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Full Length Research Paper

Effect of skip-a-day feed restriction on carcass yield characteristics and economic advantages of Rhode Island Red Pullets

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Two hundred and forty day-old chicks with average body weight of 48.92±1.5 g were randomly distributed into 12 pens each with 20 chicks, representing four feeding regimen of T_1 (Unrestricted, Control), T_2 (Restricted at 7, 14, 21 and 28 days of age), T_3 (Restricted at 35, 42, 49 and 56 days of age) and T_4 (Restricted at 63, 70, 77 and 84 days of age). The experiment lasted for 22 weeks, during which feed intake and body weight changes were monitored. At the end of the experimental period, six pullets from each treatment were randomly selected and slaughtered to evaluate carcass yield, abdominal fat and weights and lengths of different parts of gastrointestinal tracts. The daily feed intake as well as body weight changes at different ages were non-significant (P>0.05). The feed efficiency also did not significantly varied (P>0.05). In contrast, the total feed intake (g) was significantly different (P<0.05) between treatments and birds under T_4 consume less. Dressed weight (g); abdominal fat free carcass (g); carcass with abdominal fat (g) and breast meat weights (g) were significantly (P<0.05) different. Abdominal fat weight was also highly significant (P<0.01) between the treatments. The weight and percentage of GIT and total giblet and parts of giblets were not (P>0.05) affected except liver weight which was higher (P<0.05) for T_3. Cost of feed consumed per kg live weight gain was lower for the feed restricted birds and it was the least for T_4. Besides, the labor cost was lower for the feed restricted groups. It is concluded that feed restriction at later days of age (T_4) is economically beneficial compared to the other early age restricted groups based on partial budget analysis. The results of this study suggested that the feed restriction at middle age (T_3) might be considered as beneficial in terms of carcass cut characteristics and T_4 on economic return.

Key words: Carcass yield characteristics, economic advantages, feed restriction, skip-a-day, Rhode Island Red pullet.

INTRODUCTION

In commercial poultry production system profit can be maximized by minimizing feed cost which accounts for more than half of the total cost of production. According to Wilson and Beyer (2000), feed cost accounts for 60 to 70% of the cost of poultry production. Any attempt to improve commercial poultry production and increase in its efficiency therefore needs to focus on better utilization of available feed resources (DZARC, 1997). One such method is restricting the amount of daily feed offer for sometime and stimulating compensatory growth (Ibrahim and Al-Talib, 2002; Naji et al., 2003; Al-Talib, 2007; Novel et al., 2009).

The use of total feed restriction at an early age to elicit compensatory growth, improved feed efficiency and reduced abdominal fat pad has received considerable attention. Researchers (Ibrahim and Al-Talib, 2002; Naji et al., 2003) suggested that physical feed restriction at early age of birds for a short period stimulated

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compensatory growth so that at the market age feed restricted birds performed similarly to those of the full fed groups. Novel et al. (2008) and Novel et al. (2009) also reported that early period 75% *ad libitum* restriction feeding gave an economic advantage over *ad libitum* feeding mainly by enhancing feed utilization and able to attain complete live weight compensation by 42 days of age.

Even though a lot of work has been done on broilers on aspects of feed restriction, no information is available regarding the dual purpose breeds like Rhode Island Red (RIR) chicken and the effect of feed restriction on their carcass yield characteristics. Given the fact that the current extension program in Ethiopia focuses on distribution of exotic pullets to farm household's proper feeding management is important to attain better performance. Under quantitative feed restriction, the birds are not necessarily subjected to suboptimal level of nutrients, but the efficiency of utilization of these nutrients may be altered. This paper reports the effects of feed restriction at different growth stages on carcass yield and characteristics and economic advantages of Rhode Island Red chicken.

MATERIALS AND METHODS

Animals, experimental design and treatments

The experiment was conducted at poultry farm of Haramaya University, located at an altitude of 1980 m.a.s.l, 9° 26' N latitude and 42° 3' E longitude (AUA, 1998). A total of 240 day old chicks with an average body weight of 48.92±1.53 g were used for the feeding trial and were randomly assigned to the four feeding treatments [T_1 (Unrestricted, Control), T_2 (Restricted at 7, 14, 21 and 28 days of age), T_3 (Restricted at 35, 42, 49 and 56 days of age) and T_4 (Restricted at 63, 70, 77 and 84 days of age)] using a Completely Randomized Design (CRD).

Feeds and feeding

Birds were fed on a commercial starter layer diet until the age of 6 weeks and on commercial grower layer diet till the end of the experiment (at age of 22 weeks). Feed was offered to the birds twice a day at 0800 and 1600 hours except at days of feed restriction for T_2, T_3 and T_4. Feed restriction was based on skipping a-day (restrict daily ration) once in a week, totally 4 days at different age of development for each treatment for the whole experimental period and the next day's feed offer was based on the previous day's feed intake. The feed restriction was done after the completion of one treatment then the other was followed (T_3 started when T_2 was finished and then T_4 was followed). On the feed restriction day only water was given. Feed wastage was controlled by filling the feed not more than $3/4^{th}$ of the feeder capacity.

Measurements and observations

Birds were weighed per pen (replication) on weekly basis with sensitive balance of 0.005 kg to 3 kg capacity, and average body weight of the bird was computed using the weight of replications. The overall average body weight for each treatment was then computed by taking the average values for the replication. The daily as well as total feed consumption of the birds were calculated as the difference between the amount of feed offered and refused. Dry matter efficiency ratios (gain to intake) were also computed. To estimate the economic benefit of feed restriction in pullets rearing, the partial budget analyses was made taking into consideration the whole feed expense, labor cost and prices of live pullets at Haramaya University Poultry Farm based on the principles developed by Upton (1979), whereby other costs were assumed to be similar for all the treatments. The cost of labor considered during the experimental period was as needed $2/3^{rd}$ less on the days of feed restriction than the unrestricted days since only fresh water was offered at the days of restriction:

$$\text{Partial production cost per live weight gain} = \frac{\text{Cost of feed consumed (Birr)} + \text{Labor (Birr)}}{\text{Price of pullet (Birr)}}$$

At the end of the feeding trial (22 weeks), 6 randomly selected pullets from each treatment group were starved for 12 h, and weighed immediately before slaughter. After slaughtering the birds were dry de-feathered by hand plucking, eviscerated and carcass cuts and non-edible offal components were determined according to the procedure described by Kekeocha (1985). Dressed carcass weight was measured after the removal of blood and feather and the dressing percentage calculated as the proportion of dressed carcass weight to slaughter weight. Eviscerated carcass weight was determined after removing blood, feather, lower leg, head, kidney, lungs, pancreas, crop, proventriculus, small intestine, large intestine, caeca and urogenital tracts. The eviscerated carcass percentage was also calculated. Drumstick-thigh and breast meat were separated and weighed and percentage weights were determined.

Fat around the proventriculus and gizzard and against the abdominal wall and the cloacae was collected and weighed. Its percentage was calculated, the edible offal (giblets), which included the heart, gizzard and liver were weighed. The weight of crop, liver, gizzard, proventriculus, duodenum, jejunum and ileum, caeca and large intestine were weighed with and without contents. The relative weights were calculated as a proportion of weight of GIT parts to slaughter body weight. The lengths of the parts were measured by using centimeter tape. The weight of liver was also noted.

Statistical analysis

Data were analyzed using the General Linear Model (GLM) procedures of SAS (SAS, 2002). The fixed effect fitted in the model included the effect of treatment (Control, T_2, T_3 and T_4). Turkey Kramer test was used to separate means which were significant in the least squares analysis of variance (SAS, 2002). The following model was used for the analysis:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

Y_{ij} = an observation (experimental unit)
μ = overall mean
T_i = feed restriction effect of i^{th} restriction level and
e_{ij} = error term

RESULTS AND DISCUSSION

Dry matter and nutrient intake

The laboratory chemical analysis results of feeds used in

Table 1. Least squares means (±SE) for dry matter intake, body weight change and DM efficiency ratio as affected by feed restriction on different developmental stages.

Parameter	Treatments				
	T_1	T_2	T_3	T_4	F-test
Daily DM intake (g)	70.54 ± 3.20	66.68 ± 3.10	68.33 ± 1.30	64.69 ±3.80	NS
Total DM intake (kg)	11.17^{a} ±0.50	10.56^{ab} ± 0.50	10.82^{ab} ± 0.20	9.97^{b} ± 0.30	*
Daily CP intake (g)	15.8 ± 0.72	15.93 ± 0.70	15.30± 0.30	14.48±0.85	NS
Daily ME intake (kcal)	2055.36±170.60	2194.37±97.90	2045.79±132.90	2033.76 ±116.90	NS
Initial BW (g)	48.51 ± 0.30	48.48 ± 0.80	49.03 ± 0.70	49.65 ±1	NS
Daily BW gain(g)	8.933 ± 0.20	8.967 ± 0.60	9.133 ± 1.20	9.067 ±0.60	NS
Final BW (g)	1433 ±82.20	1438 ± 95.00	1464 ±89.30	1451±92.30	NS
DM efficiency ratio	0.124± 0.50	0.131 ± 0.40	0.131 ± 0.30	0.141 ±0.50	NS

BW= body weight; Initial BW (g) = at 7-day old, Final BW = at 22 weeks old, * =Significant at P<0.05, NS = Non-significant, SE=Standard error.

the experiment revealed the crude protein and energy contents of the commercial feeds of 20.22% and 3144 ME kcal/kg DM for the starter diet and 18.52% and 2883 ME kcal/kg DM for grower's layer feed offered, respectively. The CP and ME contents of the diets were within the range of the recommended CP and ME levels of starters and growers of 18% and 2950 ME kcal/kg and 17% and 2850 ME kcal/kg, respectively (Leeson and summers, 2001).

The feed restriction of skip-a-day program did not result in a significant (P>0.05) difference in average daily DM intake, CP intake and ME intake between treatments including the control group (Table 1). The non-significant difference in daily feed intake between the control and treatment groups were not in agreement with the findings of Dunnington et al. (1992) who reported that intermittently fed group consumed considerably more on the following day than *ad libitum* fed chickens did.

The similarity in daily DM and nutrient intakes in the present experiment might be due to the fact that the amount of feed offered to birds on the next day was based on the previous day's feed intake of the control group. The total DM intake, however, were significantly (P<0.05) different between feed restricted and unrestricted groups and birds under T_4 consumed less feed compared to the control group during the experimental period. The reason might be due to the fact that the feed restriction applied at later age and at the time the daily requirement was highly reduced the total consumption than the other groups due to skipping days. The results obtained in the present experiment were similar to the findings of different researcher (Al-Talib, 2007; Novel et al., 2008; Novel et al., 2009) who reported that significantly less feed was needed per unit of weight gain as did controls than after undergoing nutritional stress by consuming a diluted diet.

Carcass yield and characteristics

Least squares means and standard errors of the weight and proportion of eviscerated carcass components are presented in Table 2. The slaughter weight did not differ significantly (P>0.05) between the birds in the different stages of feed restriction and the control group. The analysis results of dressed weight, eviscerated carcass yield weight without abdominal fat as well as with abdominal fat and breast meat weight showed significant (P<0.05) differences between treatments. Among the feed restricted groups, T_3 had similar carcass yield with the control group and birds on T_2 exhibited significantly (P<0.05) lower carcass yield compared to birds on the unrestricted feeding system. On the other hand, there was no significant difference between all treatments in dressing and eviscerated carcass percentages.

Abdominal fat free carcass of birds under T_3 and T_4 was similar with the control group (Table 2). Birds in T_2 were the least in eviscerated carcass weight. The low carcass yield exhibited by the early age feed restricted group (T_2) might be due to inefficient nutrient utilization and the subsequent poor tissue and fat deposition (growth) of birds at the age subjected to feed restriction. It might be due to distribution of energy resources among different organs during very early stages of development. Similarly, Zubair (1994) stated that under-nutrition in the earlier

Table 2. Least squares means (±SE) for carcass components as affected by feed restriction.

Parameter	Treatments				
	T_1	T_2	T_3	T_4	P-value
Slaughter weight (g)	1430.43 ± 33.70	1436.55 ± 46.4	1461.65 ± 32.30	1443.62 ± 18.20	NS
Dressed weight	1335.45 ± 21^{a}	1273.62 ± 23.8^{b}	1335.78 ± 22.80^{a}	1279.72 ± 23.40^{b}	*
Dressing percentage	87.33 ± 4.17	88.94 ± 6.6	92.47 ± 7.01	88.94 ± 6.74	NS
Carcass with abdominal fat (g)	960.60 ± 11.30^{a}	924.58 ± 19 ^{b}	955.20 ± 13 ^{a}	926.10 ± 14.40^{b}	*
Carcass with abdominal fat (%)	67.15 ± 0.70	64.38 ± 1.36	65.36 ± 1.25	64.16 ± 1.43	NS
Abdominal fat free carcass (g)	939.08 ± 9.67^{a}	891.37 ± 19.7^{b}	933.32 ± 15^{a}	899.07 ± 14.50^{ab}	*
Abdominal fat free carcass (%)	65.65 ± 0.60	62.07 ± 1.33	63.86 ± 1.20	62.29 ± 1.40	NS
Drumstick-thigh weight (g)	238.33 ± 3.51^{a}	226.33 ± 2.08 ^{b}	239.67 ± 2.52 ^{a}	235.33 ± 5.03^{ab}	**
Drumstick-thigh weight (%)	16.66 ± 0.54	15.81 ± 1.14	16.60 ± 2.39	16.33 ± 0.75	NS
Breast meat weight (g)	282.72 ± 13.70 ^{a}	246.75 ± 19.8 ^{b}	290.70 ± 13.40 ^{a}	272.92 ± 14.20^{ab}	*
Breast meat weight (%)	19.76 ± 0.88	17.20 ± 1.66	19.90 ± 1.22	18.91 ± 1.15	NS
Abdominal fat weight (g)	25.33 ± 1.53^{b}	33.23 ± 0.81^{a}	21.90 ± 2.09 ^{b}	24.17 ± 1.26^{b}	**
Abdominal fat (%)	1.77 ± 0.08^{b}	2.32 ± 0.13^{a}	1.51 ± 0.15^{b}	1.68 ± 0.15^{b}	**
Feather weight (g)	108.53 ± 7.11	116.55 ± 6.19	119.33 ± 3.77	116.37 ± 6.08	NS
Leg length (cm)	13.83 ± 0.63	14.42 ± 0.76	14.08 ± 0.14	14 ± 0.50	NS

Slaughter weight (g) = at 22 weeks old, Least squares means within a row with different superscripts are significantly different; * =Significant at P<0.05; NS = Non-significant, SE=standard error.

stages of growth is more detrimental to an animal than is restricted at a later age.

Birds under T_2 exhibited significantly (P<0.01) less drumstick-thigh weights than birds on T_3 and the control group. Even though drumstick-thigh percentage increased with feed restricted group, there was no significant (P>0.05) difference among the treatments. The higher drumstick-thigh weight for T_3 might be due to compensatory growth for the group.

Eviscerated carcass and breast meat weight did vary significantly (P<0.05) between treatments and it was lower for T_2. The increase in breast meat weight with the late age initiated feed restrictions groups might be due to attainment of maximum bone and feather development at early age before feed restriction starts. Earlier age (T_2) initiated feed restrictions resulted in little evidence of compensatory growth, likely because of partition of nutrients primarily for formation of bone, muscle and adipose tissue. Novel et al. (2008) observed no effect on any of the carcass traits of both male and female broiler chickens at 21 days of age which was not in agreement with the present findings.

The analysis of abdominal fat weight showed a significant (P<0.01) difference among treatment groups. Birds on the restriction feeding system T_3 and T_4 accumulated similar amounts of abdominal fat with the unrestricted group and it was higher for birds feed restricted at earlier age (T_2). The results of Leeson et al. (1992); Susbilla et al. (1994) and Novel et al. (2009) virtually indicated no change in absolute quantity of abdominal fat in 42 to 49 days old broiler chicks subjected to feed restriction from 35 to 39 days of age. However, findings of several investigators (Plavink and Hurwitz, 1985; Jones and Farrel, 1992; Al-Talea, 2007) revealed that body fat was depressed when chickens were exposed to feed restriction. Inconsistently, Mansour et al. (2004) observed an increased level of abdominal fat percentage with advancing slaughter age.

In the present study, the feed restriction method did not affect (P>0.05) the feather weight and leg length (Table 2). The results were in agreement with the findings of Susbilla et al. (1994), who reported a non negative effect of feeding regimen on weights of legs and feather.

Giblet weight and percentage

The edible offal (giblets) except liver was not

Table 3. Least squares means (±SE) for average giblet weight (g) and percentages (%) as affected by feed restriction.

Parameter		Treatments				
		T_1	T_2	T_3	T_4	P-value
Giblet	Weight	94.82 ±4.60	97.87 ±4.00	89.12 ± 3.20	90.48 ± 6.2	NS
	Percentage	6.19 ± 0.25	6.82 ± 0.83	6.15 ± 0.63	6.27 ± 0.35	NS
Gizzard	Weight	32.22 ±1.40	33.48 ±2.60	32.37 ± 2.20	32.12 ± 3.9	NS
	Percentage	2.96 ± 0.15	3.50 ± 0.81	3.16 ± 0.32	3.33 ± 0.57	NS
Heart	Weight	9.53 ± 0.41	8.35 ± 0.48	8.18 ± 0.68	8.48 ± 0.89	NS
	Percentage	0.59 ± 0.05	0.64 ± 0.04	0.56 ± 0.09	0.55 ± 0.07	NS
Liver	Weight	35.80 ± .57^{b}	5.50 ± 0.87^{b}	39.70 ±1.21^{a}	36.17±2.50^{b}	*
	Percentage	2.34 ± 0.19	2.48 ± 0.22	2.75 ± 0.32	2.52 ± 0.33	NS

significantly (P>0.05) different in feed restricted and free accessed group of birds (Table 3). Birds on control and feed restricted groups had similar (P>0.05) gizzard and heart weights and percentages. However, weight of liver was different between the groups. Pullets reared under T_3 had significantly (P<0.05) heavier liver weight and there was no significant (P>0.05) difference on liver percentage among the pullets reared on feed restriction and the unrestricted feeding regimen. The increase in liver weight was due to effective synthesis of available energy of lipid for egg yolk formation during the re-feeding time.

The present findings were not in agreement with results of Mohmood et al. (2007) who reported a non-significant difference in the mean values of the liver among the treatment groups due to any feed restriction program when compared to those of control group. Pinchasove et al. (1985) found that intermittent feeding was accompanied by a consistent increase in the relative weight of the liver. Similar to the present findings Susbilla et al. (1994) and Jones (1995) reported a non significant difference in relative weights of liver at slaughter due to the feeding regimen.

Weight and length of gastrointestinal tract

There was no significant (P>0.05) difference in weight, length and percentage of most gastrointestinal tract (GIT) parts among the treatment groups (Table 4). Duodenum and ileum empty weight (P<0.05), large intestine empty weight (P<0.01) and large intestine length (P<0.05) were significantly different between treatments.

The empty weight of duodenum and ileum were large for birds feed restricted at the earlier age (T_2) followed by the control and birds treated at later age (T_4). The difference in empty weight of duodenum and ileum (parts of small intestine) was difficult to relate with the feed restriction, but it seems probable that growth of the digestive tract during the critical period of feed restriction was preferentially retained above that of the demanded organs. This selective maintenance of growth of the digestive tract could have contributed to the ability of the birds to achieve compensatory growth following food restriction by improving efficiency of the digestive process. However, many of the other parts were non significant (P>0.05). The lack of significant difference in most GIT parts empty weight and length reflected the fact that the feed restriction did not result in extension of the parts during re-feeding that could have accumulated more feed in the GIT. The probable reason again might be the fact that the amount of feed offered during non-restricted period was based on the previous day feed intake. Results in this study agree with the findings of Novele et al. (2008) who reported that level of feed restriction caused a non-significant increase in the size of digestive organs concerned.

The weight (P<0.01) and length (P<0.05) of large intestine were significantly lower for T_4 for which no plausible justification could be found from available literature to favor or disfavor. Susbilla et al. (1994) and Jones (1995) indicated non significant difference in organ weight (heart and lungs) at slaughter which was in line with the present results. In addition, the later also reported similar result to the present findings with regard to the lack of difference between the restricted and *ad libitum* fed birds in weights of the gizzard and proventriculus. Others (Plavink and Hurwitz, 1983; Katanbaf et al., 1989; Al-Talib, 2007), however, did obtain a significant increase in gizzard weight and reduction in relative weight of the heart at 56 days of age following short term restriction.

Economic considerations

The economic return based on the partial budget analysis results from pullets reared under different feed restrictions is presented in Table 5. The highest net

Table 4. Least squares means (±SE) for treatments on the empty weight and length of gastrointestinal tract.

Parts of GIT	Treatments				
	T_1	T_2	T_3	T_4	P-value
Esophagus(g)	6.55 ± 0.43	4.90 ± 0.22	5.35 ± 0.56	6.08 ± 0.38	NS
Esophagus(cm)	11.30 ± 1.15	8.25 ± 1.15	10.58 ± 3.20	11.75 ± 1.20	NS
Crop (g)	6.18 ± 0.88	5.70 ± 0.70	5.08 ± 0.46	5.45 ± 0.67	NS
Crop (cm)	4.58 ± 0.52	4.33 ± 0.48	5.28 ± 0.40	5.25 ± 0.75	NS
Proventriculus(g)	6.80 ± 0.58	6.38 ± 0.68	7.08 ± 0.20	6.43 ± 0.43	NS
Proventriculus (cm)	3.92 ± 0.76	4.37 ± 0.66	4.63 ± 0.32	4.05 ± 0.18	NS
Gizzard (g)	32.22 ± 1.40	33.48 ± 5	32.37 ± 2	32.12 ± 4	NS
Gizzard (cm)	19.10 ± 0.38	18.83 ± 2.90	18.67 ± 2.50	18.75 ± 1.90	NS
Duodenum (g)	9.10 ±1.40[ab]	9.43 ± 1.40[a]	7.43 ± 0.30[b]	7.8 ± 0.20[ab]	*
Duodenum (cm)	27.92 ± 4.10	26.30 ± 3.38	25.75 ± 0.50	26.42 ± 2.10	NS
Jejunum (g)	20.57 ± 2.40	23.60 ± 4.68	20.57 ± 3.80	18.87 ± 2.80	NS
Jejunum (cm)	66.10 ± 2.98	76.80 ± 1.04	77.67 ± 2.10	65.1 ± 8.98	NS
Ileum (g)	8.10 ±0.90[ab]	8.68 ±1.60[ab]	6.9 ± 0.43[b]	9.5 ± 0.87[a]	*
Ileum (cm)	32.52 ± 2.30	35.40 ± 0.95	30 ± 2.22	37.17 ± 2.90	NS
Caeca (g)	7.75 ± 0.17	7.20 ± 0.26	6.98 ± 0.32	7.3 ± 0.98	NS
Caeca (cm)	19.5 ± 20	18.10± 20	18.75 ± 2.30	18.5 ± 2.20	NS
Large Intestine (g)	3.12 ± 0.10[a]	3.18± 0.18[a]	2.9 ± 0.03[a]	2.6 ± 0.12[b]	**
Large Intestine (cm)	6.80 ± 0.14[a]	6.88 ± 0.20[a]	6.97 ± 0.20[a]	6.3 ± 0.38[b]	*

Least squares means within a row with different superscripts are significantly different; ** = P<0.01; * = P<0.05; NS = Non-significant, SE=standard error.

Table 5. Partial budgeting for effects of feed restriction on net benefit from pullets rearing.

Items	T_1	T_2	T_3	T_4
Cost of feed consumed (Birr)	18.786	17.752	18.197	17.245
Total feed consumed (kg)	11.173	10.563	10.823	10.247
Cost of feed/kg TBWG (Birr)	14.96	13.40	13.97	12.51
Labor cost[1] (Birr)	3.969	3.861	3.861	3.861
Live pullets sale (Birr)	25.00	25.00	25.00	25.00
Live pullets sale/feed cost	1.33	1.41	1.37	1.45
Total Profit (Birr)	2.245	3.387	2.942	3.894

*TBWG = Total Body Weight Gain, [1]= 0.027 Birr/bird/day and 1/3rd needed on the days of feed restriction for the feed restricted birds, total feed consumed = 154 days.

benefits of 1.65 Birr per bird was obtained from the sale of pullets reared under the feeding regimen of feed restriction (T_4) as compared to birds that were not restricted. The net benefit obtained decreased with birds under T_3 and better for birds under treatment T_2 and least for the control group. The better performance of birds which were under T_4 might be due to the fact that feed restriction at this age group might not affect body growth as birds accumulated enough reserves in the earlier periods. Similarly, Novele et al. (2009) reported that level of feed restriction caused some economic advantage over *ad libitum* feeding mainly by enhancing feed utilization. Contrary to the present findings, Sahota and Bhatti (2001) noted non-significant different on feed restriction on cost of feed/dozen eggs during the laying phase.

Conclusions

In conclusion, depending on carcass cuts basis, feed restriction by skip-a-day feeding system at medium age (T_3) attains better performance and feeding system at later age of development (T_4) resulted in low feed consumption and better net benefit of pullet rearing and these can be considered as the optimum age to apply feed restriction accordingly. Future work may also address the incorporation of additional days on skip-a- day feeding system by increasing the total days either twice per week or more to obtain better performance on pullet rearing without affecting the bird's production performance.

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