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CAPONIZATION AND ITS EFFECTS ON GROWTH PERFORMANCE AND CHEMICAL COMPOSITION OF MEAT IN SONALI BIRDS

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ABSTRACT
This study was conducted to find out a suitable approach of caponization to increase the survival rate. We also aimed to evaluate the effects of caponization on growth performance and chemical composition of meat of sonali birds. Caponization was done in three groups which were designed according to weight, group-A (500-600gm), group-B (600-700gm) and group-C (700-800gm) containing ten (10) birds in each group. Survival rate was determined among the groups. Another thirty (30) healthy cockerels were randomly distributed into two experimental groups, namely control and caponized group of fifteen (15) cockerels each. Data of body weight, body weight gain, protein, fat, fiber and moisture percentage of meat were analyzed and recorded. Higher survival rate was found in group-A (500-600gm) than in other groups. Average final live weight gain was highest in a caponized group than a control group. Fat percentage was found significantly high ($p<0.01$) in the meat of caponized birds. Caponization had no significant ($p<0.05$) effect on the content of moisture, protein and fiber in bird muscle.

1. INTRODUCTION

Sonali chicken is crossbred of Fayoumi female and RIR (Rhode Island Red) male developed in 1986. Sonali chicken has been reported to perform better with respect to egg and meat production, rapid growth and low mortality under scavenging, semi-scavenging and intensive farming system. Due to its adaptability and acceptability in the climatic conditions of Bangladesh, it has been taking its place beside the indigenous hens. By rearing this type of poultry about 76 percent of Sonali beneficiary has improved their conditions (Hossen *et al.*, 2012). There has been an increase in the consumer's demand for more variety and quality of poultry meat products in recent time which has led to a reappraisal of the use of traditional practices such as caponization (Tor *et al.*, 2002). Capons are male chickens whose testicles have been surgically removed through the process of caponization. Due to the removal of testis there is a deficient production of androgens, which results in a smaller size of the comb and wattle, a reduced level of aggressiveness (Chen *et al.*, 2007), and decreased sexual drive (Chen *et al.*, 2006). The energy retained leads to increased efficiency of feed conversion into growth (Rikimaru et al., 2009; Volk et al., 2011) increased fat deposition, and improved meat quality (Calik *et al.*, 2015; Gesek *et al*., 2017; Kwiecien *et al.*, 2018). Caponization increases the growth rate of chicken (Chen *et al.*, 2006; Hsieh, 2003). This positive result was not found by the other researchers (Chen *et al.*, 2005; Murawska *et al.*, 2019). A negative result on growth was also found (Kuo, 2002). Such dissimilarity in results may be due to differences in breed, age and age at caponization (Kuo-Lung *et al.*, 2007). Capons are sold as high-quality products in Italy, France, China, and the United States (Sirri *et al.*, 2009; Amorim *et al.*, 2016). Previous studies (Adamski *et al.*, 2016; Zawacka *et al.*, 2017; Kwiecien *et al.*, 2018; Murawska *et al.*, 2019; Wojtysiak *et al.*, 2019) have shown the comparison of slaughter performance and meat quality of cockerels and capons by origin, age, breeding system and nutrition. The results of these studies prove that caponization causes the accumulation of fat tissue in the abdominal cavity, subcutaneous fat, and especially intramuscular fat increases. It enhances flavour, texture and meat juiciness due to accumulation of body lipids when compared with intact cockerels (Chen *et al.*, 2005). Despite the fact that fat is not generally appreciated by modern consumers in meat products due to health-related reasons, its ability to enhance sensory attributes remains a major part of traditional or quality products (Symeon *et al.*, 2010). As the number of sonali chicken farms is increasing in Bangladesh, caponization can be done in sonali cockerels to see the effect on growth performance and meat quality. This will give us an idea of whether capon can be used for alternative poultry farming or not. Though caponization is an old technique, it is not commonly practiced due to the low survival rate after caponization. Considering these above discussions, we aimed to find out the suitable approach of caponization to increase survival rate and evaluate the effects of caponization on growth rate and chemical composition of meat in sonali cockerels to create alternative poultry farming.

2. MATERIALS AND METHODS

2.1 Experimental birds, diets, and management

The experiment was carried out in the Departments of Medicine, Surgery and Obstetrics, Hajee Mohammad Danesh Science and Technology University, Dinajpur. The aim of the present study was to find out a suitable approach of caponization to increase survival rate and explore the effects of caponization on growth rate and chemical composition of meat in sonali birds. Sixty (60) Sonali birds were procured from Vet Agro Limited, Basherhat, Dinajpur. Thirty (30) cockerels were distributed in three groups which were designed according to body weight, the groups were group-A (500-600gm), group-B (600-700gm) and group-C (700-800gm) containing ten (10) birds in each group. Caponization was done in three groups. After caponization, survival rate of cockerels was determined. Another Thirty (30) cockerels were randomly allocated into two experimental groups, the control and caponized group containing fifteen (15) birds in each group. Birds were reared for a period of 9 weeks. Body weight was measured in every week. After 9 weeks, the birds were slaughtered and protein, fat, fiber and moisture content of meat were determined. The birds were exposed to similar care and management throughout the experimental period. Wire net and bamboo materials were used for partitioning the pen. Fresh and clean drinking water was supplied three times daily (morning, noon, and evening). Therefore, the birds were provided with water ad-libitum. The rates of feed supply per bird per day were 50, 60, 70, 80 g for 8-10, 10-12, 12- 14 and 14-17 weeks of age respectively. The nutrient composition of the feed is shown in Table 1. Feeders were cleaned every day in the evening, while drinkers were washed two times daily (morning and evening). The birds were exposed to 23 hours of lighting and a dark period of 1 hour daily. A foot bath was maintained at the gate of the shed. Spraying was done outside the shed twice daily (morning and evening). Fresh and dried rice husk was used as litter at a depth of 2-3 inch.

2.2 Caponization

Caponization was done at eight (8) weeks of age. Before caponization, birds have fasted for 24 hours. Then the feathers were removed and the skin was cleaned with an antiseptic (Viodin®-Square Pharmaceuticals Co. Ltd., Dhaka, Bangladesh) socked cotton, 1.5cm incision was made between the last two (2) ribs. A ribs spreader was inserted and the membranes were cleared with groove director. The testicles were then removed. The site was again cleaned with antiseptic and left unstitched (Jacob and Ben Mather, 2000). The birds were postoperatively medicated with antibiotic [Oxytetracycline hydrochloride, (Renamycin), Renata Ltd. (Animal Health Division), Bangladesh].

2.3 Measurement

All weights were measured using an electronic balance (*Mega Digital Scale, Mega Digital Scale* & Tools *Co*, Dhaka, Bangladesh). Live weight of birds was measured every week started from eight (8) weeks of age until the end of week seventeen (17). Feed intake was also monitored daily beginning from week eight (8) till week seventeen (17).

2.4 Meat sample collection

At the end of the experiment, the birds were fastened 24 hours before slaughtering and ten (10) chickens per group (control and caponized) were randomly selected to determine the effects of caponization on the chemical composition of meat of the chickens. The birds were slaughtered using Halal method of slaughtering (Wilson, 2005) and were allowed to bleed for two (2) minutes before been de-feathered. Then the meat sample was collected from both groups.

2.5 Chemical analysis of meat

Chemical analyses (moisture, crude protein, crude fiber, and fat) were performed according to the Association of Official Analytical Chemists (AOAC) standards (AOAC, 2000). A certain amount of meat sample (6 gm) was dried to constant weight at 105°C to determine the moisture content. Crude protein was determined by the Kjeldahl method (using the factor 6.25). The soxhlet apparatus (Soxhlet Extractor Apparatus, Zhengzhou-Nanbei-Instrument-Equipment-Co-Ltd, China) was used to determine the fat content. Each analysis was repeated twice.

2.6 Data collection and record keeping

Body weights were measured every week. Survival rate and protein, fat, fiber and moisture percentages were measured at the end of the experiment.

2.7 Statistical analysis

Data of body weight, body weight gain, protein, fat, fiber and moisture percentages were recorded. Data were expressed as mean±standard error (SE) and analyzed using one-way analysis of variance (ANOVA) using IBM SPSS Statistics 20.0 software package.

3. RESULTS

3.1 Survival rate after caponization

The effect of different body weights on survival rate after caponization is presented in Table 2. This study indicated that different weights have effect on survival rate after caponization. The highest survival rate was found in the Group-A (500-600gm), followed by the Group-B (600-700gm) and the lowest survival rate was found in the Group-C (700-800gm).

3.2 Growth performance

Body weights of the two groups of birds were recorded in every week after caponization and the results are shown in the Table 3. The mean initial body weights in control and caponized group were 523.80 ± 9.60 gm and 530.80 ± 7.25 gm respectively. At the end of the experiment, significantly ($P<0.01$) different final body weight was found between the groups. The higher live weight was found in caponized group (1573.80 ± 20.60 gm) than control group (1170.80 ± 17.55 gm). Figure 1 represents weekly body weight gain between the two groups. Caponized group gained the significantly ($P<0.05$) higher weekly body weight gain than control group every week. Total live weight gain was also significantly ($P<0.01$) higher in caponized group (1043.00± 16.91 gm) than control group (647.00± 19.51 gm) which is presented in Figure 2. The initial live weight of birds belonging to the two groups was similar. The final live weight was significantly ($P<0.01$) higher in caponized group than control group (Fig 3).

3.3 Chemical analysis of meat

Table 4 represents the effect of caponization on chemical composition of meat. Statistically significant ($P<0.01$) differences were found in the fat content of muscles. Fat percentages in control and caponized group were 3.24 ± 0.04 and 5.23 ± 0.04 respectively. The highest fat percentage was found in the caponized group. Statistically no significant ($P<0.05$) differences were found in the content of moisture, protein and fiber in bird muscles.

3.4 Cost benefit analysis

Figure 4 represents the cost benefit analysis of two groups (control and caponized). Compare to the control group total profit per bird was higher in the caponized group. Further study can be carried out to explore the effects of caponization on bone and blood parameters of sonali cockerels.

4. DISCUSSIONS

This study indicated that different weights have effect on survival rate after caponization. The highest survival rate was found in the lowest weight Group-A (500-600gm). The reason of highest survival rate in this group is probably due to less developed testicular artery and loosely attachment of testicles with the surroundings compared to the other two groups. So removal of testicles was easy and chance of bleeding was low during surgical procedure. As a result, no mortality occurred in this group. Previously no study was found regarding effect of different body weights on survival rate after caponization.

Statistically significant ($P<0.01$) difference observed in the mean final body weights between the groups. The heavier live-weight in the caponized birds compared with intact cockerels in this study support the results of Chen et al., (2000). Capons were significantly heavier than intact males was also reported by previous researchers (Chen *et al.*, 2006; Rahman *et al.*, 2004; Franco *et al.*, 2016; Calik *et al.*, 2017; Kwiecien *et al.*, 2018). Due to the elimination of the male sex hormone in the caponized birds, males become more docile and less active which allows more efficient conversion of feed into growth, fat deposition and improved meat quality (Jacob and Ben Mather, 2000). Lin *et al.*, (1999) suggested that the reduced body weight in the intact males may be due to the androgen's inhibitory effect on growth hormone secretion and the increased aggression and mount-bite behavior and decreased feed intake. This result opposite to the results of some researchers (Muriel Duran, 2004; Miguel *et al.*, 2008) who found that there seem to be no significant effect of caponization on body weight gain in older ages ranging from 12-32 weeks. The diversity in these results may be due to many factors, e.g. age at caponization, age at slaughter, breed, susceptibility to stress, and interactions between the factors.

Statistically significant ($P<0.01$) difference was found in the fat content of muscles. This difference of fat in the muscles of cockerels and capons as found in the present research was also reported by other researchers (Hsu and Lin, 2003; Symeon *et al.* 2012; Kwiecien *et al.*, 2015; Calik *et al.*, 2017 and Obrzut *et al.*, 2018). Testosterone is a principal androgen that is a major determinant of body composition in male mammals (Blouin *et al.*, 2010; Dubois *et al.*, 2012). The caponization of cockerels results in reduced concentration of testosterone and causes increases in lipogenesis capability and lipid accumulation in the body (Chen et al., 2005). Other researchers (Symeon *et al.*, 2012; Duan *et al.*, 2013) also reported that caponization accelerates abdominal fat deposition in male chickens, which is accompanied by testosterone level. Similarly, in men abdominal obesity is usually associated with a low serum testosterone level (Gapstur *et al.*, 2002; Blouin *et al.*, 2010). Therefore, it was speculated that caponization would induce fat accumulation by reducing testosterone levels in male chickens, although the molecular mechanisms behind this hypothesis have remained incompletely understood. Capons consume more feed and due to the lack of fighting behaviour they are less active, which leads to deposition of fat in the body (Chen *et al.*, 2006). In this study, it was found that Caponization had no significant ($P<0.05$) effect on the content of moisture and protein in bird meat. This result is in harmony with the result of Chen *et al.*, (2007).

5. CONCLUSIONS

500-600gm body weight of birds is suitable for caponization to get the highest survival rate. Caponization technique can be used in sonali birds to improve the body weight and meat quality. Capon can be used for alternative poultry farming. Further study can be carried out to explore the effects of caponization on bone and blood parameters of sonali cockerels.

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Conflict of interests

The authors declare no conflict of interest.

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TABLES

Table 1. Nutrient composition of feed.

Nutrient ingredients	Percentages (%)
Moisture	10-11
CP	21-22
CF	3-4
Fat	6-7
Ash	7-8
Ca	0.95
Av.P	0.45
ME (Kcal/Kg)	3100
Vitamin-Mineral premix	0.85
Lysine	1.10
Methionine	0.48

% = Percentage; CP = Crude protein; CF = Crude fiber; Ca = Calcium; Av.P = Available phosphorus; ME = Metabolizable energy; Kcal = Kilo calorie; kg = Kilogram.

Table 2. Effect of different body weights on survival rate after caponization.

Groups	Body weights	Number of birds	Number of live bird after caponization	Survival rate (%)
Group-A	(500-600gm)	10	10	100
Group-B	(600-700gm)	10	8	80
Group-C	(700-800gm)	10	6	60

Group-A = (500-600gm bird); Group-B = (600-700gm bird); Group-C = (700-800gm bird); gm= Gram; % = Percentage.

Table 3. Effect of caponization on weekly body weight (gm) of different groups.

Parameters	Control	Caponized	Level of Significance
8th week	523.80 ± 9.60	530.80 ± 7.25	NS
9th week	593.0 ± 10.78	623.93 ± 6.04	*
10th week	665.60 ± 7.81	740.40 ± 6.56	***
11th week	743.60 ± 11.88	861.27 ± 6.91	***
12th week	829.60 ± 20.05	980.06 ± 10.84	***
13th week	893.46 ± 20.99	1110.00 ± 11.37	***
14th week	955.60 ± 19.67	1225.27 ± 9.77	***
15th week	1025.40 ± 19.19	1345.13 ± 11.18	***
16th week	1106.33 ± 15.59	1459.07 ± 13.45	***
17th week	1170.80 ± 17.55	1573.80 ± 20.60	***

All values indicate mean ± Standard error of mean; NS = Non significant; * = Statistically significant (P<0.05); *** = Statistically highly significant (P<0.01); gm = Gram.

Table 4. Effect of caponization on chemical composition of meat.

Parameters	Control	Caponized	Level of Significance
Moisture %	75.90 ± 0.26	74.97 ± 0.38	NS
Protein%	20.22 ±0.05	20.14 ± 0.03	NS
Fat%	3.24 ± 0.04	5.23 ± 0.04	***
Fiber%	0.80 ± 0.07	0.67 ± 0.05	NS

All values indicate mean ± Standard error of mean; % = Percentage; NS = Non Significant; *** = Statistically highly significant (P<0.01).

FIGURES

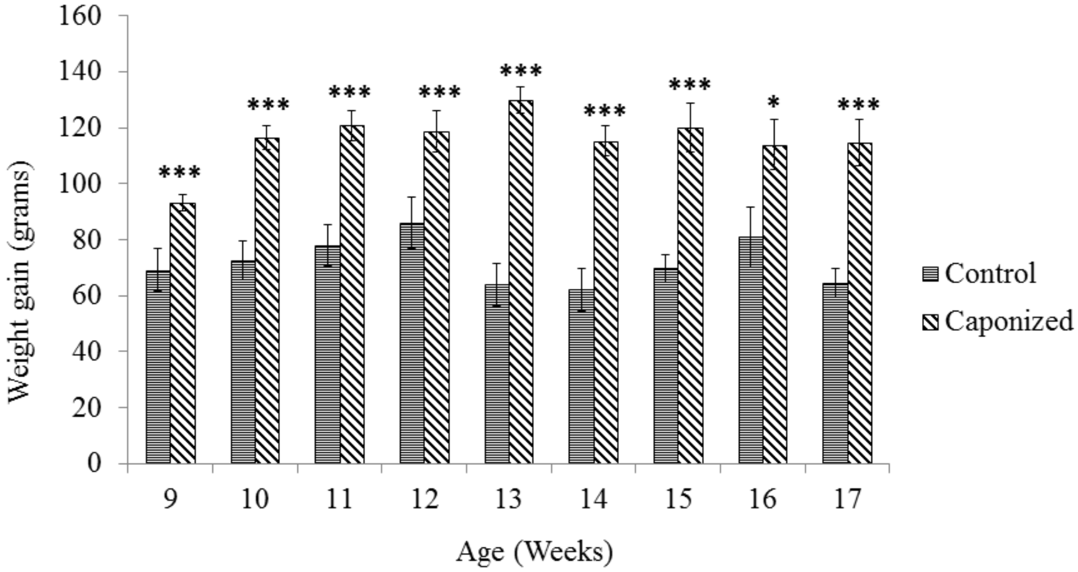

Figure 1. Comparison of weekly body weight gain (grams) between two groups (control and caponized). Where * = significant (p<0.05) and *** =highly significant (p<0.01).

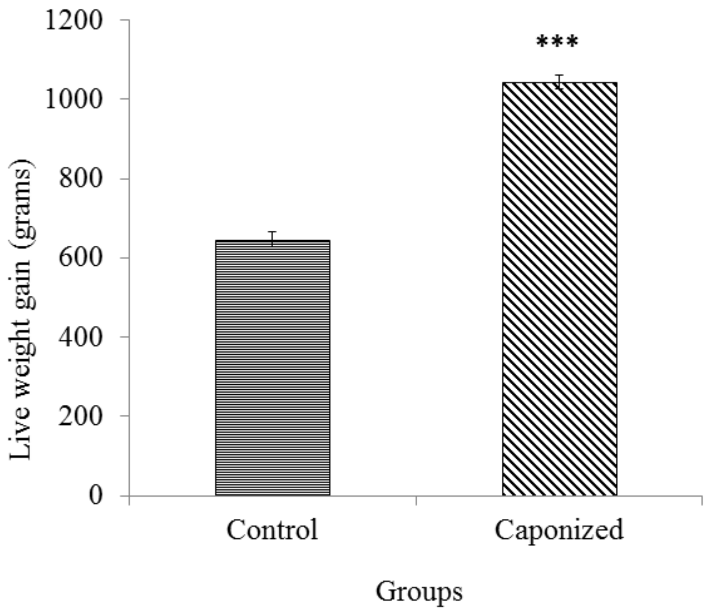

Figure 2. Comparison of live weight gain (grams) between two groups (control and caponized). Where *** = highly significant (p<0.01).

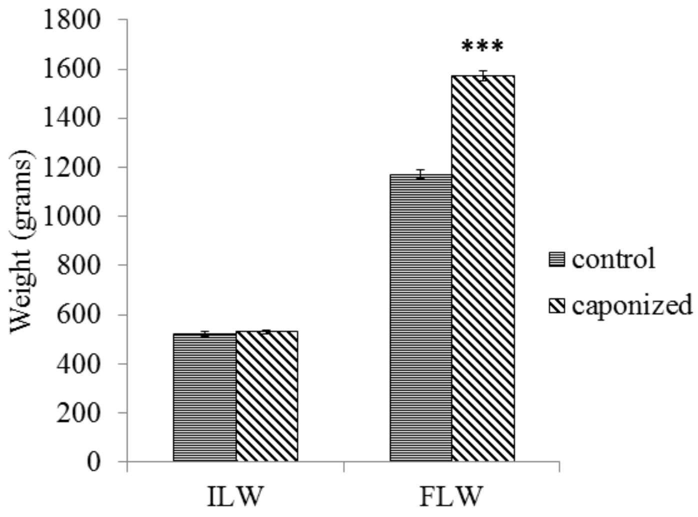

Figure 3. Comparison of (ILW = Initial live weight) and (FLW = Final live weight) between two groups (control and caponized). Where NS = non-significant and *** = highly significant (p<0.01).

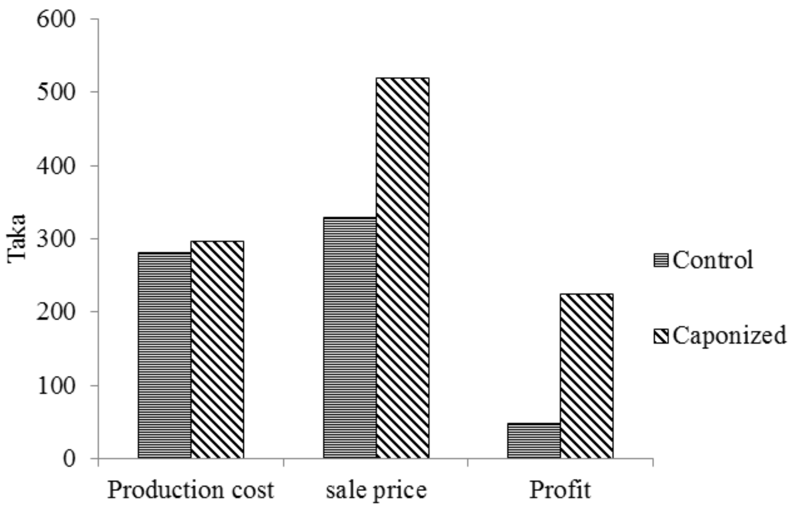

Figure 4. Comparison of cost of production and profit between two groups (control and caponized).