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Growth Performance and Carcass Quality of Layer Type Cockerels and Broiler Chicken

Research Article

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ABSTRACT

The aim of the study was to compare the growth performance and carcass quality of layer-type cockerels and broilers reared under identical conditions. A total of 180 one-day-old broiler male (BM), broiler female (BF) and brown layer male (LM) chicks were distributed into 9 floor pens in a completely randomized design, with 3 replicates of 20 birds per experimental unit. The body weights and feed consumption was recorded at weekly intervals. Body weight gains and feed conversion ratio (FCR) were calculated. The carcass quality trait was determined at 4th, 6th, 8th, 12th and 16th weeks of age. There was a significant effect FCR (P<0.05) of genotype on body weight and feed intake. The BM and BF showed higher feed consumption and better feed conversion compared to LM for all growing stages (P<0.05). The LM had higher percentage of blood, feather, shank, head and internal organ compared to BM and BF (P<0.05). The BM and BF had significantly higher values for dressing percentage (P<0.05). The LM had least amount of subcutaneous fat in neck, subcutaneous fat in thigh and abdominal fat despite of slaughtering ages (P<0.05). Genotype had been shown to significantly influence on colour of pectoralis major and biceps femoris muscles. The LM had recorded highest L* for both muscle at 8th week of slaughtering age (P<0.05). The BM and BF had significantly higher a* coordinates for pectoralis major compare to LM (P<0.05). Moreover, LM had least shear force value (P<0.05). These results suggest that layer males are acceptable for an alternative system of meat production from the aspect of carcass and meat characteristics.

KEY WORDS broiler female, broiler male, carcass, growth, layer male, meat production.

INTRODUCTION

The antagonistic relationship between meat and egg production led to the separation of meat and egg type strains of fowl (Lichovnikova *et al.* 2009). Broiler chicks of both sexes are used for meat production but egg production is based only on female layer chicks. It is estimated that annually about 8 million day-old layer chicks are produced in Sri Lanka (Livestock Statistical Bulletin, 2014), resulted similar number of day-old-male layer chicks. The layer farmers usually buy female chicks from the hatcheries and male chicks remains in the hatcheries or are sold at a low price or destroyed in hatchery itself as a common procedure in the egg industry. The number of day old male layer chicks likely to be increased day by day with the increase of Sri Lankan egg consumption. Therefore elimination of these day old layer cockerel chicks is a great problem for hatcheries, killing of layer males at hatch is considered ethically unacceptable and has despised hence look for possibilities to raise cockerels and possibly working with dual purpose chicken. At the same time, the egg industry is experiencing increasing pressure from groups advocating animal welfare, which indicates a need to consider production techniques observing the humane treatment of animals (Mench *et al*. 2011; Thompson *et al*. 2011; Xin *et al*. 2011). However, sustainable solutions for the egg industry enabling the utilization of these males are needed. The scope for utilizing cockerels as a source of animal protein for human consumption is high. Male chicks from layer strains reared for meat have desirable flavour, juiciness and tenderness are almost similar to the village chicken and many people consider that it is tastier than the broiler meat (Murawska *et al*. 2005; Murawska and Bochno, 2007). But studies done on fattening of layer type cockerels are few (Wickramaratne *et al*. 1993; Bochno *et al*. 1999; Murawska *et al*. 2005; Murawska and Bochno, 2007).

Additionally, there is a growing demand for cockerels because of their smaller size in Sri Lanka. A rearing system is partially developed in Sri Lanka where the male layer chicks are reared by the farmers and market them. Wickramaratne *et al*. (1993) emphasized that surplus cockerels are good source of meat in Sri Lanka because of their smaller size. Utilization of these male chicks through commercial meat farming helps to control environmental pollution, increase nutrition, income and employment in the community. Lower chick price, lower mortality, less disease susceptibility, lower management cost, lower initial investment, easy management, better market demand, low abdominal fat and more organoleptic preference are the strategic advantages for cockerels rearing as business.

The evaluation of layer cockerels with broiler chicken is of much importance in view of commercializing both options for a viable segment of local meat production. Therefore this study was conducted to develop an ethically justifiable production system for layer-type males and to evaluate growth performance and carcass quality of brown layer cockerel versus broiler chickens fed commercial broiler diets *ad libitum*.

MATERIALS AND METHODS

A total of 180 one-day-old Hubbard classic broiler male (BM), female (BF) and Novogen brown layer male (LM) chicks were distributed into 9 floor pens in a completely randomized design. Broilers were reared to 8th weeks and others reared till 16th weeks of age and all birds were fed the same standard broiler commercial diets *ad libitum*. Brooding was done for first two weeks of age on deep littered (paddy husk) electrically heated floor brooder. After brooding, the chicks were housed in same floor pens which used for brooding to keep birds during grow out period.

A three-phase feeding program was adopted, until 2 weeks of age all birds fed the same commercial broiler chick booster diets {CIC feeds, Sri Lanka: protein (Min) 23.5%, fat (Min) 7%, ash (Max) 7%, fiber (Max) 4.5%, calcium 1.0-1.2%, available phosphorus 0.7-1.0% and metabolizable energy (Min) 3000 kcal/kg} *ad libitum*. Broiler starter crumbles diet {CIC feeds, Sri Lanka: protein (Min) 22%, fat (Min) 7%, ash (Max) 7.5%, fiber (Max) 4.5%, calcium (Min) 0.9-1.2%, available phosphorus (Min) 0.7-1.0% and metabolizable energy (Min) 3000 kcal/kg}was provided *ad libitum* up to 4 weeks of age. From 4 weeks of age onward, all chickens received broiler finisher pellets {CIC feeds, Sri Lanka- protein (Min) 20%, fat (Min) 7%, ash (Max) 7.5%, fiber (Max) 4.5%, calcium 0.9-1.2%, available phosphorus 0.65-1.0% and metabolizable energy (Min) 3100 kcal/kg} *ad libitum* to 16 weeks of age. All birds were vaccinated against Gumboro (Infectious Bursal Disease) using Ceva Intermediate live vaccine on day 10, 16 and 22 via drinking water. A coccidiostat was given to prevent coccidiosis. The birds' beaks were not trimmed.

The average group body weights and feed consumption were recorded at weekly intervals during the experimental period. Body weight gains and feed conversion ratio (FCR) were calculated using the above measurements. Two birds from each replicate were randomly selected at 4th, 6th, 8th, 12th and 16th weeks for carcass trait assessment. Respective bird's weights and the weights of blood, feather, shank, head and internal organ was measured. Abdominal fat content around vent and subcutaneous fat content in (clavico-cervical (neck) and sartorial femoral (thigh)) were measured. Instrumental colour measurements (CIE L* a* b*) were taken with Minolta Chroma Meter CR-200 colorimeter (Konica Minolta Sensing Inc.) as described by Souza *et al*. (2011). Random readings were taken at 3 different locations of cranial, medial surface of the bone side of the right pectoralis major muscle in the breast and right quadriceps femoris muscle in the thighs. The readings from the 3 locations were averaged and the color for each sample was expressed in terms of CIE values for L* refers to lightness; a* refers to redness and b* refers to yellowness. Tenderness was measured following a procedure similar to those described by Abdullah and Matarneh (2010).

The data were analyzed by ANOVA using SAS software package (SAS, 2002). For growth performance, cage was the experimental unit. For carcass and meat quality, bird was the experimental unit. When significant difference (P<0.05) existed among the treatment, Duncan's multiple range test (DMRT). (Duncan, 1955) was used to separate treatment mean.

RESULTS AND DISCUSSION

Genotype was significantly (P<0.05) affected body weight during 16 weeks of age. The increasing trend in body weight as the birds advanced in age whereas the mean body weight values increased marginally with the increase in the age of LM are shown in Figure 1. In BM and BF, intensive growth occurred during the first 28 days. Day old LM chicks were 2 g lighter than broiler chicks. At the age of 4, 6 and 8 weeks, LM, in comparison to broiler chicken (BM or BF) of the same age, had a 3.9, 3.5 and 3.3 times smaller body weight, respectively.

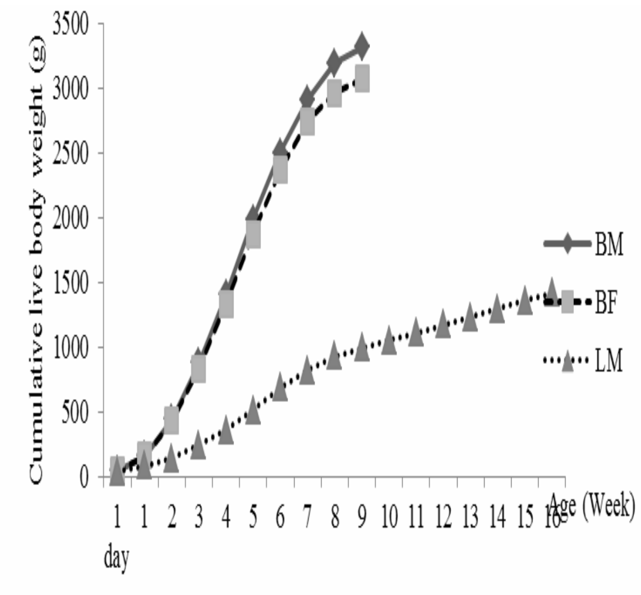

Figure 1 Mean values of weekly cumulative live body weight (g) of experimental birds

Lichovnikova *et al.* (2009) reported layer cockerels are slow-growing birds and had lower body weight compare to fast growing commercial broilers. Genetic disposition was the major factor affecting the growth rate of chicken. As same four-fold smaller body weight in egg type cockerels compared to broiler chicken (666 g *vs*. 2577 g) of the same age of 6 weeks were detected by Murawska and Bochno (2007). During the rearing period initial body weight of LM (38.73±0.96 g) increased significantly 928.93 ± 26.77 g at 8 weeks of age to 1414.96 ± 33.23 g at 16 weeks of age. Since the experimental chicken were all reared under the same housing and management conditions and compared at the same age, differences between genotypes would indicate genetic effects. The data obtained from present experiment agree with previous researches (Wickramaratne *et al*. 1993; Murawska *et al*. 2005; Murawska and Bochno, 2007) observing that difference in growth rate and weight gain at different ages by different genetic origin of the flock used since other factors were similar. The BM had 6.25% mortality within the 8 weeks of age while BF had 5 % mortality during first week of age but LM had zero mortality until the end of the experiment. Livability of the birds was 100%, indicating that the LM responded well. Cannibalism was not observed, during the entire experimental period, even though the birds' beaks were not trimmed.

In general, the findings showed BM and BF consumed more feed than LM (P<0.05) at all stages of growth. At first week of age broiler chicken consumed 52.72% more feed than others, while at 4 and 8 weeks of age they consumed 72.92% and 64.07% more feed respectively. The BM and BF had heavier live weights than others and it could be explained in terms of higher feed intake in BM and BF. An amount of feed consumed by LM was lower (2255.14±169.48 g) during first 8 weeks of age. With regard to feed intake, there was an increase in feed consumption as the birds advanced in age and this increment occurred across the genotype (P<0.05). It is well known fact that as chicken grows older and larger, they consume more feed to meet the increasing requirement for maintenance and growth. Table 1 shows the effect of slaughtering age on by product weight. Mean values of weekly FCR of experimental birds as affected by genotype and age and FCR increased with advancing age for both genotypes (P<0.05). At 8th week, BM had the significantly lowest FCR (2.06±0.03) but FCR of BF (2.18±0.02) lower than LM but was insignificant (P>0.05). The LM had 4.03 ± 0.07 FCR value throughout 16th week of growing period. It was observed that the FCR of LM was inferior to that of BM and BF due to BM and BF showed lethargic activity while others have spent more time in walking, scratching and wing flapping activities increasing their energy expenditure, ultimately affecting their performance using much energy for metabolism rather than body weight gain.

The live weight at slaughter of any animal is an important variable that determines the market value of that animal. Genotype and sex significantly affect live body weight at slaughter (P<0.05) and it was significantly increased (P<0.05) progressively with age. The BM attained average body weight of 3696.17 ± 33.37 g which was superior to BF (3471.17±35.47 g) at 8th weeks of age. At 16th weeks of age LM had 1476.83 ± 24.58 g live weight. Byproduct weight expressed as a % of live body weight of different chicken genotypes and sex at 6th, 8th, 12th and 16th week are summarized in Table 1. There was a significant effect in percentage of blood on genotype and sex at 4th, 6th and 8th weeks of age (P<0.05). The LM had higher blood percentage compare to BM and BF. Similar tendency by genotype and sex was observed for feather percentage. There were no significant (P>0.05) genotype and sex differences found among the % of shank and head. The percentage of internal organs was significantly higher in LM than BM and BF (P<0.05). The greater by product weight in LM could be associated with total body weight and different growth rate between broiler and layer male chicken. Murawska and Bochno (2007) found that giblet of layer cockerel at 6th, 8th and 10th weeks of age were 7.87%, 7.02% and 5.12% respectively.

Table 1 Effect of slaughtering age on by product weight (expressed as a percentage of live weight) of experimental birds

Age		BL	FE	SK	HD	IO	L	H	G
	BM	3.65[b]	4.99[b]	4.23[a]	3.07[b]	5.66[b]	2.02[b]	0.51[a]	1.76[b]
4	BF	3.53[b]	5.09[b]	4.04[a]	2.86[c]	5.37[b]	2.00[b]	0.54[a]	1.80[b]
	LM	4.15[a]	7.41[a]	4.38[a]	3.31[ab]	8.30[a]	2.33[a]	0.50[a]	2.20[a]
	BM	3.50[cb*]	4.69[b]	4.07[a]	2.75[a]	5.32[b]	1.90[bc]	0.50[a]	1.67[c]
6	BF	3.39[c]	4.84[b]	3.66[a]	2.59[a]	5.19[b]	1.86[c]	0.51[a]	1.71[bc]
	LM	3.95[a]	6.72[a]	3.93[a]	3.08[a]	7.20[a]	2.10[ab]	0.46[a]	1.86[ab]
	BM	3.32[bc]	4.52[b]	3.83[a]	2.54[a]	4.80[b]	1.79[ab]	0.47[a]	1.58[b]
8	BF	3.20[c]	4.66[b]	3.36[a]	2.29[a]	4.67[b]	1.63[b]	0.49[a]	1.62[b]
	LM	3.71[a]	6.17[a]	3.77[a]	2.84[a]	6.18[a]	2.02[a]	0.44[a]	1.82[a]
12	LM	3.57[a]	5.44[a]	3.60[a]	2.64[a]	5.74[a]	1.87[a]	0.42[a]	1.77[a]
16	LM	3.35[a]	4.83[a]	3.49[a]	2.52[a]	5.35[a]	1.82[a]	0.39[a]	1.67[a]

BL: blood; FE: feather; SK: shank; HD: head; IO: internal organ; L: liver; H: heart; G: gizzard; BM: broiler male; BF: broiler female and LM: layer male.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

On live weight basis, % of by product decreased (P<0.05) progressively with age and weight of the chicken. The % of the external and internal by product was highest at 4[th] weeks of slaughtering regardless of genotype and sex (P<0.05). However, with increased slaughter age of chicken there was a significantly (P<0.05) better dressing percentage regardless genotype (Figure 2).

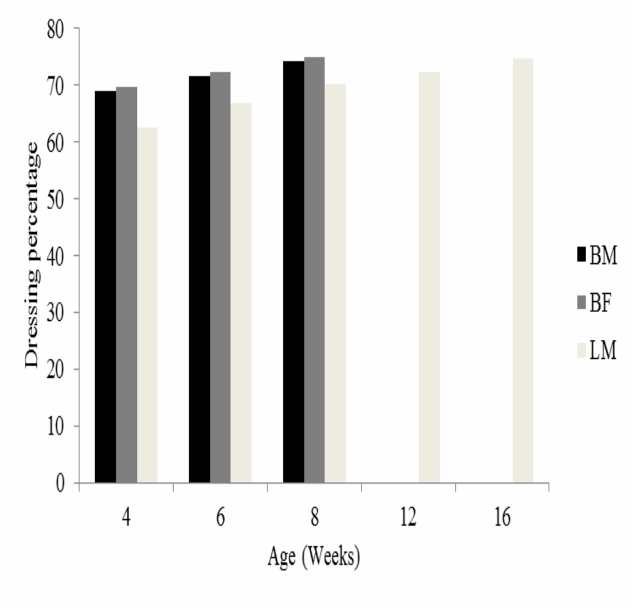

Figure 2 Effect of slaughtering age on dressing percentage of different chicken genotypes

Moreover BM and BF had significantly higher values for dressing percentage (P<0.05). This finding suggests that the differences in carcass traits across genotype probably arise from metabolic differences and from differences in the onset of fattening. The higher dressing percentage of broilers than layer cockerel was agreed with the lower % of total by products.

A lower dressing percentage of layer cockerel compared with broiler chicken was also observed by Murawska and Bochno (2007).

They reported that dressing percentage with giblets 77.63% in broiler and 68.68% in layer cockerels at 6[th] weeks of slaughtering.

Genotype has significant effect on subcutaneous fat in thigh, neck and abdominal fat despite slaughtering ages (P<0.05; Figure 3). Layer cockerel (BC) had least subcutaneous fat in neck (0.79±0.23), subcutaneous fat in thigh (0.60±0.25) and abdominal fat (1.11±0.51) than broilers.

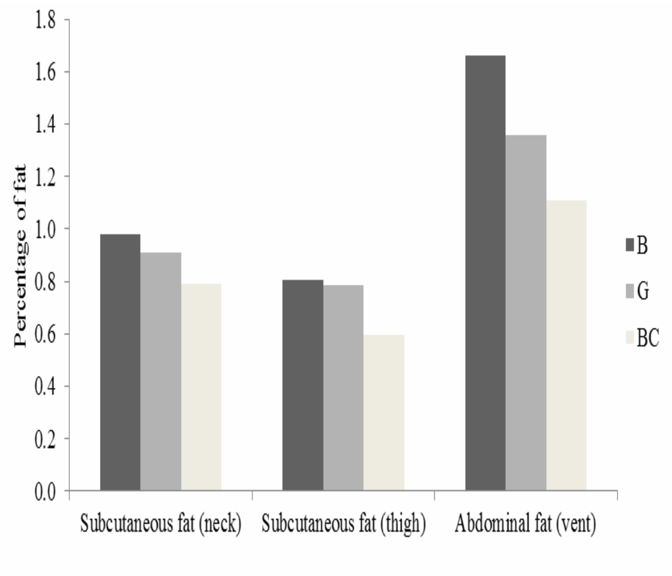

Figure 3 Effect of different genotype on percentage of fat content

The LM had lower fat content in carcass over the rearing period presumably as a consequence of their greater physical activity likely to affect muscle metabolism and reduced the fat deposition. Further this study suggest that slower growing LM as opposed to the fast growing broiler chicken either BM or BF, results in less fat accumulation even at advanced ages. Murawska and Bochno (2007) found that abdominal fat of layer cockerel at 6[th], 8[th] and 10[th] weeks of age were 0.60%, 0.57% and 1.56% respectively. Further they stated that in modern broilers abdominal fat content may be even five-fold higher than layer type cockerels.

The LM had recorded highest L* value for breast (60.58±1.18) and thigh (49.41±1.08) muscle at 8th week of slaughtering age (P<0.05). Least b* coordinate recorded by BM (4.48±1.09) while BF had significantly higher b* (5.27±0.64) for breast muscle (P<0.05). LM had lowest a* for pectoralis major (1.18±0.01) in contrast to that LM had highest a* for biceps femoris (3.49±0.02) at similar slaughtering stage. Conversely, a* and b* for biceps femoris muscle of BM and BF had significantly lower values (P<0.05). This difference in meat color among genotype can be due to the difference of their slaughter age which can affect the content of myoglobin in muscle. It was found that genotype was significantly affect on shear force (SF) value (P<0.05). BM (1.67±0.65) and BF (1.52±0.71) had significantly higher SF value at 8th week of age than LM (1.20±0.54). The SF values of LM at 16th week was higher than BM and BF at 8th week of age (P<0.05).

CONCLUSION

This study concludes that variation in the genetic make up and slaughtering age of chickens accounted for observed differences in growth and carcass quality characteristics. Considering all these attributes in the performance and carcass quality, the egg industry can take advantage considering the availability of these light egg-type males in the market. Gains in sustainability, reducing environmental pollution, and allowing alternative production practices that comply with animal welfare could positively affect egg producers and also add value to the activity.

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