Int.J.Curr.Microbiol.App.Sci (2018) *7*(8): 1891-1897

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 08 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.708.217

Gonadal Steroids during Growth in Gir and Jaffarabadi

Ninan Jacob[1,2*], J.S. Arya[1,3] and R.G. Shah[1,4]

[1]Department of Veterinary Physiology and Biochemistry, College of Veterinary Science & Animal Husbandry, Anand Agricultural University, Anand, Gujarat, India
[2]Department of Veterinary Physiology, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry – 605 009
[3]Department of Veterinary Physiology, COVSAH, A.A.U., Anand, India
[4]Director of Research, Kamdhenu University, Sabarkantha, Gujarat, India
**Corresponding author*

Keywords

Age, Gir, Estrogen, Progesterone, Testosterone

Article Info

Accepted:
12 July 2018
Available Online:
10 August 2018

A B S T R A C T

Plasma gonadal steroid (estradiol-17β, progesterone in females and testosterone in males) levels were estimated in Gir and Jaffarabadi breeds at different ages. Estradiol-17β levels at 36 m age were significantly ($P<0.05$) higher than that at 3 and 6 m age but were non-significantly higher than that at 24 m age. Progesterone levels at 36 m of age were significantly ($P<0.05$) higher than that at lower ages upto 24 m, indicating that the animals reached maturity between 24 and 36 m age. No significant variation was found in the plasma testosterone levels upto 12 m age.

Introduction

Steroid hormones play an important role in the growth and have a wide range of physiological functions in an animal. *Estrogens* (non-specific group name for 17-beta estradiol and its metabolites – estriol and estrone) arise mainly from ovary, testis, feto-placental unit and adrenal cortex and may also arise from peripheral metabolism of androgens to estrogens occurring in non-glandular tissue such as adipose tissue, muscle and brain (Pineda, 2003). *Progesterone* is a cyclic hormone synthesised in the corpus luteum, placenta and adrenal cortex (small amount). It dominates during the luteal phase of the estrous cycle and is in pregnant animals it maintains the pregnancy up to the full term or complete development of fetus inside the mother by maintaining its threshold value in blood, which is secreted from corpus luteum in early stage and placenta in later stage. *Testosterone* (one of the principal androgen) is secreted from the Leydig cells and is chemically 17 β – hydroxy – 4 – androsten – 3 – one (Anderson, 2008). It is responsible for the development of male secondary characters and for the masculine

behaviour in males. Research work has mainly been oriented around the steroid gonadal levels after maturity and during different physiological stages in animals. However, the study on level of gonadal steroid hormones before the animal attains maturity is very meagre. Hence, the present study was planned to detect the gonadal steroid hormone levels in Gir females and males till the age they reached maturity.

Materials and Methods

Gir cattle (female and male) of various ages maintained under standard feeding and managemental conditions followed at the Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, Gujarat were used in the present study. The project was approved by the Institutional Animal Ethics Committee (IAEC). Blood (2 ml, n=8 at each age) was collected aseptically, between 0600 hrs to 0800 hrs of the day, through the jugular vein in lithium heparin vacuettes from Gir and Jaffarabadi females at 3, 6, 12, 24 and 36 m age and from Gir and Jaffarabadi males at 1wk, 1, 3, 6 and 12m age and also in adult breeding Bulls and castrated males. Clear plasma was separated and stored in vials at -20 ºC till analyses. The samples were analysed at the Reproductive Biology Research Unit, College of Veterinary Science & A.H., A.A.U., Anand by RIA method using the Kits manufactured by Immunotech, Beckman Coulter, Czech Republic. The data obtained were subjected to statistical analyses by using the completely randomised design (CRD) as described by Snedecor and Cochran (1990)

Results and Discussion

The Mean ± S.E. levels at different ages of plasma estradiol – 17β (pg/ml), progesterone (ng/ml) (3 m to 36 m) are presented in Table 1 and plasma testosterone (ng/ml) (1 wk to 12 m) are presented in Table 2.

Plasma estradiol -17β (pg/ml)

GIR

Plasma estradiol – 17β (pg/ml) levels varied from 6.03 ± 0.14 (3 m age) to 16.49 ± 7.11 (36 m age) at different ages in Gir females. The levels increased from 3 m age to 36 m age. The value at 36 m age was significantly ($P < 0.05$) higher than that at 3 m and 6 m age.

Jaffarabadi

Plasma estradiol – 17 β (pg/ml) exhibited a range from 2.35 ± 0.44 (3 m age) to 5.06 ± 0.67 (36 m age) across all ages in Jaffarabadi females. A progressive increase was found in the values of estradiol–17 β from 3 m age to 36 m age, with the levels at 36 m being significantly ($P < 0.05$) higher than that at 3 m age.

Between Gir and Jaffarabadi

Plasma estradiol – 17 β (pg/ml) levels were lower at all ages studied in Jaffarabadi buffaloes as compared to Gir cows. The levels were significantly ($P < 0.05$) lower at 3, 6, 12 and 24 m age in Jaffarabadi buffaloes as compared to Gir cows.

Age had a significant ($P < 0.05$) effect on the plasma estradiol – 17 β levels in Gir cows and Jaffarabadi buffaloes. Significantly ($P < 0.05$) lower values were observed in neonates, which progressively increased as the animal grew older. The range obtained in our study was in line with that reported by Sarvaiya and Pathak (1992) in Surti buffaloes and Sharma *et al.*, (1999) in cyclic buffalo heifers. Estrogen promotes ductal growth in the mammary gland (Thompson, 2005). The increasing value of plasma estradiol – 17 β as

the cow and buffalo grew older could be an indicator of the development of the gonads (ovaries) and the attainment of puberty and maturity in them. Plasma estradiol – 17 β levels are dependent on the stage of oestrous cycle in which the animal is, after it attains puberty. Significantly ($P < 0.05$) lower levels of plasma estradiol – 17 β in Jaffarabadi buffaloes as compared to Gir cows at all ages could be a pointer toward the late puberty and maturity attained by these species.

Plasma progesterone (ng/ml)

GIR

Plasma progesterone (ng/ml) at different ages and physiological stages varied from 0.21 ± 0.01 (3 m age) to 2.15 ± 0.50 (36 m age) in Gir females. The levels increased progressively from 3 m age to 36 m age with the values at 36 m age being significantly ($P < 0.05$) higher than that of the preceding ages.

Jaffarabadi

Plasma progesterone (ng/ml) exhibited a range from 0.11 ± 0.001 (3 m age) to 2.65 ± 0.94 (non-lactating pregnant) across all ages and physiological stages in Jaffarabadi females. As age advanced, the plasma progesterone levels increased with the concentration at 36 m age being significantly ($P < 0.05$) higher than that noted at 3, 6, 12 and 24 m age.

Between Gir and Jaffarabadi

No significant difference was noted in the plasma progesterone concentration at different ages studied between Jaffarabadi buffaloes and Gir cows.

Significant ($P < 0.05$) effect of age was seen in plasma progesterone levels in Gir cows and Jaffarabadi buffaloes and the observed range of values were in line with the findings of Baruah (1997) in crossbred cows, Kumar *et al.,* (2009b) in Sahiwal cows, Sarvaiya and Pathak (1992) in Surti buffaloes and Bansal *et al.*, (2004) in Murrah buffaloes.

The higher levels at 36 m age indicates the presence of functional corpus luteum and that the animals have attained reproductive cyclicity. Though the progesterone levels are dependent on the estrous cyclic stage of the animal as demonstrated in cows by Baruah (1997), Kumar *et al.,* (2009a) and in buffaloes by Sanwal *et al.,* (1980), Sarvaiya and Pathak (1992) and Sharma *et al.,* (1999), we could presume that in our study the animals reached puberty between two and three years of age.

The animals in the present study may be on different days of estrous cycle and hence may account for variation in progesterone levels. Larson (1985) observed that estrogen and progesterone are involved as mitogenic and morphogenic agents responsible for early alveolar and lobular development.

Plasma testosterone (ng/ml)

Gir

In Gir males the range of plasma testosterone (ng/ml) was recorded to vary from 0.093 ± 0.016 (1 m age) to 2.350 ± 0.362 (bulls) at different ages and physiological stages studied. The concentration was below detectable level at 1 week age.

The values progressively increased as age increased. However, no significant difference was found in the levels from 1 m age to 12 m age. Plasma testosterone concentration in bulls was significantly ($P < 0.05$) higher than that observed at different ages studied and also from that in castrated males.

Table.1 Plasma estradiol 17 - β (pg/ml) and Progesterone (ng/ml) levels at different ages in Gir cows and Jaffarabadi buffaloes (Mean ± S.E.)

Hormone	Age Animal	Months				
		3	6	12	24	36
Estrogen	G	6.03^{at} ± 0.14	7.03^{at} ± 1.61	11.13^{abt} ± 2.64	10.26^{abt} ± 1.94	16.49^{b} ± 7.11
	J	2.35^{au} ± 0.44	2.78^{abu} ± 0.09	3.25^{abu} ± 0.59	4.09^{bu} ± 0.54	5.06^{b} ± 0.67
Progesterone	G	0.21^{a} ± 0.01	0.22^{a} ± 0.08	0.24^{a} ± 0.07	0.27^{a} ± 0.05	2.15^{b} ± 0.50
	J	0.11^{a} ± 0.001	0.19^{a} ± 0.04	0.29^{a} ± 0.06	0.30^{a} ± 0.07	2.65^{b} ± 0.94

Superscripts: a – e: between different ages. t – u: between Gir cows and Jaffarabadi buffaloes

Table.2 Plasma testosterone (ng/ml) levels at different ages and physiological stages in Gir and Jaffarabadi males (Mean ± S.E.)

Hormone	Age Animal	Wk	Months				Bulls	Castrated
		1	1	3	6	12		
Testosterone	G	BDL	0.093^{a} ± 0.016	0.132^{a} ± 0.054	0.295^{a} ± 0.061	0.323^{a} ± 0.031	2.350^{bor} ± 0.362	0.016^{ap} ± 0.003
	J	BDL	BDL	BDL	BDL	BDL	1.308^{s} ± 0.806	-

Superscripts: a – e : between different ages; o – p: between Gir bulls and Gir castrated males; r – s: between Gir bulls and Jaffarabadi bulls

Note: * Means having the same superscript do not differ significantly from each other ($P < 0.05$).

* n = 8

Key: G – Gir; J – Jaffarabadi; BDL – Below Detectable levels

Jaffarabadi

The value noted for plasma testosterone (ng/ml) was 1.308 ± 0.806 in bulls of Jaffarabadi species. Plasma testosterone concentration was below detectable level at 1 wk, 1, 3, 6 and 12 m age in Jaffarabadi males.

Between Gir and Jaffarabadi

Plasma testosterone (ng/ml) concentration in Gir bulls was noted to be significantly ($P < 0.05$) higher than that in Jaffarabadi bulls.

The low but progressive increase in plasma testosterone levels in Gir males as age advanced could be indicative of the gonadal (testis) development with the advancement in age. The finding in our study of the concentration being below detectable level in Jaffarabadi males upto 12 m age was supported by the report of Filho *et al.,* (1996) who opined that the association between low serum testosterone concentration and the histological findings in Murrah X Jaffarabadi males indicate delayed sexual development and shows that these animals were not sexually mature till 24 months of age. Maturation of bull testis is accompanied by a considerable increase in the production of testosterone and a smaller increase in the production of androstenedione (Lindner, 1961). Below detectable level of plasma testosterone at young age in Jaffarabadi males could also indicate delayed conversion of androstenedione to testosterone. The levels of testosterone obtained in our study in Gir bulls are lower than that reported by Sharma *et al.,* (1986) in Brown Swiss cross and Dhami *et al.,* (2003) in Gir bulls. Plasma testosterone levels in Jaffarabadi bulls estimated in our study is in line with that reported in winter seasons by Barnabe *et al.,* (1995) in Jaffarabadi cross and Malfati *et al.,* (2006) in Italian buffaloes. Circadian rhythm affects testosterone concentration with a higher level seen in morning hours as compared to evening hours (Eiler, 2005). In our study also the blood collection was done around 0700 hours of the day during the winter month of December, 2011. The levels were higher than those reported by Dhami *et al.,* (2003) in Jaffarabadi bulls and Sajjad *et al.,* (2007) in Nili-Ravi bulls. The significantly ($P < 0.05$) high values noted in Gir bulls in our study over that of Jaffarabadi bulls was in line with the findings of Shelke and Dhami (2001 and 2002) but they reported that the levels in Gir bulls were 10 to 15 times higher than that in Jaffarabadi bulls, which is not in agreement with our findings. In our study, the comparatively lower levels of thyroid hormones (T_3 and T_4) along with the testosterone concentration which were below detectable levels from 1 wk to 12 m age in Jaffarabadi males as compared to Gir males is a pointer towards the slow growth and delayed sexual maturity in Jaffarabadi males. The variation in plasma testosterone levels depends upon the age, breed, species, nutrition and time of blood collection.

Summary

Significantly higher levels of plasma estradiol (pg/ml) levels at 36 m age over that at 3 and 6 m age and plasma progesterone (ng/ml) levels at 36 m age over that from 3 m to 24 m age indicate that Gir cows attained maturity between 24 m to 36 m age. Low plasma testosterone levels at 12 m age indicate that Gir males had not attained maturity at this age.

Acknowledgements

The authors express their heartfelt thanks to the authorities of Anand Agricultural University and Junagadh Agricultural University for granting permission and facilities to conduct the research work at the Cattle Breeding Farm, J.A.U., Junagadh. The

authors are especially grateful to Dr. P.U. Gajbhiye, Research Scientist (retired), CBF, J.A.U. for all the help provided and to Dr. Ankita Killedar, Research Scientist, RBR unit, Veterinary College, Anand for providing the facilities for RIA

References

Andersson, H. (2008). Clinical Reproductive Endocrinology. In: *Clinical Biochemistry of Domestic Animals*, Ed. Kaneko, J.J., Harvey, J.W. and Bruss, M.L. 6th edn., Academic Press, New York. P 637.

Bansal, N., Jindal, R., Nayyar, S. and Malik, V.S. (2004). Ovarian morphology and plasma hormonal concentration during phases of reproductive cycle in buffaloes (*Bubalus bubalis*). *Indian J. Anim. Sci.*, 74(12): 1192 – 1193.

Barnabe, V.H., Barnabe, R.C., Oliveira, C.A.de, Gambarini, M.L., Guido, M.C. and Valentim, R. (1995). Testosterone concentration in blood serum of buffalo bulls during 24 hours in winter and summer seasons. *Brazilian J. Vet. Res. Anim. Sc.*, 32(3): 191-193.

Baruah, S. N. (1997). Effect of β carotene on serum progesterone level in dairy heifers. *Indian J. Anim. Reprod.*, 18(1): 29 – 32.

Dhami, A.J., Shelke, V.B., Patel, A.V., Dave, R.R. and Kavani, F.S. (2003). Comparative patterns of episodic release of testosterone and androstenedione following GnRH treatment in Gir and Jafarabadi breeding bulls. *Indian J. Anim. Sci's*., 73(11): 1214-1218

Eiler, H. (2005). Endocrine glands. In *Dukes' Physiology of Domestic Animals.* Ed. Reece, W.O., 12th edn., Panima Publishing Corporation, New Delhi. P 626.

Filho, J.B.B., Melo, M.I.V., Lage, A.P., Marques, A.P.Jr. and Filho, V.R.V. (1996). Buffalo (*Bubalus bubalis*) sexual development: endocrinological and testicular histological aspects. II. From 10 to 24 months of age. *Buff. Bull*., 15(2): 42-43.

Kumar, R., Butani, M.G., Dhami, A.J., Kavani, F.S., Patel, M.D. and Shah, R.G. (2009a). Progesterone, metabolites and minerals in anestrus, subestrus, repeat breeding and cyclic cows. *Indian J. Anim. Reprod.*, 30(2): 19 – 22.

Kumar, S., Chutia, G.S., Das, P.K., Tripathi, M.K., Ghosh, P.R., Sanyal, S. and Pandiyan, G.D.V. (2009b). Progesterone and luteinizing hormone profile during estrous cycle of indigenous repeat breeding Sahiwal cattle. *Indian J. Anim. Physiology, 4*(1): 38 – 40.

Larson, B.L. (1985). Biosynthesis and cellular secretion of milk. In: *Lactation.* Ed. Larson, B.L., 1st edn., Iowa State University Press, U.S.A. P 130.

Lindner, H.R. (1961). Androgens and related compounds in the spermatic vein blood of domestic animals. IV. Testicular androgens in the ram, boar and stallion. *J. Endocrinol.*, 23: 171.

Malfati, A., Barbato, O, Todini, L., Terzano, G.M., Debenedetti, A. and Borghese,A.(2006). Blood testosterone levels in Italian Mediterranean buffalo bulls managed in two different breeding conditions. *Theriogenology*, 65(6): 1137-1144.

Pineda, M.H. (2003). Female Reproductive System. In: *McDonalds Veterinary Endocrinology and Reproduction.* 5th edn., Ed. Pineda, M.H. and Dooley, M.P. Iowa State Press, U.S.A. P 326.

Sajjad, M., Ali, S., Ullah, N., Anwar, M., Akhter, S. and Andeabi, S.M.H. (2007). Blood serum testosterone level

and its relationship with scrotal circumference and semen characteristics in nili-ravi buffalo bulls. *Pakistan Vet. J.*, 27(2): 63-66.

Sanwal, P.C., Varshney, V.P., Pande, J.K., Sharma, J.K. and Rahman, M. (1980). Peripheral plasma levels of progesterone in buffalo during oestrus cycle and early pregnancy. *Indian J. Anim. Sci.*, 50(6): 480-482.

Sarvaiya, N.P. and Pathak, M.M. (1992). Profiles of progesterone, 17 β-oestradiol, triiodothyronine and blood biochemical parameters in Surti buffalo heifers. *Buffalo J.*, 1: 23-30.

Sharma, K.B., Shashi Nayyar, Malik, V. S., Rajvir Singh and Sodhi, S.P.S. (1999). Levels of hormones and minerals in cyclic, anestrus and subestrus buffalo heifers. *Indian J. Anim. Sci.*, 69(4): 214 – 216.

Shelke, V.B. and Dhami, A.J. (2001). Haematology, blood biochemistry and testosterone profile in Gir and Jafarabadi breeding bulls of good and poor freezability grades. *Indian J. Anim. Sci.*, 71(5): 448-451.

Shelke, V.B. and Dhami, A.J. (2002). Clinical andrology and testosterone profile of Gir (*Bos indicus*) and Jafarabadi (*Bubalus bubalis*) bulls. *Indian J. Anim. Reprod.*, 23(1): 25-28

Snedecor, G.W. and Cochran, W.G. (1990). Statistical Methods, 8th ed. Iowa State University Press, Iowa, USA.

Thompson, F.N. (2005). Female reproduction in mammals. In: *Duke's Physiology of Domestic Animals*, 12th edn., Ed. Reece, W.O., Panima Publishing Corporation, New Delhi. Pp. 693.

How to cite this article:

Ninan Jacob, J.S. Arya and Shah, R.G. 2018. Gonadal Steroids during Growth in Gir and Jaffarabadi. *Int.J.Curr.Microbiol.App.Sci.* 7(08): 1891-1897.
doi: https://doi.org/10.20546/ijcmas.2018.708.217