the other researchers (Konjufca *et al.,* 1997; Ademola *et al.,* 2004; Onibi *et al.,* 2009), observed no effect of garlic supplementation on body weight gain. Whereas, higher (P<0.05) body weight gain in the garlic supplemented group than the control group has been reported (Noman *et al.,* 2015; Varmaghany *et al.,* 2015; Khan *et al.,* 2017).

Significantly (P<0.05) reduced feed intake was observed in early feed restriction with garlic (T_2) and without garlic (T_3) at 2nd week of age and late feed

Table 2. Effect of feed restriction and garlic supplementation on growth performance in male broilers

Item	Treatment					SEM
	T_1	T_2	T_3	T_4	T_5	
Average body weight gain (g)						
1st wk	92.80	89.20	86.37	91.66	88.13	1.136
2nd wk	163.37[a]	143.43[b]	140.04[b]	163.16[a]	156.43[a]	3.168
3rd wk	238.10	234.04	231.50	238.27	231.39	1.876
4th wk	278.02[a]	282.39[a]	275.91[a]	270.47[ab]	265.33[b]	1.439
5th wk	353.29	355.22	348.22	362.41	347.29	2.607
Average feed intake						
1st wk	155.60	147.39	144.25	150.8	145.63	1.351
2nd wk	280.40[a]	248.45[b]	246.90[b]	278.48[a]	274.78[a]	3.383
3rd wk	447.33[a]	439.22[ab]	436.11[b]	446.61[a]	446.85[a]	2.091
4th wk	556.02[a]	557.90[a]	553.60[a]	541.20[b]	533.32[b]	1.654
5th wk	808.62	805.33	802.20	810.12	806.16	2.822
Feed conversion ratio (kg feed consumed/kg gain)						
1st wk	1.67	1.65	1.67	1.64	1.65	0.023
2nd wk	1.71	1.73	1.76	1.70	1.75	0.025
3rd wk	1.87	1.87	1.88	1.87	1.93	0.014
4th wk	1.99	1.97	2.00	2.00	2.01	0.013
5th wk	2.28[ab]	2.26[b]	2.30[a]	2.23[b]	2.32[a]	0.032
Protein efficiency ratio						
1st wk	2.70	2.73	2.71	2.75	2.73	0.070
2nd wk	2.63	2.61	2.56	2.65	2.57	0.072
3rd wk	2.48	2.48	2.47	2.48	2.41	0.061
4th wk	2.57	2.60	2.56	2.57	2.56	0.060
5th wk	2.25	2.27	2.23	2.30	2.22	0.079
Calorie efficiency ratio						
1st wk	0.199	0.202	0.200	0.203	0.202	0.010
2nd wk	0.194	0.192	0.189	0.195	0.190	0.002
3rd wk	0.174	0.173	0.172	0.175	0.169	0.034
4th wk	0.161	0.163	0.161	0.161	0.160	0.001
5th wk	0.141	0.142	0.140	0.144	0.139	0.002

[a,b,c]Means bearing different superscripts in the same row differ significantly (P<0.05)

Table 3. Effect of feed restriction and garlic supplementation on nutrient digestibility (%) in male broilers

Digestibility	Treatment					SEM
	T_1	T_2	T_3	T_4	T_5	
Crude protein	68.8[b]	71.69[a]	69.09[b]	71.18[a]	67.65[b]	0.918
Ether extract	88.57	87.96	87.93	89.05	87.11	0.797
Fiber	37.15	35.97	37.34	36.39	37.09	0.847
Organic matter	71.17[b]	75.33[a]	71.13[b]	75.31[a]	71.21[b]	0.786
Calcium	50.82	50.87	50.60	50.89	50.65	0.248
Phosphorus	46.58	46.65	46.41	46.63	46.36	0.316

[a,b,c]Means bearing different superscripts in the same row differ significantly (P<0.05)

restriction with garlic (T_4) and without garlic (T_5) at 4th week of age as compared to control (Table 2). It indicated that feed restrictions with or without garlic supplementation reduced (P<0.05) the feed intake. Results of various previous studies (Zhan *et al.,* 2007; Mehmood *et al.,* 2013; Omosebi *et al.,*2014) showed that duration of restriction and level of restriction reduced (P<0.05) feed intake in poultry. However, other workers (Yalcin *et al.,* 2006; Onibi *et al.,* 2009; Saber *et al.,* 2011; Afsharmanesh *et al.,* 2016) observed non-significant feed intake due to feed restriction and garlic supplementation. Whereas, Al massad *et al.*(2018) and Islam *et al.* (2018), reported highery (P<0.05) feed consumption due to garlic supplementation. There was no significant effect on FCR in different treatments as compared to control upto 4th week of age. Saber *et al.* (2011) and Sidhu *et al.* (2017) did not found any significant effect of feed restrictions on FCR. Also, Onibi *et al.*(2009) did not found any significant difference in FCR in garlic supplemented broilers (8-56 days). But, garlic supplemented groups *i.e.* T_2 and T_4 had better FCR than the non-garlic supplemented group *i.e.* T_3 and T_5 at 5th week of age. Rincon and Leeson (2002), Omosebi *et al.* (2014) and Malpotra *et al.* (2017) reported better FCR with feed restriction. A better (P<0.05) FCR in garlic powder supplemented groups.has been reported (Fadlalla *et al.* 2010; Raessi *et al.,* 2010; Patel *et al.,* 2017; Ratika *et al.,* 2018).

There was no significant difference in PER and CER due to early and late feed restriction with or without garlic supplementation in different weeks of age from 1st to 5th week of age as well as in different phases and overall period. In this context, Butzen *et al.* (2015) and Sidhu *et al.* (2017) reported that PER and CER were not affected by feed restrictions during different phases. While Saleh *et al.* (2005) and Ratika *et al.* (2018) reported that PER and CER were better in garlic supplemented and feed restricted groups as compared to control group. Furthermore, Malpotra *et al.* (2017) reported that PER and CER were higher for 2nd week feed restricted group during 2nd week and 4th week feed restricted group during 4th week. Overall improved protein feed efficiency due to feed restrictions followed by compensatory growth was also reported (Mollison and Guenter, 1984); Ramlah *et al.* 1996; Al-Taleb, 2003).

Early and late feed restrictions with garlic supplementation (T_2 and T_4) had higher (P<0.05) digestibility of crude protein and organic matter. The digestibility of of ether extract, fibre, calcium and phosphorus due to early and late feed restriction with or without garlic supplementation was similar in all the groups. Feed restriction increased nutrient digestibility by 5% with 25% feed restriction from 28-39 days of age (Teeter and Smith 1985). However, significantly lower value for phosphorus retention was observed in third week restrictions as compared to second week restrictions as reported by Malpotra *et al.* (2017). Singh *et al.* (2017) reported higher crude fibre digestibility in garlic supplemented diets as compared to control and also calcium retention was found to be higher in garlic supplemented diets but dry matter metabolizability, ether

extract digestibility, percent nitrogen and phosphorus retention remained unaffected.

CONCLUSION

It was concluded that garlic supplementation irrespective of restriction period (early or late) improved the FCR at the 5th week of age, crude protein digestibility and organic matter digestibility.

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