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EFFECTS OF SURGICAL CASTRATION ON SOME BIOCHEMICAL PARAMETERS, TRIIODOTHYRONINE AND RECTAL TEMPERATURE OF RED SOKOTO GOATS

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ABSTRACT

The effects of surgical castration on some biochemical parameters, triiodothyronine and rectal temperature were investigated in Red Sokoto bucks. Ten bucks were used for the study. Five of the bucks were surgically castrated while the other five were not castrated (control). Following surgical castration, the parameters assayed for were measured weekly for 4 weeks. Total protein, albumin, globulin and the serum enzymes assayed showed no significant variation between the two groups throughout the study period. The castrated bucks had a significantly higher ($p < 0.05$) blood glucose and urea at week 1, and significantly higher creatinine ($p < 0.05$) at week 1 and 2 post castration. The castrated bucks also had a significantly higher ($p < 0.05$) total triiodothyronine throughout the study period, and a significantly higher rectal temperature at week 2 and 3. This study has shown that within the first 28 days of surgical castration in Red Sokoto bucks, blood glucose, urea, creatinine and triiodothyronine levels are significantly altered at certain periods.

***Keywords*:** Castration, serum biochemistry, thriiodothyronine, temperature, goats.

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INTRODUCTION

Nigeria goat population was estimated at 54 million [1]. This genetically diverse group of animals comprises the Red Sokoto goats, the Sahel goats and the West African dwarf goats. The population of

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Red Sokoto goats in Nigeria was estimated at 16.28 million [2]. The Red Sokoto goat has numerous productive advantages over the rest and this has led to its popularity and demand worldwide. Goats are reared in Nigeria mainly for meat and are a major source of income especially for rural people. Castration is one of the management protocols in goat buck rearing, and bucks that are not used for breeding are usually castrated and kept as a meat source. Castration affects animal growth and carcass composition as it alters metabolism [3]. Concentrations of several blood metabolites as well as thyroid hormone may be altered due to metabolic shift that ensues following surgical castration in goats. Such alterations in blood chemistry and thyroid hormone allow the animal to adapt their metabolic activities to changes in nutrient requirements and availability, and also to homeostatic changes resulting from surgical castration which brings the animal into an entirely different physiological status [4].

The effect of bloodless castration on serum biochemistry has been carried out in West African Dwarf goats [5], but there is no information in available literature on the changes in blood metabolites and thyroid hormones associated with castration in Red Sokoto goats. The present study was designed to evaluate the effect of surgical castration on some serum biochemical parameters, total triiodothyronine and rectal temperature in Red Sokoto bucks.

MATERIALS AND METHODS

Experimental Animals

The study was conducted in the Physiology Unit of Department of Veterinary Physiology and Biochemistry, Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto using ten clinically healthy, non cryptorchid Red Sokoto bucks. The bucks were aged 3-5 months old and their body weight was 8.55 ± 1.01 kg at the commencement of the study. The bucks were housed in the Small Ruminant Research Unit of Veterinary Teaching Hospital, throughout the study period. The bucks were acclimatized for three weeks during which they were treated prophylactically against endo- and ecto-parasites using, Ivermectin (200 μg/kg), Ciprofloxacin (2 mg/kg), and Amprolium (55 mg/kg/day). The bucks were fed *ad libitum* on wheat offal, bean husk and groundnut hay. Water was also provided *ad libitum* throughout the study period.

Experimental Design

The bucks were randomly divided into two groups (A and B) of five bucks each prior to castration. The bucks in group A were identified as A1 - A5 while those in group B were identified as B1 - B5. The bucks in group A were surgically castrated while those in group B served as the control. Surgical castration was performed using the method described by Tibary and Van Metre [6].

Sample Collection and Analysis

Whole blood (3 ml) was collected aseptically from the jugular vein using sterile needles and syringes, and a commercially prepared plain vacautainer tubes from all the five bucks in each of the two groups, weekly for 4 weeks post castration. Blood glucose was determined following the glucose oxidase method [7]. Serum for the determination of total protein, albumin, urea, creatinine and total triiodithyronine was obtained by allowing the blood to clot at room temperature, centrifuged at 4000 revolution per minute for 10 minutes and then stored in another plain vacoutainer tubes at -20°C until the time of analysis. Total protein was determined using Biuret method [8]. Albumin was determined using bromocresol green method [9]. Urea was determined colorimetrically using diacetyl monoxime method [10]. Creatinine was determined by enzymatic colorimetric method [11]. Total triiodothyronine (tT3) was measured by competitive enzyme immunoassay (type 5), using total triiodothyronine AccuBind™ ELISA test kit, as described by the manufacturer (Monobind Inc. Lake Forest, CA, USA). Rectal temperature was determined using digital clinical thermometer.

Statistical Analysis

Independent samplet-test with Welch correction was used to compare data of all the parameters from the castrated and uncastrated bucks. The difference was considered significant at values of $p < 0.05$. Data were presented in tables. Statistical analysis was performed using GraphPad InStat for Windows, (version 3.05) and SPSS 18.

RESULTS

Weekly variations in some biochemical parameters of the castrated and uncastrated Red Sokoto bucks are presented in Table 1. Blood glucose level was higher in castrated bucks throughout the study period, but the difference was significant ($p<0.05$) only at week 3 post castration. The differences in serum total protein, albumin and globulin between the two groups were not significant throughout the study period. Serum urea was significantly higher ($p < 0.05$) in castrated buck at week 1, but showed a non significant difference ($p > 0.05$) between the two groups at week 2, 3 and 4 post castration. The castrated bucks had a significantly higher ($p < 0.05$) serum creatinine level at week 1 and week 2 , but the difference at weeks 3 and 4 was not significant ($p > 0.05$).

Table 1. Mean ± SD of some biochemical parameters of castrated and intact Red Sokoto bucks

Parameters		Week(s) post castration 1	2	3	4
Glucose (mmol/L)	Castrated	1.93±0.19[a]	2.37±0.50[a]	3.78±0.79[a]	2.63±1.24[a]
	Intact	1.87±0.23[a]	2.26±0.30[a]	2.20±0.35[b]	1.76±0.574[a]
Total protein (g/dl)	Castrated	6.04±0.81[a]	6.83±1.54[a]	7.31±3.71[a]	7.73±1.91[a]
	Intact	6.83±0.66[a]	6.34±1.51[a]	5.81±0.81[a]	6.46±2.46[a]
Albumin (g/dl)	Castrated	2.97±0.35[a]	3.38±0.51[a]	3.01±0.20[a]	2.73±0.41[a]
	Intact	2.88±0.28[a]	2.79±0.72[a]	2.73±0.72[a]	3.38±0.89[a]
Globulin (g/dl)	Castrated	3.07±0.85[a]	3.45±1.39[a]	4.30±3.73[a]	5.00±2.19[a]
	Intact	3.95±0.64[a]	3.55±1.05[a]	3.08±1.02[a]	3.08±1.90[a]
Urea (mmol/L)	Castrated	8.90±1.38[a]	6.39±0.69[a]	7.82±0.94[a]	8.97±3.79[a]
	Intact	6.86±0.62[b]	6.56±0.65[a]	7.95±0.62[a]	7.13±2.67[a]
Creatinine (mg/dl)	Castrated	1.59±0.31[a]	1.01±0.23[a]	1.05±0.26[a]	0.63±0.07[a]
	Intact	0.75±0.11[b]	0.66±0.07[b]	0.79±0.08[a]	0.68±0.09[a]

[ab]Pairs of means bearing different superscript are significantly different ($p< 0.05$).

The serum alanine aminotranferase, aspartate aminotranferase and alkaline phosphatase activity of castrated and the uncastrated Red Sokoto bucks are presented in Table 2. There were no significant differences ($p > 0.05$) between the two groups in the serum levels of those enzymes, throughout the study period.

The serum total triiodothyronine levels and rectal temperature of the castrated and the uncastrated Red Sokoto bucks are presented in Table 3. The castrated bucks had a significantly higher ($P<0.05$) serum total triiodothyronine throughout the study period. The differences in the rectal temperature between the two groups was not significant ($p > 0.05$) at week 1 and week 4, but the castrated bucks had a significantly higher ($p < 0.05$) rectal temperature at week 2 and 3 post castration.

DISCUSSION

The differences in blood glucose level observed in week 3 during this study was probably as a result of stress induced by surgical castration which may have elicited an increase in cortisol secretion. Cortisol has gluconeogenic effect, and glucose is synthesized using protein stores and fat depots [12]. This may have resulted in increased cellular uptake and utilization of glucose for energy generation, thereby enabling the cells to cope with homeostastic challenges resulting from the stress of castration. The observation in this study is in agreement with the findings of earlier workers [13,14,15], who reported an increase in blood glucose level following surgical castration in Awassi lambs, Wistar rats and Nubian male kids, respectively.

Table 2. Mean ± SD of some serum enzymes of castrated and intact Red Sokoto bucks

		Week(s) post castration			
Parameters		1	2	3	4
Alanine	Castrated	10.20±4.60	7.20±3.03	8.60±1.95	8.60±3.36
Aminotranferase	Intact	10.40±1.52	9.80±4.82	8.00±1.63	8.00±1.63
ALT (IU/L)					
Aspartate	Castrated	34.20±12.46	31.20±15.19	28.20±7.43	34.20±16.48
Aminotransferase	Intact	49.80±11.26	32.20±17.53	34.50±29.82	39.00±9.23
AST (IU/L)					
Alkaline	Castrated	99.00±11.05	135.76±76.13	184.28±44.90	226.76±84.61
Phosphatase (IU/L)	Intact	103.76±12.38	154.10±54.08	187.88±100.76	169.13±51.55

No significant differences between the means ($p < 0.05$)

Table 3. Mean±SD of triiodothyronine and rectal temperature of castrated and intact Red Sokoto bucks

		Week(s) Post castration			
Parameters		1	2	3	4
Total	Castrated	2.74±0.44[a]	2.73±0.13[a]	2.68±0.29[a]	2.07±0.35[a]
triiodothyronine	Intact	1.91±0.47[b]	1.85±0.45[b]	1.83±0.36[b]	1.54±0.22[b]
(ng/ml)					
Rectal	Castrated	38.48±0.22[a]	38.64±0.32[a]	38.56±0.58[a]	37.30±0.67[a]
temperature (^{0}C)	Intact	38.36±0.15[a]	38.04±0.42[b]	37.60±0.47[b]	36.40±0.90[a]

[ab]Pairs of means bearing different superscript is significantly different ($p< 0.05$).

The findings in this study that the differences in serum total protein, albumin and globulin between the two groups were not significant ($p > 0.05$) throughout the study period implied that the removal of the testis and thus withdrawal of testosterone did not have any immediate effects on serum proteins. Surgical castration causes a significant decrease in plasma testosterone and this was expected to, in turn, affect protein metabolism [16]. The anabolic effects of testosterone stem from its influence on protein metabolism, as it increases their anabolism and the development of non reproductive tissue (muscle, bone mineral density and bone length) but decrease their catabolism.

The observation in this study of significant effects on serum proteins was probably as a result of the non-expression of the effect of elimination of testicular androgen on plasma protein concentration within one month post surgical castration in Red sokoto bucks or it is possible that the manifestation of the effect of decrease in plasma testosterone on plasma protein is mild within the first 28 days post castration. This observation is consistent with the findings of Nasr *et al*. [15], who reported a non significant changes in

serum total protein following Burdizzo castration in Nubian male kids, Mohammed *et al*.[13] and Hassan [14] had earlier reported a non significant changes in serum total protein, albumin and globulin following surgical castration in Awassi lambs and Wistar rat, respectively. However, Oyeyemi *et al*. [17] and Olaifa and Opara[5], reported a significant hypoproteinaemia, hypoalbuminaemia and hypoglobulinaemia following surgical and Burdizzo castration in West African Dwarf bucks.

The differences in blood urea concentration of the castrated and uncastrated bucks in this study were probably due to increase in protein catabolism as a result of tissue inflammation, and necrosis that accompanies surgical castration. Urea is produced in the liver as a by-product of protein catabolism in ruminants and it is recycled in the renal tubule, rumen and hindgut for amino acid and protein biosynthesis [18]. It is thought that tissue destruction resulting from the surgical castration may have been accompanied by acute protein catabolism which resulted in increased blood urea.

The observed differences in serum urea level in this study is consistent with the findings of Mohammad *et al*. [13] and Olalifa and Opara [5] who both reported a significant increase in serum urea following surgical castration in Awassi lambs and Burdizzo castration in West African Dwarf bucks, respectively. However, Nasr *et al*. [15] reported a significant decrease in serum urea level following Burdizzo castration in Nubian male kids

The differences observed in serum creatinine level between the two groups showed that, castration caused a significant rise in serum creatinine level within 2 weeks of castration. This result agrees with what was reported by Mohammad *et al*. [13] and Olaifa and Opara [5] in surgically castrated Awassi lamb and Burdizzo castrated West African Dwarf bucks. Creatinine is a product of creatine phosphate catabolism in the muscle [19]. Serum creatinine level is an index of renal health, and the amount of creatinine secreted daily is a function of the muscle mass and to a lesser extent the diet, age, sex, or exercise [20]. As a major by-product of energy metabolism in the muscles, the increase in creatinine level observed in the castrated group was probably due to increased rate of energy metabolism induced by surgical castration. This can also be correlated with the increase in serum total triiodothyronine level observed in this study which is the major regulator of energy metabolism.

The non significant ($p>0.05$) differences in alanine aminotranferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) levels observed between the castrated and uncastrated group in this study is in agreement with the findings of Olaifa and Opara [5], except for the significant decrease in AST he recorded only at one week post Burdizzo castration in West African dwarf bucks. Oyeyemi *et al*. [17] reported a significant rise in ALP following surgical castration in West African bucks which is in contrast to the findings of this study. In surgically castrated animals, varying degrees of hypertrophy have often been observed, even involving non reproductive organs. Liver hypertrophy appears particularly interesting in view of the metabolic alteration that could possibly ensue [21]. The findings of this present study imply that even if liver hypertrophy ensued following surgical castration in Red Sokoto bucks, it did not induce significant changes in the serum levels of ALT, AST and ALT within one month of castration.

A significantly higher ($p < 0.05$) levels of total triiodothyronine (tT3) was recorded in the castrated group throughout the experiment, indicating that surgical castration in Red Sokoto bucks led to enhanced production of total triiodothyronine, and that probably an inverse relationship exists between plasma testosterone and total triiodothyronine level in bucks. Thyroid hormones are likely the primary determinants of basal metabolism. Among the recognized functions of thyroxine are; increase oxygen consumption of tissues (calorigenic effect), increasing intestinal glucose absorption and facilitating the movement of glucose into both muscles and adipose tissues, facilitating normal growth and development by enhancing amino acid uptake by tissue and enzyme systems involved in protein synthesis, increase lipid metabolism and stimulation of cardiac and neural functions [17,22]. Many factors are able to affect

thyroid activity and hormone concentrations in blood in goats, acting at the level of hypothalamus, pituitary and/or thyroid gland, as well as on peripheral monodeiodination. Surgical castration as shown by the result of this study is one those factors.

The significantly higher rectal temperature recorded in the castrates was probably as a result of the increase serum levels of total triiodothyronine. Triiodothyronine enhances oxygen consumption and glucose utilization at cellular level, and this has a direct influence on calorigenesis/thermogenesis [23]. That is, it enhances heat production which manifests as an increase in body/rectal temperature. However, it is also possible that the relative increase in rectal temperature could have resulted from surgical stress since the control animals were not sham-operated.

CONCLUSION

Based on the results of this study, it was concluded that within one month post-surgical castration in Red Sokoto bucks, significant changes occurred in serum glucose, urea and creatinine concentrations but not in serum total protein, albumin and globulin. The results also suggest that surgical castration also caused a significant increase in serum total triiodothyronine level within one month, and this may have enhanced thermogenesis which manifested as increase in rectal temperature.

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