

Effects of Feed restriction on the growth performance, organ size and carcass characteristics of Broiler chickens

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Abstract: An experiment was conducted with an objective to study the effects of feed restriction on the performance of broiler chicken. Total of 96, Indian River strain, unisex broiler day old chicks were distributed into four experimental units in a complete randomized design. The birds in the control treatment were fed *ad libitum* throughout the experimental period and the birds in other three treatments were fed restricted by withdrawing the feed for 3 hours (9 a.m. to 12 p.m), 5 hours (9 a.m. to 2 p.m) and 7 hours (9 a.m. to 4 p.m), respectively from day 10 to day 30. Each diet was fed to 24 birds in three replicates. The body weights and feed consumption were recorded weekly and the body weight gains and feed conversion ratio were calculated. Three birds from each replicate were used for the measurement of organ size on day 41. The average weight of the day-old chicks was 50 g. The results revealed that the growth performance and carcass characteristics of broiler chickens were not affected by the feed restriction for 3, 5 and 7 hours. However, significantly higher relative gizzard weights were observed in the birds fed restricted for 3 hours and 5 hours while significantly highest relative liver weight was observed in the birds fed *ad libitum*.

Keywords: Broiler, body weight, carcass, feed withdrawal, organ.

INTRODUCTION

Growth performance of broiler chickens is increased by genetic progress, improvements in nutrition and controlled environment. Unfortunately, the growth rate is accompanied by body fat deposition, mortality and incidence of metabolic diseases and skeletal disorders when fed *ad libitum*. Feed restriction is one of the ways to eliminate these problems. Early feed restriction programs used to reduce abdominal and carcass fat in broiler chickens rely on the event called compensatory growth which is defined as abnormally rapid growth related to age. Compensatory growth will enable the birds to catch up the market body weight. An enhanced rate of growth occurs when growth has been retarded by nutritional deprivation and followed by *ad libitum* feeding which occurrence has long been used as an effective method to reduce growth rates and altering body composition of animals [1].

Feed restriction is a method of feeding in which the time or duration or amount of feed is limited. In general, the feed restriction is carried out by quantitative and qualitative feed restriction methods. In broiler chickens, the feed cost encompasses more than 70% of the total production cost. Restricted feeding for the broiler chickens prevents the feed wastage and thereby minimizes the cost of production. In addition, the fat deposition in the broiler chickens could be minimized through the restricted feeding. The broilers with heavy deposit of abdominal fat indicate poor

finishing [2]. Furthermore, the fat deposition reduces the carcass quality and feed efficiency leading to less demand by the consumers. Moreover, the fat deposition may cause the metabolic diseases leading to mortality in the broiler chickens.

In this regard, this experiment was designed with the objective to study the effect of the duration of the feed restriction on the performance of broiler chickens. The specific objectives of this experiment were to study the effect of the duration of feed restriction on the growth performance, organ size and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

This experiment was carried out in the Livestock farm of the Department of Animal Science, Eastern University, Sri Lanka. Total of ninety six, Indian River strain, unisex broiler day old chicks were purchased from Prima (Pvt.) Ltd. in Sri Lanka and assigned into four dietary treatments in a complete randomized design. After eight days of brooding period in the electrically heated floor brooder, each group was divided into three replicates of eight chicks in each. The chicks were housed in floor pens. Four treatments namely *ad libitum* feeding as control treatment, feed withdrawal for 3 hours from 9 a.m. to 12 p.m., feed withdrawal for 5 hours from 9 a.m. to 2 p.m. and feed withdrawal for 7 hours from 9 a.m. to 4 p.m. were assigned. Feed withdrawal for these three treatments

was practiced from day 10 to day 30. After 30th day of age, all the birds in these three feed withdrawal treatments were fed *ad libitum* up to the age of 41 day. Starter diets and finisher diets were offered from day 1 to 21 and from day 22 to 41, respectively. Clean water was provided all the time. The birds were vaccinated

twice for Gumboro (Infectious Bursal Disease) on day 11 and 28 and for Newcastle Disease on day 5. The nutrient composition of broiler starter and broiler finisher diets that have been used in this experiment is given in below Table 1.

Table 1. Nutrient composition of broiler starter and finisher diets

Nutrient	Broiler Starter %	Broiler Finisher %
Metabolizable energy (kcal/kg)	2980	3025
Crude protein (%)	22.00	18.00
Crude fibre (%)	5.00	5.50
Oil (%)	4.00	3.90
Ash (%)	7.00	7.00
Calcium (%)	0.90	0.80
Phosphorus (%)	0.60	0.60
Lysine (%)	1.25	1.15
Methionine (%)	0.34	0.34

Growth performance

The average group body weights and feed consumption were recorded on 7th, 14th, 21st, 28th, 35th and 42nd days during the experimental period. Body

weight gains and feed conversion ratio (FCR) were calculated using these measurements. Performance Efficiency Factor (PEF) was calculated using the following equation.

$$\text{Performance Efficiency Factor} = \frac{\text{Live weight (kg)} \times \text{Liveability (\%)}}{\text{Day of Slaughter} \times \text{FCR}} \times 100$$

Organ Size

On day 41, three birds per replicate were used for the organ weight measurements. Birds were individually weighed just before killing them. The weights of gizzard, heart, liver and spleen were measured. Relative organ weights were then calculated using these measurements. Relative organ weights were expressed as g/100 g body weight.

finisher (day 22-42) and on overall (day 0-42) periods are presented in Table 2. The results revealed that there was no significant difference among the treatments for the body weight gains and FCR of broiler chickens during the starter diet, finisher diet and overall periods. In addition, the PEF was not significantly differed among the treatments. The feed restricted birds showed the compensatory growth with the *ad libitum* fed birds throughout the experimental period.

Carcass characteristics

The birds were slaughtered on day 41 after withdrawal of feed 12 hours before slaughtering. The live body weights and dressed weight of birds were recorded.

Statistical Analysis

All Data were analyzed by Analysis of variance (ANOVA) using SAS 9.2 software package. Significant differences among treatment means were determined using Duncan's Multiple Range Test.

Significantly similar body weight gains in the feed restricted birds when compared to the *ad libitum* fed birds could be due to the improved feed efficiency in the feed restricted birds. Significantly similar body weight gains in the feed restricted and *ad libitum* fed birds were reported in several research studies [3,4,5]. Another research study reported that the broiler chickens kept under feed withdrawal for 3, 5 and 7 hours from 8th to 28th day, gained less body weight than those kept under *ad libitum* [6]. Furthermore, the feed restricted birds gained less weight than full-fed control birds also reported [7,8]. However, the growth performance of broiler chickens has not been affected by the time duration of feed restriction in the current experiment.

RESULTS AND DISCUSSION

Growth Performance

The effects of dietary treatments on body weight gain, FCR and Performance Efficiency Factor (PEF) of broiler chicken during the starter (day 0-21),

Table 2. Effect of feed restriction on growth performance of broiler chickens on days 0-21, 22-42 and 0-42 (Mean \pm SD).

	Control	FW-3 hrs	FW-5 hrs	FW-7 hrs
Body weight gain (g)				
0-21 days	924 \pm 26.44	914 \pm 9.11	915 \pm 15.85	914 \pm 15.43
22-42 days	1501 \pm 57.43	1432 \pm 44.42	1476 \pm 10.92	1503 \pm 57.63
0-42 days	2425 \pm 58.36	2346 \pm 51.95	2392 \pm 54.73	2417 \pm 52.45
FCR				
0-21 days	1.13 \pm 0.03	1.14 \pm 0.01	1.14 \pm 0.02	1.14 \pm 0.02
22-42 days	2.14 \pm 0.08	2.24 \pm 0.07	2.17 \pm 0.02	2.14 \pm 0.08
0-42 days	1.75 \pm 0.06	1.81 \pm 0.04	1.77 \pm 0.00	1.76 \pm 0.04
PEF	346 \pm 39.49	324 \pm 22.49	336 \pm 2.44	343 \pm 27.34

SD: Standard deviation of means (n=3). Treatments: *Ad libitum* feeding (Control), feed withdrawal for 3 hours (FW-3 hrs), feed withdrawal for 5 hours (FW-5 hrs) and feed withdrawal for 7 hours (FW-7 hrs). FCR: Feed Conversion Ratio. PEF: Performance Efficiency Factor

Organ Size

Effects of dietary treatments on relative organ size of broiler chickens on day 41 are presented in

Table 3. The results of relative organ weight revealed that there was significant difference among the treatments for relative weights of gizzard and liver.

Table 3. Effect of feed restriction on the relative organ weights (g/100 g body weight) of broiler chickens on day 41 (Mean \pm SD).

Organ weight	Control	FW-3 hrs	FW-5 hrs	FW-7 hrs
Gizzard	2.01 \pm 0.85 ^b	2.88 \pm 0.65 ^a	2.87 \pm 0.39 ^a	2.57 \pm 0.53 ^{ab}
Heart	0.45 \pm 0.20	0.54 \pm 0.15	0.50 \pm 0.03	0.45 \pm 0.06
Liver	2.09 \pm 0.52 ^a	1.72 \pm 0.28 ^{ab}	1.83 \pm 0.26 ^{ab}	1.68 \pm 0.33 ^b
Spleen	0.11 \pm 0.02	0.12 \pm 0.02	0.12 \pm 0.04	0.11 \pm 0.02

a, b, c: Means having different letters within the same row are significantly different (P<0.05). SD: Standard deviation of the mean (n=3). Treatments: *Ad libitum* feeding (Control), feed withdrawal for 3 hours (FW-3 hrs), feed withdrawal for 5 hours (FW-5 hrs) and feed withdrawal for 7 hours (FW-7 hrs).

The birds fed restricted for 3 hours and 5 hours showed significantly higher relative gizzard weights while the birds fed *ad libitum* showed a lowest. The relative liver weight was significantly highest in the birds fed *ad libitum* while the same was significantly lowest in the birds fed restricted for 7 hours. None of the treatments had significant effect on the relative heart and spleen weights.

Similarly, a significant increase in the relative weight of gizzard was reported in broiler chickens fed restricted for 3 hours during day 21-42 [9]. However, this result is not consistent with another research study [10], in which a significant difference in gizzard weight between early restricted birds and *ad libitum* fed birds was not observed. A significant increase in the relative liver weight in the birds fed *ad libitum* might be due to the increase feed intake when compare to the feed restricted birds. Furthermore, this study revealed that none of the treatments contributed for the immune organ (spleen) development.

Carcass characteristics

Effects of dietary treatments on the carcass characteristics of broiler chickens on day 41 are presented in Table 4. The results revealed that there was no significant difference among the treatments for the live weight and dressing percentage of broiler chickens on day 41. This might be due to the significantly similar body weight gains of birds. This finding is supported by another research study [11] in which a significant difference for the dressing percentage of broiler chickens fed restricted and *ad libitum* was not observed. Similar research study reported that no significant difference for the dressing percentage among the broiler chickens fed quantitatively restricted feed and the birds fed *ad libitum* [12]. However, another study reported that the dressing percentage of broiler chickens significantly reduced by the restricted feeding [13]. In contrast, significantly increased dressing percentage was reported in broiler chickens fed restricted by feed withdrawal of 3 hours per day during day 21-42 experimental period when compared to the *ad libitum* fed birds [9].

Table 4. Effect of feed restriction on the Carcass characteristics of broiler chickens on day 41 (Mean ± SD).

Organ weight	Control	FW-3 hrs	FW-5 hrs	FW-7 hrs
Live weight (g)	2475 ± 58.36	2396 ± 51.95	2442 ± 54.73	2467 ± 52.45
Dressing Percentage (%)	70 ± 2.22	73 ± 1.99	71 ± 1.81	74 ± 1.53

SD: Standard deviation of the mean (n=3). Treatments: *Ad libitum* feeding (Control), feed withdrawal for 3 hours (FW-3 hrs), feed withdrawal for 5 hours (FW-5 hrs) and feed withdrawal for 7 hours (FW-7 hrs).

CONCLUSION

The results revealed that the growth performance and carcass characteristics of broiler chickens were not affected by the feed withdrawal for 3, 5 and 7 hours from day 10 to day 30. However, significantly higher relative gizzard weights were observed in the birds fed restricted for 3 hours and 5 hours while significantly highest relative liver weight was observed in the birds fed *ad libitum*.

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