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Keerthana Surabhi
NTR College of Veterinary Science, Sri Venkateswara Veterinary University, Gannavaram, Andhra Pradesh, India

Raghavendra Srikanth N
Livestock Research Station, Lam, Sri Venkateswara Veterinary University, Guntur, Andhra Pradesh, India

M Mutha Rao
Livestock Research Station, Lam, Sri Venkateswara Veterinary University, Guntur, Andhra Pradesh, India

Corresponding Author
Raghavendra Srikanth N
Livestock Research Station, Lam, Sri Venkateswara Veterinary University, Guntur, Andhra Pradesh, India

Cholesterol and testosterone interplay compared in young and adult Ongole breeding bulls

Keerthana Surabhi, Raghavendra Srikanth N and M Mutha Rao

Abstract
There were scanty studies on the interaction between cholesterol and testosterone and far scantier studies on this topic in indigenous bovine. Hence the present study was aimed to know the interplay of cholesterol and testosterone with regards to the age of the breeding bulls. Twelve breeding bulls of the Livestock Research Station, Lam, Guntur, Andhra Pradesh were grouped into two different age groups (n = 6) each *viz.,* young breeding bulls and adult breeding bulls. Serum cholesterol and Serum testosterone were estimated in all the bulls. The effect of age on serum cholesterol and serum testosterone and their mutual interaction was studied. Serum Total protein was also estimated in both the groups to see the difference in feeding status of the bulls, if any. Significantly higher values (P<0.05) were observed in serum testosterone in adult breeding bulls compared to young ones. On contrary, significantly lower values (P<0.05) were noticed in serum total cholesterol in adults compared to young breeding bulls. The serum total protein in both the groups were significantly similar.

Keywords: Serum testosterone, total cholesterol, total protein, ongole breeding bulls

1. Introduction
Testosterone is an androgen and is a steroid hormone. It plays a pivotal role in growth, reproduction and development irrespective of the genders. Like every other steroid hormone, testosterone too has its synthesis from cholesterol [1] as depicted in figure.1.
Ever since the advent of the isolation of the cholesterol, it has gain lot of importance physiologically and clinically. Cholesterol is mostly linked for its evil side, being the causative of atherosclerosis in humans [2]. However, one should not forgo the fact that cholesterol is a necessary evil. There are numerous places where cholesterol proves its essentiality. One of them is steroidogenesis.
Cholesterol is the sole and is the mother precursor of steroids and there by the steroid hormones. The cytochrome P450 cholesterol side chain cleavage enzyme i.e., CYP11A1 located in the inner mitochondrial membrane catalyzes the conversion of cholesterol to pregnenolone. For the later stages of the enzymatic reactions for the production of the testosterone, pregnenolone enters the endoplasmic reticulum [3].
There are observations by workers that cholesterol decreases with age (from young to adult) in cattle, guinea pigs and rabbits [4], buffaloes [5] and humans [6]. On contrary, the testosterone increases with age from young breeding bulls to adult breeding bulls [7]. Testosterone concentration, scrotal circum-ference, semen ejaculate volume and semen quality improved in Bunaji and N`Dama bulls [8].
Evidences from previous workers suggest that there is undeniable interaction between cholesterol and the testosterone. As the testosterone is produced from the parent molecule cholesterol, it can be anticipated that there will be strong interdependence between both the molecules. A study on the pigs demonstrated that castration induced testosterone deficiency caused a significant elevation of in serum cholesterol concentration in pigs fed with high cholesterol diet and the same was reversed by testosterone replacement therapy [9]. Cholesterol homeostasis is essential for testosterone production, sertoli cell function and differentiation of germ cells in testicular environment. Altered blood cholesterol concentrations may lead to male infertility [10]. Scanty information on these interactions between cholesterol and testosterone in the indigenous cattle led us to the present study to elucidate the interplay of cholesterol and testosterone in the Ongole breeding bulls.

2. Materials and Methods
Blood samples were collected from young breeding bulls and adult breeding bulls of the

Livestock Research Station, Lam, Guntur, Andhra Pradesh, India. A total of 12 samples were collected with six samples in each group *i.e.*, six samples from young breeding bulls and six samples from adult breeding bulls. The blood samples were collected in serum activator coated vacutainers and were subjected to serum separation by centrifugation, after a brief incubation. The serum samples were immediately estimated for concentrations of serum testosterone, serum cholesterol and serum total proteins. Serum testosterone (ng/ml) was estimated by chemiluminescence method whereas the serum total cholesterol (mg/dl) (direct method of Kim & Goldberg [11]) and serum total proteins (g/dl) (Biuret) were estimated by spectrophotometric method.

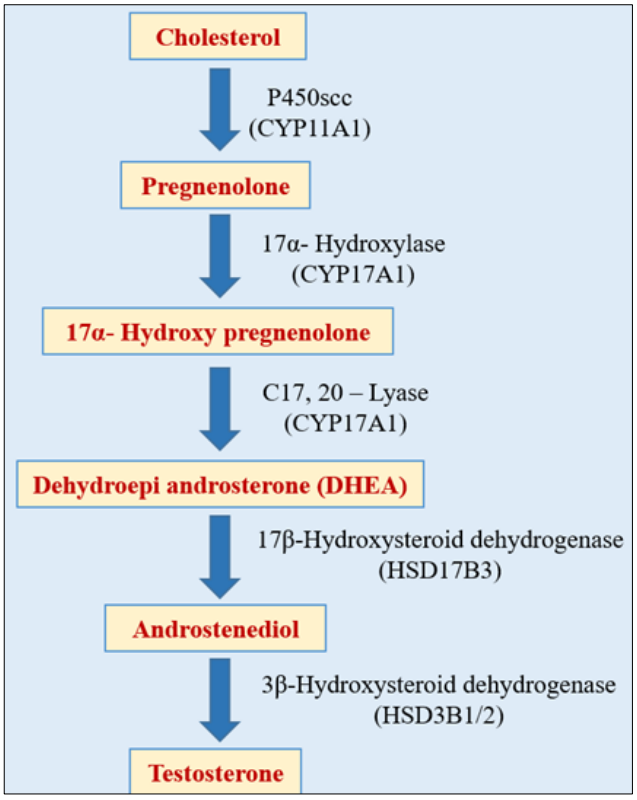

Fig 1: Synthesis of Testosterone from Cholesterol

3. Results

Serum testosterone, total cholesterol and total proteins were estimated in the young (n=6) and adult (n=6) breeding bulls and were presented in Table-1. The effect of testosterone on the total cholesterol is depicted in the graph (Figure-1). Serum testosterone mean value in adult breeding bulls (10.55±0.78 ng/ml) was significantly higher than the mean testosterone value in the young breeding bulls (7.31±0.29 ng/ml). On the contrary, serum total cholesterol mean value in the adult breeding bulls (106.67±14.24 mg/dl) was significantly lower than that of the young breeding bulls (159.33±7.29 mg/dl). There was no significant difference between serum total protein mean values between young breeding bulls (7.07±0.13 g/dl) and adult breeding bulls (7.08±0.09 g/dl).

Table 1: Means of serum testosterone, serum total cholesterol and serum total proteins in young and adult breeding bulls

Parameter	Young	Adults
Total Cholesterol (mg/dl)	159.33±7.29[a]	106.67±14.24[b]
Testosterone (ng/ml)	7.31±0.29[a]	10.55±0.78[b]
Total Proteins (g/dl)	7.07±0.13	7.08±0.09

Different superscripts [a,b] indicate significant difference at $P<0.05$

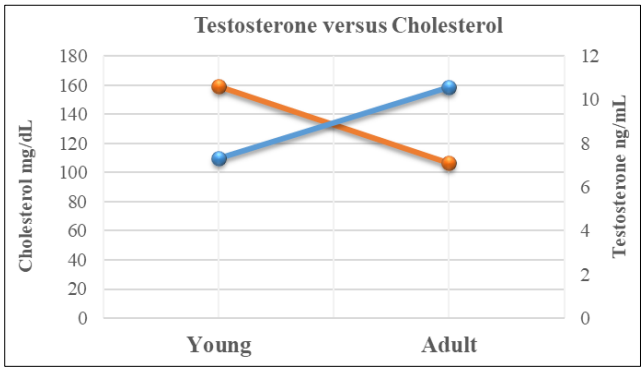

Fig 2: Graphical representation of the interplay of the serum testosterone and serum total cholesterol in young and adult breeding bulls

4. Discussion

Steroid hormones play a crucial role in different physiological aspects of the mammals. Cholesterol is the parent molecule from which all the steroid hormones gets derived. Steroid hormones are produced in the mammalian body at two places *viz.*, adrenals and gonads. Sex steroidal hormones are produced in the gonads. The male of the species produce testosterone in the testes [12].

In the present study, the testosterone is estimated in the young and adult breeding bulls. Serum testosterone concentration was significantly higher in the adult breeding bulls in the study than that of in the young breeding bulls. Similar findings were given by [13, 14] who reported that serum testosterone concentrations in buffalo bulls increase with sexual maturity. The findings of [15] in Charolais bulls were in acceptance with the present study results, who found that in Charolais bulls the testosterone in pubescence was low and gradually increased with age. The effect of age on testosterone was studied by [16] in Pesisir Cattle, [17] in Black-and-White Holsteins and either of the studies found steady increase in the levels of testosterone up to adult age, as was the outcome of the present study.

As cholesterol is the parent steroid for the formation of the sex steroids like testosterone, the present study was designed to see the trends of serum cholesterol interactive to serum testosterone with the altering age in Ongole breeding bulls. On contrary to the concentrations of the serum testosterone, with age, serum total cholesterol found decreasing in previous studies by various workers in various animals [4, 5, 6], which are in acceptance with the findings of the present study.

In this study, it was observed from the results that the serum testosterone is higher in the adult breeding bulls and is lower in young breeding bulls; on the contrary, serum total cholesterol is more in young ones compared to the adults. Regulation of testosterone and cholesterol homeostasis is vital for mammalian fertility. [12] in their study observed that testosterone effect on gene expression is associated with suppression of cholesterol *de novo* synthesis, which supports the present study finding. An experimental study in pigs was conducted by [9] and found that castration induced testosterone deficiency caused severe hypercholesterolemia in pigs fed with high fat high cholesterol diet. In a study conducted in rats, [18] observed that high dietary cholesterol reduces the testosterone levels by down-regulating the steroidogenic enzymes, which the scientists attributed to endoplasmic reticulum stress in the testes. Either way, it is proven that cholesterol and testosterone are inversely proportional in their concentrations at a given time.

The total protein in the present study showed no significant difference between the groups, which prove that both the groups were in similar nutritive status.

5. Conclusion

Though there were meagre experimental studies in other animal species, there was no proper data regarding the testosterone and cholesterol interplay in indigenous cattle breeding bulls. This study in Ongole breeding bulls put forth that as the sexual maturity enhances in the bulls, testosterone increases and cholesterol decreases. Further, in depth gene expression studies in this area may throw more light on this topic.

6. Acknowledgements

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7. References

1. Shea JL, Wong PY, Chen Y. Free testosterone: Clinical utility and important analytical aspects of measurement. Advances in clinical chemistry. 2014;63:59-84.
2. Luo J, Yang H, Song BL. Mechanisms and regulation of cholesterol homeostasis. Nature reviews Molecular cell biology. 2020;21(4):225-45.
3. Rone MB, Fan J, Papadopoulos V. Cholesterol transport in steroid biosynthesis: role of protein–protein interactions and implications in disease states. Biochimica et Biophysica Acta (BBA)-Molecular and Cell Biology of Lipids. 2009;1791(7):646-58.
4. Shope RE. The effect of age on the total and combined cholesterol of the blood serum. Journal of Biological Chemistry. 1928;80(1):141-8.
5. Li Q, Wang Y, Tan L, Leng J, Lu Q, Tian S, *et al*. Effects of age on slaughter performance and meat quality of Binlangjang male buffalo. Saudi journal of biological sciences. 2018;25(2):248-52.
6. Ferrara A, Barrett-Connor E, Shan J. Total, LDL, and HDL cholesterol decrease with age in older men and women: The Rancho Bernardo Study 1984–1994. Circulation. 1997;96(1):37-43.
7. Chacur M, Arikawa A, Oba E, Souza C, Gabriel Filho LR. Influence of Testosterone on Body and Testicular Development in Zebu Cattle in the Tropical Climate. InAdvances in Testosterone Action. Intech Open, 2018.
8. Sekoni VO, Rekwot PI, Bawa EK, Barje PP. Effects of age and time of sampling on serum testosterone and spermiogram of Bunaji and N'Dama bulls. Research Journal of Veterinary Sciences. 2010;3(1):62-7.
9. Cai Z, Xi H, Pan Y, Jiang X, Chen L, Cai Y, *et al*. Effect of testosterone deficiency on cholesterol metabolism in pigs fed a high-fat and high-cholesterol diet. Lipids in health and disease. 2015;14(1):1-0.
10. Sèdes L, Thirouard L, Maqdasy S, Garcia M, Caira F, Lobaccaro JM, *et al*. Cholesterol: a gatekeeper of male fertility?. Frontiers in endocrinology. 2018;9:369.
11. Kim E, Goldberg M. Serum cholesterol assay using a stable Liebermann-Burchard reagent. Clinical chemistry. 1969; 15(12):1171-9.
12. Eacker SM, Agrawal N, Qian K, Dichek HL, Gong EY, Lee K, *et al*. Hormonal regulation of testicular steroid and cholesterol homeostasis. Molecular Endocrinology. 2008;22(3):623-35.
13. Gunarajasingam D, Rajamahendran R, Downey BR, Lague PC. Testosterone secretion in young and adult buffalo bulls. Theriogenology. 1985;24(2):185-95.
14. Shatab MS, Kumar A, Honparkhe M, Singhal S, Kaur S, Brar PS. Endocrine Status of Serum Testosterone, Estrogen and Thyroid Hormones in High Fertility Breeding Buffalo Bulls and their Male Calves. Journal of Animal Research. 2016;6(6):1073-5.
15. Kwiatkowski T, Marcinkowski K, Halawa B, Gładysz A, Lewandowski L, Dobkowicz Z, *et al*. Testosterone levels of the plasma of bulls in relation to growth, breed, semen quality and sexual activity. Polskie Archiwum Weterynaryjne. 1983;23(4):9-22.
16. Budhiyadnya IG, Udin Z, Purwati E, Yellita Y. The effect of age, body height, weight, testosterone hormone concentration and semen quality on the libido level of pesisir cattle. Journal of Animal Health and Production. 2021;9(1):78-87.
17. Abilov AI, Mityashova OS, Mymrin SV, Gudilina AA, Pyzhova EA, Kombarova NA, *et al*. Endogenous hormone level in bull sires in relation to age, autoimmune status, and production performance of maternal ancestors. Sel'skokhozyaistvennaya biologiya [Agricultural Biology]. 2018;53(4):743-52.
18. Yu C, Jiang F, Zhang M, Luo D, Shao S, Zhao J, *et al*. HC diet inhibited testosterone synthesis by activating endoplasmic reticulum stress in testicular Leydig cells. Journal of cellular and molecular medicine. 2019;23(5):3140-50.