

Growth Performance, Blood Biochemical Profile, Carcass Traits and Chemical Composition of Meat in Female Broiler as Affected by Feed Restriction and Garlic Supplementation

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Abstract

An experiment was conducted to study the effects of feed restriction and garlic supplementation on growth performance, blood biochemical profile, carcass traits and chemical composition of meat in female broilers. In this study, 120, day old female broilers 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 i.e. starter phase, grower phase and finisher phase. Treatment T1 was served as control. The other treatments comprised: T2 = T1 with feed restriction (10-12 h) at 8-17 days of age (DOA) with garlic supplementation, T3 = T1 with feed restriction at 8-17 DOA (10-12 h) without garlic supplementation, T4 = T1 with feed restriction at 18-27 DOA (10-12 hrs) with garlic supplementation, T5 = T1 with feed restriction at 18-27 DOA (10-12 hrs) without garlic supplementation. Early feed restriction with or without garlic supplementation (T2 and T3) reduces the average body weight gain and average feed intake as compared to control (T1) significantly ($P < 0.05$) in starter phase. Garlic supplementation in early feed restriction (T2) had significantly ($P < 0.05$) higher average body weight gain as compared to early feed restriction without garlic supplementation (T3) in starter phase. For overall period, early feed restriction without garlic supplementation (T3) had significantly ($P < 0.05$) reduced average body weight gain as compared to control (T1). Late feed restriction without garlic supplementation (T5) significantly ($P < 0.05$) reduced the average feed intake as compared to control (T1) and late feed restriction with garlic supplementation (T4) for overall period. Cholesterol levels were found to be significantly ($P < 0.05$) lower in garlic supplemented as well as in early and late feed restricted groups. Abdominal fat content was also reduced due to feed restrictions. So, it was concluded that feed restrictions were used a tool to alter the chemical composition of meat in terms of cholesterol level and fat contents of muscles.

Keywords: Feed Restriction, Female Birds, Garlic Supplementation, Nutrient Digestibility, Meat Quality

Introduction

Indian poultry sector has been growing at a rate of 8-10% annually with broiler meat volumes growing up at a rate of 10% due to increased domestic consumption. If feed is offered ad-libitum, broilers consumes 2-3 times above maintenance requirements. This enhanced growth due to ad-libitum feeding is unfortunately accompanied by certain ill-effects. Feed restriction is a method of feeding in which the time or duration or amount of feed is limited and is one of the ways to eliminate these ill-effects. Male broilers have a greater ability to exhibit compensatory growth following a period of under nutrition than females (Plavnik and Hurwitz, 1991). Feed restriction strategy in broilers can also improve feed efficiency; reduce feed cost and mortality along with the production of quality meat at cheaper rates. Garlic (*Allium sativum*) has been called the wonder drug of the herbal world. It possess antibacterial, antifungal, antiparasitic, antiviral and antioxidant properties. Garlic as natural growth promoter in poultry can improve growth rate, feed conversion ratio and carcass characteristics (Makwana *et al.*, 2015).

But effect of feed restriction and garlic supplementation in female broilers is not study yet. This study was therefore conducted to assess the effect of feed restriction (at 8-17 days of age (DOA) and 18-27 DOA) along with garlic supplementation @1.5% on growth performance, blood biochemical profile, carcass traits and chemical composition of meat in female broilers.

Materials and Methods

The present investigation was carried out to study the effect of feed restriction and garlic supplementation in female broilers. The study was conducted at the poultry farm and poultry nutrition laboratory of the department of animal nutrition, GADVASU, Ludhiana, Punjab. 120 female, day old meat type chicks (IBL-80) were procured from GADVASU hatchery and distributed randomly into 5 groups having total 24 birds per treatment with 4 replicates having 6 chicks in each replicate representing different treatments which are as follows-T₁ - Control female group fed *ad libitum* 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: T₂ = T₁ with feed restriction (10-12 h) at 8-17 DOA (10-12 hrs) with garlic supplementation, T₃ = T₁ with feed restriction at 8-17 DOA (10-12 hrs) without garlic supplementation, T₄ = T₁ with feed restriction at 18-27 DOA (10-12 hrs) with garlic supplementation, T₅ = T₁ with feed restriction at 18-27 DOA (10-12 hrs) without garlic supplementation. The percent ingredient composition of all the phases was kept as per ICAR (2013) specifications given in 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 hours during 8 p.m. to 8 a.m. (next day) to apply feed restriction. At the end of feeding trial, two birds (1 male + 1 female) from each replicate were slaughtered to record eviscerated weight, dressing percentage, abdominal fat and weight of heart, liver and gizzard as well as giblet. About 50gms of breast and thigh muscle sample were taken and stored in deep freezer. Moisture, fat and protein content of muscles were evaluated as per the standard procedure. Blood sample of one bird per replicate totaling to four birds from each treatment on 35th day was collected from wing vein in two EDTA containing and non EDTA vials. The serum was prepared from the later. EDTA containing sample was used for determining hemoglobin (hemometer method) and packed cell volume, while serum was used for estimating glucose, triglycerides, cholesterol, and total protein content. The measurements were taken using commercial Siemens auto pack kits with RA 50. The collected data of different experiments was 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.

Table 1: Percent ingredient composition of experimental diets

	Ingredients (kg/100 kg)	Treatments				
		T ₁	T ₂	T ₃	T ₄	T ₅
Starter Phase	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	4.5	4	4.5
	De-oiled Rice Bran	1	0.5	1	0.5	1
	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 Phase	Maize	57	57	57	57	57
	Soybean Meal	27	27	27	27	27
	Groundnut Extraction	4	4	4	4	4
	De-oiled Rice Bran	5	3.5	5	3.5	5
	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	1	1	1	1
	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 Phase	Maize	57	57	57	57	57
	Soybean Meal	27	27	27	27	27
	Groundnut Extraction	4	4	4	4	4
	De-oiled Rice Bran	5	3.5	5	3.5	5
	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	1	1	1	1
	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 D₃ 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.

Results and Discussion

Growth Performance of Female Broilers

The data pertaining to effect of feed restriction and garlic supplementation on growth performance in term of average body weight gain, average daily feed intake, feed conversion ratio, protein efficiency ratio and calorie efficiency ratio in female broiler is given in Table 2.

Table 2: Effect of feed restriction and garlic supplementation on growth performance of female broilers

	T ₁	T ₂	T ₃	T ₄	T ₅	S.E.M
Average Body Weight Gain						
Starter phase	234.34 ^a	225.387 ^b	215.9 ^c	234.82 ^a	231.56 ^{ab}	1.933
Grower phase	222.35 ^a	216.79 ^{ab}	214.75 ^b	224.77 ^a	221.89 ^{ab}	1.354
Finisher phase	568.06 ^b	577.86 ^a	566.63 ^b	570.38 ^{ab}	565.15 ^b	1.463
Overall period	1024.75 ^{ab}	1020.037 ^b	997.29 ^c	1029.97 ^a	1018.6 ^b	2.763
Average Feed Intake						
Starter phase	401.93 ^a	371.68 ^b	369.65 ^b	394.53 ^a	391.66 ^a	2.176
Grower phase	414.79 ^a	399.14 ^b	403.22 ^b	418.61 ^a	420.35 ^a	1.594
Finisher phase	1269.29 ^{ab}	1286.97 ^a	1279.77 ^a	1270.02 ^{ab}	1265.24 ^b	1.735
Overall period	2086.01 ^a	2057.79 ^c	2052.65 ^c	2083.16 ^a	2077.25 ^b	3.185
FCR						
Starter phase	1.7	1.64	1.7	1.67	1.68	0.198
Grower phase	1.86	1.84	1.87	1.86	1.89	0.186
Finisher phase	2.23	2.22	2.25	2.22	2.23	0.194
Overall period	2.03	2.01	2.05	2.02	2.03	0.191
PER						
Starter phase	2.63	2.74	2.65	2.69	2.68	0.105
Grower phase	2.5	2.53	2.48	2.5	2.46	0.093
Finisher phase	2.36	2.39	2.35	2.37	2.35	0.101
Overall period	2.5	2.55	2.49	2.52	2.49	0.098
CER						
Starter phase	0.194	0.202	0.195	0.198	0.198	0.052
Grower phase	0.175	0.178	0.174	0.176	0.173	0.051
Finisher phase	0.148	0.149	0.147	0.149	0.147	0.043
Overall period	0.172	0.176	0.172	0.174	0.172	0.063

*Values with different superscripts differ significantly ($p \leq 0.05$) within each row

Due to early feed restrictions with or without garlic supplementation (T₂ and T₃) reduces the average body weight gain as compared to control (T₁) significantly ($P < 0.05$) in starter phase. But, garlic supplementation in early feed restriction (T₂) had significantly ($P < 0.05$) higher average body weight gain as compared to early feed restriction without garlic supplementation (T₃) in starter phase. It indicated that garlic supplementation in early feed restrictions improved the average body weight gain during the starter phase in female broilers. There was no significant effect in grower phase was observed due to feed restriction with or without garlic supplementation as compared to control (T₁). But, T₄ had significantly ($P < 0.05$) higher body weight gain as compared to T₃ in grower phase. Early and late feed restriction without garlic supplementation (T₃ and T₅) had no significant effect as compared to control (T₁) in finisher phase. But, T₂ had significantly ($P < 0.05$) higher average body weight gain as compared to T₁, T₃ and T₅ in finisher phase. For overall period, early feed restriction without garlic supplementation (T₃) had significantly ($P < 0.05$) reduced average body weight gain as compared to control (T₁). Moreover, garlic supplementation in early feed restriction with garlic supplementation (T₂) had significantly ($P < 0.05$) higher average body weight gain as compared to T₃ in overall period. Similarly, T₄ had significantly ($P < 0.05$) higher average body weight gain as compared to T₅ in overall period. It indicated that garlic supplementation in early and late feed restrictions improved the average body weight gain in female birds. Khan *et al.* (2017), Varmaghany *et al.* (2015), Noman *et al.* (2015) found significantly ($P < 0.05$) higher body weight gain in the garlic supplemented group than the control group. But, Onibi *et al.* (2009) observed no effect of garlic supplementation on body weight gain.

Due to early feed restrictions with or without garlic supplementation (T_2 and T_3) reduced the average feed intake significantly ($P<0.05$) as compared to control (T_1) in starter phase, grower phase and for overall period. But, late feed restriction with or without garlic supplementation (T_4 and T_5) did not reduced the feed intake significantly as compared to control (T_1) in different phases. But for overall period, late feed restriction without garlic supplementation (T_5) significantly ($P<0.05$) reduced the average feed intake as compared to control (T_1) and late feed restriction with garlic supplementation (T_4). Islam *et al.* (2018), Al-Massad *et al.* (2018), Elagib *et al.* (2013), Javed *et al.* (2009) and Javandel *et al.* (2008) reported significantly ($P<0.05$) higher feed consumption in garlic supplemented diets. But, Singh *et al.* (2015), Khan *et al.* (2017), Varmaghany *et al.* (2015), Noman *et al.* (2015), Onibi *et al.* (2009), observed no effect by supplementation of garlic on the amount of total feed consumption.

There was no significant difference in feed conversion ratio during various phases. However, in overall period, FCR was numerically better in feed restricted and garlic supplemented groups (T_2 and T_4). Malpotra *et al.* (2017) and Omosebi *et al.* (2014) had reported ($P<0.05$) better FCR with feed restrictions. But, Sidhu *et al.* (2017) and Saber *et al.* (2011) did not found any significant results for effects of feed restrictions on FCR. Ratika *et al.* (2018), Patel *et al.* (2017), Fadlalla *et al.* (2010) and Raessi *et al.* (2010) reported ($P<0.05$) better FCR in garlic powder supplemented groups. But, Onibi *et al.* (2009) did not found any significant difference in FCR in garlic supplemented broilers. There was no significant difference in PER due to early and late feed restriction with or without garlic supplementation in different period of age. Garlic supplementation in early and late feed restrictions had no significant effect on protein efficiency ratio. However, in overall period, PER was numerically higher in feed restricted groups and garlic supplemented groups (T_2 and T_4) as compared to control (T_1). Sidhu *et al.* (2017) and Butzen *et al.* (2015) reported no significant differences in PER during different phases due to feed restrictions. Ratika *et al.* (2018) reported that PER was significantly ($P<0.05$) better in garlic supplemented groups than the control group. But PER was significantly ($P<0.05$) higher for 2nd week feed restricted group during 2nd week and fourth week feed restricted group during 4th week was reported by Malpotra *et al.* (2017). Overall ($P<0.05$) improved protein feed efficiency due to feed restrictions followed by compensatory growth was reported by Al-Taleb (2003).

There was no significant difference in CER due to early and late feed restriction with or without garlic supplementation in different phases. However, in overall period, CER was numerically higher in feed restricted groups and garlic supplemented groups (T_2 and T_4). Sidhu *et al.* (2017) also reported no significant difference in the CER due to feed restrictions. But, Malpotra *et al.* (2017) observed that feed restriction during 2nd week gave significantly ($P<0.05$) higher value of CER for 2nd week and for 4th week, CER was found significantly ($P<0.05$) lower for fourth week restricted groups but for 5th week, fourth week restricted groups gave significantly better value. Moreover, Saleh *et al.* (2005) also reported ($P<0.05$) improved calorie efficiency ratio following feed restrictions. But, effect of garlic supplementation in early and late feed restrictions in female broiler is not available in the literature.

Blood Parameters, Carcass Traits and Chemical Composition of Meat

The data pertaining to effect of feed restriction and garlic supplementation on blood parameters, carcass traits and chemical composition of meat i.e. thigh and breast composition in female broiler is given in Table 3. Cholesterol levels were found to be significantly ($P<0.05$) lower in garlic supplemented in feed restricted groups (T_2 and T_4) as compared to control (T_1). Moreover, cholesterol levels were found to be significantly ($P<0.05$) lower in early and late feed restricted groups without garlic supplementation (T_3 and T_5) as compared to control (T_1). There was no significant difference in haemoglobin, packed cell volume, triglyceride, total protein, albumin levels due to early and late feed restriction with or without garlic supplementation. Similarly, cholesterol was reported significantly ($P<0.05$) low in feed restricted groups by Malpotra *et al.* (2017) and Afsharmanesh *et al.* (2016). Moreover, cholesterol was reported significantly ($P<0.05$) reduced due to garlic supplementation by Singh *et al.* (2017), Issa and Omar (2012) and Kirubakaran and Moorthy (2017). But, Elagib *et al.* (2013) and Onyimonyi *et al.* (2012) reported the non-significant effect of garlic powder supplementation.

There was significant ($P<0.05$) decrease in abdominal fat due to early feed restrictions with or without garlic supplementation (T_2 and T_3) as compared to control (T_1). Also, late feed restrictions with or without garlic supplementation (T_4 and T_5) had significantly ($P<0.05$) reduced abdominal fat as compared to control (T_1). Omosebi *et al.* (2014) and Mirshamsollahi (2013) reported decrease in abdominal fat with increased levels of restriction.

Table 3: Effect of feed restriction and garlic supplementation on blood biochemical profile, carcass traits and muscle composition in female broilers

Parameters	Blood Biochemical Profile					S.E.M.
	T ₁	T ₂	T ₃	T ₄	T ₅	
Blood Biochemical Profile						
Hemoglobin (gm %)	9.63	9.65	9.61	9.64	9.63	0.141
Packed cell volume (%)	26.86	26.92	26.9	27.19	26.38	0.281
Triglyceride (mg/dl)	85.9	83.68	85.54	84.36	85.47	0.222
Cholesterol (mg/dl)	150.14 ^a	131.54 ^c	138.71 ^b	131.13 ^c	142.40 ^b	2.287
Total proteins (g/dl)	2.79	2.77	2.78	2.76	2.78	0.0032
Albumin (g/dl)	1.68	1.65	1.67	1.66	1.67	0.14
Carcass Traits						
Dressing %	55.03	56.36	54.99	56.3	55.28	0.367
Liver %	2.24	2.31	2.22	2.27	2.26	0.022
Heart %	0.58	0.58	0.51	0.56	0.55	0.002
Gizzard %	2.47	2.42	2.47	2.49	2.57	0.035
Giblet %	5.3	5.31	5.21	5.33	5.39	0.045
Abdominal fat %	2.77 ^a	2.52 ^c	2.54 ^c	2.62 ^b	2.65 ^b	0.084
Shank %	5.45	5.02	5.34	5.74	5.34	0.104
Neck %	4.88	4.66	4.57	4.98	4.85	0.091
Thigh Muscle Composition						
Moisture	72.47	72.54	72.25	72.52	72.3	0.334
Crude Protein	16.33	16.4	16.38	16.11	16.16	0.124
Fat	6.97	6.75	7.04	6.8	7.02	0.071
Breast Muscle Composition						
Moisture	70.86	70.93	70.64	70.91	70.69	0.232
Crude Protein	20.94	21.01	20.99	20.72	20.77	0.245
Fat	6.88 ^a	5.86 ^b	5.95 ^b	5.91 ^b	5.93 ^b	0.065

*Values with different superscripts differ significantly ($p \leq 0.05$) within each row

But, non-significant results for abdominal fat were reported by Demir *et al.* (2004) and Saleh *et al.* (2005). Numerically higher dressing percentage was recorded in feed restricted and garlic supplemented groups (T₂ and T₄). But there was no significant difference in dressing percentage, giblets percentage, shank percentage and neck percentage in various treatments due to early and late feed restriction with or without garlic supplementation. Non-significant results for various carcass parameter were also reported by Malpotra *et al.* (2017) and David and Subalini (2015). Higher values for dressing percentage with restrictions were also reported by De Silva and Kalubowila (2012) in contrast to Saleh *et al.* (2005) who showed decrease in dressing percentage after restrictions.

There was no significant difference in moisture, crude protein and fat content values for thigh muscle composition. Sidhu *et al.* (2017) also did not found any significant difference in thigh muscle composition due to feed restrictions. Significantly ($P < 0.05$) lower fat content in breast muscle was found in early and late feed restricted groups with and without garlic supplementation as compared to control. But crude protein and moisture content were found to be non-significant in breast muscle composition. Similarly, Malpotra *et al.* (2017) and Sidhu *et al.* (2017) also observed non-significant results for crude protein but fat was decreased significantly ($P < 0.05$) due to feed restrictions. But, Souza *et al.* (2011) did not found any significant difference in thigh and breast muscle composition in male and female broiler birds. Also, Belal *et al.* (2018) did not report any effect of garlic supplemented diet on moisture, CP and fat in thigh and breast meat in birds.

Conclusion

Feed restrictions with or without garlic supplementation (T₂ and T₃) reduces the average body weight gain and average feed intake as compared to control (T₁) significantly ($P < 0.05$) in starter phase. Cholesterol levels were found to be significantly ($P < 0.05$) lower in garlic supplemented as well as in early and late feed restricted groups. Abdominal fat content was also reduced due to feed restrictions.

Conflict of Interests

There is no conflict of interest.

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