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The effect of limiting feeding time by three and six hours per day during the starter period on broiler performance

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In a completely randomized design, one hundred and twenty one- day old (Arbor acres) broiler chicks were randomly distributed in three treatments, five replicates with eight chicks per a replicate. The treatments were: 24 h *ad libitum* feeding (A), B feed removal from 9:00 to 12:00 noon (3 fasting hours) and C feed removal from 9:00 to 3:00 pm (6 fasting hours). Feed restriction was applied from 8 to 28 days of age. The experiment lasted from 8 to 37 days of age. The results showed that fasting birds for three and six hours had significantly ($p<0.05$) no effect on body weight, weight gain, feed intake and feed conversion ratio at 37 days of age.

Key words: Broilers; feed removal; starter period; performance.

INTRODUCTION

Broiler nutrition have been subjected to different types of experiments in order to reach acceptable market weight without any adverse effects that might cause failure of the birds to show their maximum growth rate**.** Researchers examined different feed ingredients, feed additives, feed qualities and examined different feeding programs attempting to find the most suitable feed or feeding program for the fast growing strains. Although *ad libitum* feeding is necessary for fast growing broiler chickens to meet their maximum growth potential, it has led to more frequent occurrences of metabolic and skeletal disorders and increased fat deposition (Yu and Robinson, 1992). Feed restriction programs are applied to reduce the negative effects of fast growth rate. These programs rely on the phenomenon called compensatory growth. Restricted feeding programs may result in synchronizing the speed of growth of different body organs and decreases bad effects of rapid growth (Balog et al., 2000), and it is expected that when feed restriction is over, feed intake would increase consequently; growth

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performance would increase and declines maintenance energy. Various quantitative and qualitative methods of feed restriction are used in broilers to improve their efficiency of feed utilization and weight gain (Mahmood et al., 2007). Such methods result in temporary reduction of growth rate, while the normal weight of broilers can be attained on removal of feed restriction, thus improving the feed efficiency and decreasing the feeding cost (Mahmood et al., 2007; Sahraei, 2012). The objective of the present study was to evaluate the effect of limiting feeding time by three and six hours during the starter period on broiler chicks` performance.

MATERIALS AND METHODS

One hundred and twenty one-day old chicks (Arbor acres) were reared in a group for one week (adaptation period). At day 8 of their age, these chicks were randomly divided into 15 experimental units of 8 chicks each. These units were further allotted randomly to three treatment groups A, B and C such that each treatment received five replicates. The chicks in group A were fed ad libitum and served as control. The chicks in groups B and C were kept on a feed restriction program**.** The weights of the birds in the replicate groups were adjusted to give near uniform initial weights for all the groups. The experiment lasted from 8 to 37 days of age. The experiment was carried out at the Animal Production Research Center, Khartoum North, Sudan, during February to March 2015. Mean monthly temperatures were 28.3 and 31.1ºC.

Restriction program

A= 24 h *ad libitum* feeding, B = 3 h feed removal from 9:00 to 12:00 noon (3 fasting hours) and C= 6 h feed removal from 9:00 to 3:00 pm. (6 fasting hours).Restriction program was applied from 8 to 28 days of age.

Experimental diets

All birds received the same pre-starter diet to 7-days of age, the same starter diet to 28 days old and the same finisher diet to 37 days old (Table 1). All diets were formulated to meet the nutrient requirements according to NRC (1994).

Housing

The birds were maintained in a thoroughly cleaned and disinfected open- sided poultry house. Each replicate was kept in a separate pen measuring 1 × 1 m^2 during the experimental period. Saw dust was used as litter material. The birds were kept under similar managemental conditions like space, feed, and vaccination program up to the age of six weeks. Fresh and clean water was available ad libitum during the experimental period.

Data collection

The data collected during the experiment included weekly body weight, feed intake, weight gain, feed conversion ratio and final body weight. The data was collected in group basis. At day 37 of age, after feed withheld for 12 h; ten birds from each treatment were randomly selected for carcass and carcass cuts weight.

Statistical analysis

In this experiment birds were assigned to the three dietary treatment groups following a completely randomized design (CRD). The experimental units were replicate cage means. All data were analyzed using the One-Way ANOVA procedure for analysis of variance. Significant differences among treatments were identified at $p<0.05$ level by Duncan's multiple range test (1955).

RESULTS

Effect of limiting feeding time by 3 and 6 h per day during the starter period on body weight and weight gain

The results of limiting feeding time by 3 and 6 hours per day on body weight and weight gain are presented in Table 2. At 14 days of age, control and six hours fasted birds showed significantly ($p<0.05$) the same body weight and weight gain. The difference in performance between control birds and three hours fasted birds was significant. Comparing restricted birds, the difference in performance was not significant. During the next weeks, limiting feeding time by three and six hours had no effect on body weight and weight gain.

Effect of limiting feeding time by 3 and 6 h per day during the starter period on feed intake and feed conversion ratio

The results of limiting feeding time by 3 and 6 h per day on feed intake and feed conversion ratio are presented in Table 3. At 14 days of age, control and six hours fasted birds consumed significantly ($p<0.05$) the same amount of feed and had the same feed conversion ratio. The differences between control birds and three hours fasted birds were significant. Comparing restricted birds, the differences were not significant. During the next weeks, limiting feeding time by three and six hours had no effect on feed intake and feed conversion ratio.

Effect of limiting feeding time by 3 and 6 h per day during the starter period on carcass weight

The results of limiting of feeding time by 3 and 6 h per day during the starter period on carcass and carcass cuts weigh are presented in Table 4. The results showed no significant differences ($p<0.05$) in whole carcass and cuts weights between control and the fasted groups. Despite that, six hours fasted birds gained the highest weight for whole carcass and carcass cuts.

Effect of limiting feeding time by 3 and 6 h per day during the starter period on overall performance

The results of limiting of feeding time by 3 and 6 h per

Table 1. Composition and calculated nutrients of the experimental diets (%).

Ingredients	Starter	Finisher
Sorghum	67.5	68.7
Groundnut cake	25	22
*Super concentrate	5	5
Lime stone	1.7	1.5
Methionine	0.15	0.15
Lysine	0.2	Not added
Anti mycotoxin	0.2	0.1
Tallow	0	2.3
Salt	0.25	0.25
Total	100	100
Calculated nutrients		
ME (kcal/kg)	2951	3112
Crude protein (%)	23	21.15
Crude fiber (%)	4.4	4.01
Methionine (%)	0.55	0.59
Lysine (%)	1.27	1.01
Ca (%)	1.34	1.10
Available phosphorus (%)	0.55	0.53

*Composition of the super concentrate: ME = 1900 kcal/ kg, CP = 35%, EE = 2.5%, CF = 3.0%, Ca = 6.5, P = 6.5, Lysine =11.0, Methionine = 4.2.

Table 2. Effect of limiting feeding time by 3 and 6 h/day during the starter period on body weight and weight gain (g).

Parameter	Treatments		
	A	B	C
Body weight (g/b)			
Bird age (days)			
8- 14	343.38±13.55^{a}	318.28±20.2^{b}	326.75±12.4^{ab}
15- 21	621.01±18.99^{a}	605.00±23.39^{a}	605.5±15.47^{a}
22- 28	1028.95±37.61^{a}	1010.4±53.96^{a}	996.2±37.88^{a}
29- 37	1478.86±127.5^{a}	1362.96±219.29^{a}	1410.53±194.18^{a}
Weight gain (g/b)			
Bird age (days)			
8- 14	216.68±12.86^{a}	191.6±19.83^{b}	200.2±12.34^{ab}
15- 21	278.4±6.54^{a}	246.8±89.38^{a}	229.6±86.72^{a}
22- 28	407.6±20.86^{a}	405.6±53.44^{a}	388.6±23.62^{a}
29- 37	450.23±97.32^{a}	437.74±68.72^{a}	496.71±30.4^{a}

Means within a raw with different super scripts differ significantly ($p<0.05$); Values are means ± standard deviation.

day during the starter period on overall performance are presented in Table 5. The results showed no significant differences ($p<0.05$) in overall performance between control, 3 and 6 h fasted birds. The highest body weight, weight gain and better feed conversion ratio were showed by control bird. Six hours fasted birds showed more body weight, weight gain than 3 h fasted birds. Three hours fasted birds consumed more feed than the other two groups and showed the poorest feed conversion ratio.

DISCUSSION

Performance at 14 days old

Control birds showed significantly ($p<0.05$) heavier body weight than the other restricted groups (Table 2).

Table 3. Effect of limiting feeding time by 3 and 6 h/day during the starter period on feed intake and feed conversion ratio (g).

Parameter	Treatment		
	A	B	C
Feed intake (g/b)			
Bird age (days)			
8-14	293.36±21.85[a]	255.2±22.07[b]	274.4±8.47[ab]
15- 21	322.43±32.81[a]	325.6±19.28[a]	314.6±21.04[a]
22- 28	811.6±37.38[a]	796.6±18.34[a]	784.28±31.51[a]
29- 37	968.27±145.27[a]	774.91±394.96[a]	937.19±66.37[a]
***FCR(g feed: g weight gain)**			
Bird age (days)			
8-14	1.36±0.11[a]	1.33±0.04[a]	1.38±0.08[a]
15- 21	1.16±0.12[a]	1.14±0.11[a]	1.17±0.11[a]
22- 28	1.99±0.05[a]	2.0±0.28[a]	2.0±0.12[a]
29-37	2.21±0.38[a]	2.14±0.31[a]	1.94±0.05[a]

Means within a raw with different super scripts differ significantly ($p<0.05$); *FCR = feed conversion ratio (gram feed intake/gram weight gain); Values are means ± Standard deviation.

Table 4. Effect of limiting feeding time by 3 and 6/day on carcass weight (g).

Treatment (h)	Carcass	Breast	Thigh	Drumstick	Wings
Control	963.44±96.94[a]	312.00±56.41[a]	206.00±33.80[a]	135.00±16.58[a]	121.0±15.17[a]
3	1061.0±21.98[a]	321.00±36.98[a]	209.20±18.79[a]	144.00±16.73[a]	123.0±12.55[a]
6	1024.0±98.34[a]	323.00±47.64[a]	224.00±34.35[a]	146.00±18.17[a]	128.0±12.04[a]

Means within a column with the same super scripts do not differ significantly ($p<0.05$); Values are means ± Standard deviation.

Table 5. Effect of limiting feeding time by 3 and 6 h/day on overall performance (g).

Treatment (h)	Body weight	Weight gain	Feed intake	*FCR
Control	1478.80±127.41[a]	1353.10±127.02[a]	2378.38±178.37[a]	1.762±0.06[a]
3	1363.00±219.42[a]	1308.72±98.94[a]	2438.33±60.88[a]	1.892±0.17[a]
6	1410.40±194.07[a]	1345.86±56.64[a]	2390.56±127.97[a]	1.788±0.09[a]

Means within a column with the same super scripts do not differ significantly ($p<0.05$); *FCR = feed conversion ratio (gram feed intake/gram weight gain); Values are means ± standard deviation.

This result agrees with Mahmood et al. (2007) and Acheampong-Boateng et al. (2012). Decreased body weight of restricted groups was due to feed removal (Zubair and Leeson, 1996; McGovern et al., 1999). Different results were observed by Saleh et al. (1996) who reported no effect of feed removal on body weight. The results showed that restricted birds gained less weight than control ones (Table 2). This result is in accordance with those of Acheampong-Boateng et al. (2012) and is not in accordance with those of Lee and Leeson (2001) who reported higher weight gain in restricted birds than those fed *ad libitum.* Zhong et al. (1995), and Zubair and Leeson (1996) reported different results. They found similar weight gain in restricted and control birds. The probable explanation of the lower body weight and weight gained is the reduced feeding time of restricted birds. Control birds consumed more feed than restricted birds (Table 3). The result of this study follows those of Mahmood et al. (2005, 2007) and Acheampong-Boateng et al. (2012) who found that restricted birds consumed lesser quantities of feed. According to the present study, fasting for 3 and 6 h had no effect on feed conversion ratio at 14 days old (Table 3). Control and restricted birds showed significantly the same feed conversion ratio. This result does not follow what was reported by Deaton (1995), Zhong et al. (1995), Lee and Leeson (2001) and Mahmood et al. (2007). They observed better conversion values in birds kept under

restricted feeding compared to *ad libitum* fed birds. It seemed that fasting broilers do not affect their ability the utilize nutrients at 14 days of age.

Performance at 21 to 37 days old

At this age, restriction regime applied in the present study had no effect on body weight, weight gain (Table 2), feed intake and feed conversion ratio (Table 3) of full fed and restricted birds. The insignificant differences in weight gain were supported by the findings of Netshipale et al. (2012), and disagree with De Silva and Kalubowila (2012) and Netshipale et al. (2012) who found body weight reduction with increased limiting of feeding time at this age. This result agrees with De Silva and Kalubowila (2012) and Netshipale et al. (2012) who observed the same feed intake of restricted birds. The results of feed intake in this study do not agree with Novel et al. (2009) and Boostani et al. (2010) who reported reduced feed intake of restricted birds. The insignificant differences in feed conversion ratio of control, 3 and 6 h restricted group follow the findings of Dozier et al. (2002) and Khajali et al. (2007). This result in feed conversion ratio due to feed restriction does not agree with the findings of Lee and Leeson (2001), Dozier et al. (2003), Navidshad et al. (2006), and Mahmood et al. (2007). They observed better conversion values in birds kept under restricted feeding compared to ad libitum fed birds and do not follow the findings of Balog et al. (2000), Camacho et al. (2004) and Boostani et al. (2010) who reported reduced body weight and feed intake of 8 h/ day restricted birds. Aziz (2012) also found that weight gain, feed intake and feed conversion ration of restricted birds were lower than those of control ones. Different results were reported by Mehmood et al. (2013) who found that the maximum feed intake was recorded in *ad-libitum* and 3 h fed birds than those of 1 or 2 h access to feed. This could be attributed to ample time available with full-fed and 3 h feeding as compared to limited access birds which could have resulted in higher feed consumption. Similarly, Mahmood et al. (2007) also reported significantly higher feed intake in full fed birds as compared to restricted ones.

Carcass weight

The feed restriction procedure applied in this study showed no significantly differences in whole carcass and cuts between restricted and *ad libitum* fed birds (Table 4). Despite that restricted birds had higher carcass and cuts weights than the *ad libitum* fed birds. Six hours fasted birds were the best, which may be a preferred restriction method for whole carcass and cuts production. More studies should be conducted to affirm this suggestion. The insignificant differences in whole carcass and carcass cuts weights between the control and fasted birds follow the findings of Camacho et al. (2004), and Mohebodini et al. (2009) who found no significant differences in carcass weight and thigh weight between restricted and control birds and do not follow the findings of Mohebodini et al. (2009) who found significantly lower carcass weight breast weight compared to that of control birds. The results also do not follow the findings of Boostani et al. (2010) who found significantly lower carcass weight and breast weight as compared to those of control birds.

Overall performance

The results obtained in this study showed no significant differences ($p<0.05$) in overall performance between control, 3 and 6 h fasted birds (Table 5). The insignificant differences in overall performance between the control and fasted birds follow the findings of De Silva and Kalubowila (2012) who found no significant differences in feed intake between control and 3 h restricted birds. The results of the overall performance also agree with the findings of Urdaneta-Ricon and Lesson (2002), Dozier et al. (2002, 2003), and Khajali et al. (2007) who stated that broiler chickens are able to compensate for loss of weight resulting from short periods of feed restriction at early age, and do not follow the findings of De Silva and Kalubowila (2012) who found significant reduction in body weight at 42 days old after 3 h fasting per day from 21 to 42 days old. The in significant differences in overall performance between the control and fasted birds is supported by the findings of Navidshad et al. (2006), Mohebodini et al. (2009) and Benyi et al. (2011). Acheampong-Boateng et al. (2012) found that feed restriction birds could not recover from the slow growth during restriction and they were lighter than the control group. Netshipale et al. (2012) also found that reducing feeding time do not allow complete compensatory growth at 49 days old, while Boostani et al. (2010) found that 8 h feed removal during the day allow complete compensatory growth at 42 days old. David and Subalini (2015) also found that the growth performance and carcass characteristics of broiler chickens were not affected by feed restriction for 3, 5 and 7 h**.** The feed removal for 3 and 6 h used in this study showed good but not complete compensatory growth at 37 days old.

Conclusion

In this study birds whose feeding time was reduced by 3 or 6 h from 9:00 to 12:00 noon and 9:00 to 3:00 pm between 8 and 28 days of age were able to compensate for the loss of weight incurred during the period of feed restriction and have statistically the same body weight as their counterparts which were fed *ad libitum* throughout this study. It could be concluded that, restricted broiler

chicken compensate the weight lost during 20 days of feed removal for 3 and 6 h/day in 9 days re-feeding time.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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