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Research Article

Osteometric Effects of Surgical Caponisation on Some Long Bones in Cockerel Chickens

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The study was conducted to assess the osteometric effects of surgical caponisation on long bones of cockerel chickens. Sixty- (60-) day-old chicks were distributed into two experimental groups with thirty (30) cockerels per group. The birds were caponised at eight (8) weeks of age. The mean of final body weights of caponized groups was significantly higher ($P \leq 0.05$) than the uncaponised group. The weights of all long bones measured as well as lengths between the two groups were not statistically different ($P > 0.05$) from one another except the weight of femur of the caponized group and the lengths of tibia and tarsometatarsus ($P < 0.05$) that differed significantly from one another ($P < 0.05$). All the proximal, midshaft, and distal diameters of all the long bones measured between the two groups were not statistically different ($P > 0.05$) from one another except the midshaft diameter of ulna that was significantly higher ($P < 0.05$) in caponized group. It was concluded that caponisation of cockerel chickens at eight (8) weeks of age has no significant osteometric effects ($P > 0.05$) on almost all the long bones studied when they were normalised to the final body weights.

1. Introduction

Surgical caponisation is defined as a process whereby the testes are artificially removed via a surgical operation on 6- to 12-week-old chickens [1]. It results in androgen deficiency and thus secondary male sexual characteristics such as the comb, the wattle, fighting behavior, and vocalisation degeneration [2]. It is well known that the abdominal fat pad is significantly increased in capons, regardless of the breed and the age of caponisation or slaughter [3, 4].

There are conflicting reports on the effects of caponisation on the growth of chickens. Several studies have demonstrated that caponisation enhanced chicken growth [5–7] and has no effects on growth [2, 8, 9] or even negative results [10]. Androgen has long been recognized as playing an important role in bone development, physiology, and metabolism [11, 12]; increased growth rate is often achieved after caponisation and likely as a result of androgen deficiency [2]. In humans, Manolagas et al. [13] reported that depressed androgen through exposure to chemicals, testectomy operation, or age has adverse effects on bone growth and development.

In poultry, however, very few experiments conducted on the effects of caponisation on the bones of chickens have shown consistent results. For example, Hutt [14] found increased bone length on the caponised white leghorn while Chen et al. [1] and Landauer [15] found no significant effects of caponisation on bone length of male chickens. Still, several studies have found negative responses to caponisation [16–22]. Therefore, the aim of this study was to generate baseline data on the osteometric effects of surgical caponisation on some long bones in cockerel chickens and to add to the few available data on its effects on the bones of chicken in general.

Table 1: Means (±SEM) of final body weight and weight of some long bone of caponised and uncaponised cockerels in (g).

Parameters	Uncaponised	Caponised	*P* value
Final body weight (g)	1123.862 ± 26.841	1374.037 ± 32.761	0.000*
Humerus	2.800 ± 0.327	2.800 ± 0.327	1.000NS
Femur	3.200 ± 0.327	4.400 ± 0.267	0.011*
Ulna	2.000 ± 0.000	2.000 ± 0.000	NR
Tibia	4.800 ± 0.533	5.600 ± 0.267	0.202NS
Tarsometatarsus	3.200 ± 0.327	3.200 ± 0.327	1.000NS

NSNot significant ($P > 0.05$), *significant ($P \leq 0.05$), NR = no result.

Table 2: Mean (±SEM) lengths of long bones of caponised and uncaponised cockerels in (cm).

Parameters	Uncaponised	Caponised	*P* value
Humerus	3.860 ± 0.045	3.960 ± 0.100	0.380NS
Femur	4.866 ± 0.175	5.000 ± 0.132	0.531NS
Ulna	4.780 ± 0.116	5.060 ± 0.173	0.199NS
Tibia	7.100 ± 0.225	7.800 ± 0.159	0.022*
Tarsometatarsus	4.590 ± 0.176	5.020 ± 0.071	0.043*

NSNot significant ($P > 0.05$), *significant ($P \leq 0.05$).

2. Materials and Methods

2.1. Birds Management and Experimental Design. The present study was conducted in the poultry unit, Niger State College of Agriculture farm Mokwa. Sixty- (60-) day-old chicks were purchased from Zarm farm Ilorin, Nigeria, and were randomly distributed into two experimental groups (caponized and uncaponized groups) with thirty (30) cockerels per group. The birds were given water and commercial starter diet *ad libitum* from week one (1) to week six (6) and then commercial grower diet (vital feed) from week seven (7) till the end of the experiment at week sixteen (16).

2.2. Caponisation. All the cockerels in the caponized group were caponized at eight (8) weeks of age. The birds were deprived of feed and water overnight before the procedure. Anaesthesia was performed using a combination of ketamine dosed at 20 mg/kg live body weight and diazepam dosed at 1 mg/kg live body weight. After the removal of the feathers and disinfection of the skin with methylene spirit, 1.5 cm incision was made between the two (2) last ribs. A ribs retractor was inserted and the membranes were cleared with groove director. The testicles were then removed. The site was then re-disinfected and left unstitched.

2.3. Slaughter Procedure. The birds were fastened 24 hours and slaughtered using *Halal* method [23]. They were allowed to bleed for two (2) minutes before being defeathered. The limbs were then harvested. The soft tissue attached to all the long bones harvested such as muscles, fascia, tendons, and ligaments which were removed using the scalpel.

2.4. Measurement of the Bones. All weights were measured in grams using a sensitive electronic balance (Mettler balance P 1210, Mettler instrument AG. Switzerland; sensitivity: 0.001 g). The lengths of all the bones were measured in centimetres using a thread. The readings were taken by stretching the measured length of the thread against a ruler. Diameters of the bones extremities and midshaft were measured in (mm) using vernier caliper.

2.5. Statistical Analysis. All recorded weights, lengths, and diameters were expressed as mean ± SEM (standard error of mean) and subjected to statistical analysis using statistical package for social sciences (SPSS) version 17.0. Independent sample *t*-test at 95% confidence interval was used to determine the level of significant difference in mean values between the two groups. Values of ($P \leq 0.05$) were considered significant.

3. Results

Table 1 presented the mean final body weight and mean weights of long bones in the two groups (caponized and uncaponized). The results indicated that the mean final body weights of the caponized group were significantly higher ($P \leq 0.05$) than those of the uncaponized group. The mean weights of ulna, tibia, and humerus between the two groups were not significantly different ($P > 0.05$) from one another. However, the mean weight of femur of caponized group was significantly higher ($P < 0.05$) than that of the uncaponized group.

Table 2 presented the mean lengths of humerus, femur, ulna, tibia and tarsometatarsus in the two groups. The mean lengths of all the measured bones were not statistically higher ($P > 0.05$) than those of the uncaponized group. However, the mean lengths of tibia and tarsometatarsus of the caponized group were significantly higher ($P < 0.05$) than those of the uncaponized group.

Table 3 presented the mean diameters of the proximal extremities of the long bone in the two groups. The differences in diameter of the proximal extremities of all the long bones

Table 3: Mean (±SEM) diameters of proximal extremities of long bone in caponised and uncaponised cockerels in (cm).

Parameters	Caponised	Uncaponised	*P* value
Humerus	19.200 ± 0.429	19.560 ± 0.557	0.615^{NS}
Femur	25.220 ± 1.256	23.820 ± 0.907	0.379^{NS}
Ulna	10.000 ± 0.351	11.100 ± 0.542	0.108^{NS}
Tibia	23.940 ± 0.389	25.460 ± 0.643	0.062^{NS}
Tarsometatarsus	23.260 ± 1.100	23.200 ± 0.326	0.959^{NS}

^{NS}Not significant ($P > 0.05$), *significant ($P \leq 0.05$).

Table 4: Mean (±SEM) diameters of midshafts of long bones in caponised and uncaponised cockerels in (cm).

Parameters	Caponised	Uncaponised	*P* value
Humerus	8.320 ± 0.278	8.140 ± 0.231	0.625^{NS}
Femur	12.380 ± 0.386	12.020 ± 0.386	0.479^{NS}
Ulna	6.520 ± 0.125	7.040 ± 0.109	0.006^{*}
Tibia	11.980 ± 0.644	11.280 ± 0.818	0.510^{NS}
Tarsometatarsus	12.480 ± 0.249	11.600 ± 0.401	0.082^{NS}

^{NS}Not significant ($P > 0.05$), *significant ($P \leq 0.05$).

Table 5: Mean (±SEM) diameters of distal extremities of long bones in caponised and uncaponised cockerels in (cm).

Parameters	Caponised	Uncaponised	*P* value
Humerus	15.500 ± 0.380	15.040 ± 0.375	0.362^{NS}
Femur	25.000 ± 0.72	23.960 ± 0.365	0.221^{NS}
Ulna	9.920 ± 0.174	9.860 ± 0.417	0.897^{NS}
Tibia	25.920 ± 0.507	25.780 ± 0.919	0.896^{NS}
Tarsometatarsus	21.560 ± 0.730	21.820 ± 0.341	0.752^{NS}

^{NS}Not significant ($P > 0.05$), *significant ($P \leq 0.05$).

studied in the two groups were not significantly different ($P > 0.05$) from one another.

Table 4 presented the mean diameter of the midshafts of the long bones in the two groups. With the exception of the midshaft diameter of ulna that was significantly higher ($P < 0.05$) in the caponized group, all other diameters of the midshaft of humerus, femur, tibia, and tarsometatarsus of the two groups were not significantly different ($P > 0.05$) from one another.

Table 5 presented the mean diameters of the distal extremities of the long bone in the two groups. The mean diameters of the distal extremities of all the studied bones in the two groups were not significantly different ($P > 0.05$) from one another.

4. Discussion

All the data recorded on the long bones were normalised to the body weight of the cockerel chickens. The statistical difference observed in the weights of femur might be as a result of age of caponisation in this study (8 weeks) since the target cells of the effects of sex steroids on bone growth are different from the target cells of their effects on the maintenance of the mature skeleton [13]. The present result is not consistent with an earlier study in castrated young male rats, whose skeletal growth was delayed even when they were castrated after puberty [24]. However, this observed difference might be due to difference in species and nutritional level [5, 25–27].

The statistical significance observed in the lengths of tibia and tarsometatarsal bone study might be due to the age of caponisation since in the mature skeleton the change in bone size with time is trivial [13]. The present study is in line with the findings of Hsieh [6] who found a significant difference in the tibia length of Taiwan cockerel chicken and Chen et al. [1] who reported that the tarsometatarsal perimeter in the capons was higher than uncaponised chicken. This finding is not in agreement with other studies that showed no influence [8, 17] or decreased tibia length [28].

The nonsignificant difference found in the lengths of other bones was in line with the finding of an earlier study by Landauer [15] who did not find a significant effect on bone length in caponized males chickens fed up to 10 months of age, while it was not consistent with the finding of Hutt [14] who reported that caponized white leghorn chickens increased bone length.

Generally, though it is not documented to our knowledge, the osteometric effects of surgical caponisation on the long bone diameters in birds but androgen has been reported to influence mammalian bone development [29]. Therefore, its depression through chemical, testectomy operation or age has adverse effect on bone growth and development in human beings [13] as well as in bone growth of broiler chickens [19–22].

5. Conclusion

Based on this study, surgical caponisation of cockerel chickens at eight (8) weeks of age has no significant osteometric effects ($P > 0.05$) on almost all the parameters of the long bones studied when they were normalised to the final body weights.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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