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A Study of Thyroid Hormone Levels in Beetal Goats During Different Development Stages

Jyotsna Madan[1], Sandeep Kumar[1], Sonia Sindhu[1], Meenakshi Gupta[1], Anand Kumar Pandey[2]*, Abhay Singh Yadav[3], Manoj Kumar Rose[1]

[1]Dept. of Veterinary Physiology and Biochemistry, [2]Dept. of Veterinary Clinical Complex, [3]Dept. of Animal Genetics and Breeding, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana (125 004), India

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Corresponding Author
Anand Kumar Pandey
e-mail: dranandpandey@gmail.com

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Abstract

The present study was investigated on age associated variations in thyroid hormones in male and female Beetal goats. Blood samples were collected at different age groups viz. 15 days, 1 month, 2 months, 3 months and then at three-month interval until 24 months age. The plasma was analysed for tri-iodothyronine (T_3) and thyroxine (T_4). The T_3 levels in male goats were significantly higher (p<0.05) at 15 days (1.80±0.19 ng ml^{-1}), 6 months (1.45±0.16 ng ml^{-1}) and 12 months (1.49±0.05 ng ml^{-1}) of age than that found at different ages till 24 months age. Likewise, the mean T_3 levels in female goats had significantly higher (p<0.05) at 15 days (1.92±0.17 ng ml^{-1}) and 6 months (1.69±0.23 ng ml^{-1}) of age than that found at different ages upto24 months age. The mean T_4 levels in male goats were significantly (p<0.05) higher for 2 months (70.60±6.19 ng ml^{-1}), 3 months (64.00±3.14 ng ml^{-1}) and 6 months (75.60±2.54 ng ml^{-1}) of age than at different ages till the age of two years. The mean T_4 levels in female goats were found to be significantly (p<0.05) higher for 3 month (70.20±2.54 ng ml^{-1}) and 6 months (74.10±6.54 ng ml^{-1}) of age than at different ages till the age of two years. There was no statistically significant difference between sexes, but in female goats, the values were non-significantly higher than male goats during respective ages. In conclusion, the significantly higher concentrations of thyroid hormones during young and growing stages in Beetal goats may have role in growth and development.

Keywords: Age, goats, thyroid hormones, tri-Iodothyronine, thyroxine

1. Introduction

Thyroid hormones are the key regulators of mammalian physiological functions. These hormones have been shown to be crucial for growth, development, energy metabolism and reproduction (Eiler, 2005). These hormones are known to be important modulators of developmental processes and general metabolism in mammals (Kaneko et al., 2008). They also play an important role in defense against infection through the modulation of innate immune cell function (Spek et al., 2017). Changes in the concentrations of serum thyroxine (T_4) and tri-iodothyronine (T_3) of sheep in seasonal heat and cold stress have already been investigated (Dhanda et al., 2001). Circadian variation in thyroid hormones levels have also been reported in domestic animals (Nazifi et al., 2008). Plasma concentrations of tri-iodothyronine are related to environmental

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temperature (Yahav et al., 1996; Rose et al., 2012) and levels fall immediately after heat exposure in poultry (Uni et al., 2001). Age related differences in the level of thyroid hormones have also been investigated in buffaloes (Sharma et al., 1985). The variations in thyroid hormone levels in different breeds of cattle have been reported (Rastogi and Agarwal, 1990). Previous studies have reported variations in T_3 levels between male and female goats, with higher concentrations in female goats (Celi et al., 2003; Todini, 2007; Pandey et al., 2011) and ewe (Eswari et al., 1999). The T_3 and T_4 concentrations remain lower during pregnancy than lactating beetal-cross goats (Raoofi et al., 2017).

Broadly, T_3 and T_4 regulate the cell functions through stimulating oxygen utilization and heat production in all types of body cells. These hormones enhance the basal metabolic rate, makes easy to available more glucose to cells, stimulate protein synthesis, increase lipid metabolism, and stimulate cardiac and neural functions, consequently affecting the cell metabolism (Raoofi et al., 2017). There is no report showing the age-related differences of thyroid hormones in goats. In the present study, we investigated the levels of thyroid hormones and tried to correlate them with different age groups of Beetal goats.

2. Materials and Methods

The investigation was carried out on twenty Beetal goats (10 male and 10 female) maintained in the animal farm of the Department of Animal Genetics and Breeding, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, India between 2016 and 2018. These animals were housed in concrete paddocks with an open enclosure and were fed gram straw, concentrate mixture and greens along with 5-6 h of daily grazing. Drinking water was provided *ad libitum*. The blood samples were collected via jugular vein at different age's viz. 15 days, 1 month, 2 months, 3 months and after every three months till the age of 24 months. The plasma was separated by centrifugation and stored at -20 °C till analysis.

The plasma was analysed for T_3 and T_4 by Enzyme Immuno Assay (EIA) technique using Total (tT_3) EIA and total (tT_4) EIA kits respectively supplied by Bio-Detect, DB Maarn, Netherlands. The protocol as supplied with kit based on competitive enzyme immune assay was followed. Briefly, the plasma sample, antibody and enzyme labelled antigen were incubated in a micro-well for 60 min. After obtaining equilibrium the excess reagents were washed off via a wash step. A chromogen-substrate (tetramethylbenzidine-hydrogen peroxide) was added. After 15 min of incubation, the reaction was stopped by theaddition of strong acid. The colour developed was inversely proportional to the concentration of un-labelled thyroid hormones in calibrators, controls and samples. Standard curve was elaborated with the four parameters logistic curve and the hormone concentrations was calculated through inbuilt software in plate reader (Thermo Scientific Multiskan FC). The data were statistically analyzed using ANOVA followed by Duncan's multiple range test for comparison among different age groups using SPSS software.

3. Results and Discussion

The mean values of T_3 and T_4 in male and female Beetal goats during different ages were presented in Table 1 and Table 2, respectively. The mean T_3 levels in male goats were found to be significantly (p<0.05) higher at 15 days (1.80±0.19 ng ml^{-1}), 6 months (1.45±0.16 ng ml^{-1}) and 12 months (1.49±0.05 ng ml^{-1}) of age than that at different ages till the age of two years. Likewise, the mean T_3 levels in female goats were observed to be significantly (p<0.05) higher at 15 days (1.92±0.17 ng ml^{-1}) and 6 months (1.69±0.23 ng ml^{-1}) of age than that at

Table 1: Thyroid hormone concentration (Mean±SE) of male Beetal goats from birth to 24 months of age (n=10)

Age	Tri-iodothyronine (ng ml^{-1})	Thyroxine (ng ml^{-1})
15 Days	1.80±0.19^{a}	52.40±3.12^{a}
1 Month	1.24±0.18^{b}	53.70±7.01^{a}
2 Months	1.35±0.13^{b}	70.60±6.19^{b}
3 Months	1.10±0.05^{b}	64.00±3.14^{b}
6 Months	1.45±0.16^{a}	75.60±2.54^{b}
9 Months	0.92±0.08^{bc}	24.47±1.72^{c}
12 Months	1.49±0.05^{a}	30.68±1.42^{c}
15 Months	1.36±0.25^{b}	22.63±2.07^{c}
18 Months	0.69±0.11^{d}	21.98±2.48^{c}
21 Months	1.02±0.18^{bcd}	25.17±1.22^{c}
24 Months	1.18±0.10^{bcd}	22.16±1.33^{c}

Means bearing different superscripts in the same column are significantly different (p<0.05)

Table 2: Thyroid hormone concentrations (Mean±SE) of female Beetal goats from birth to 24 months of age (n=10)

Age	Tri-iodothyronine (ng ml^{-1})	Thyroxine (ng ml^{-1})
15 Days	1.92±0.17^{a}	57.10±3.80^{a}
1 Month	1.15±0.15^{b}	47.10±3.14^{b}
2 Months	1.41±0.10^{bc}	61.50±2.70^{a}
3 Months	1.39±0.10^{bc}	70.20±2.54^{b}
6 Months	1.69±0.23^{a}	74.10±6.54^{b}
9 Months	0.86±0.11^{d}	28.04±3.66^{c}
12 Months	1.17±0.13^{bcd}	26.43±1.77^{c}
15 Months	0.82±0.07^{d}	25.03±1.34^{c}
18 Months	0.97±0.09^{bcd}	29.55±3.19^{c}
21 Months	1.22±0.17^{bcd}	24.27±2.26^{c}
24 Months	1.17±0.16^{bd}	25.29±1.36^{c}

Means bearing different superscripts in the same column are significantly different (p<0.05)

different ages till the age of two years. The mean T_4 levels in male goats were significantly (p<0.05) higher for 2 months (70.60±6.19 ng ml^{-1}), 3 months (64.00±3.14 ng ml^{-1}) and 6 months (75.60±2.54 ng ml^{-1}) of age than those found at different ages till the age of two years. The mean T_4 levels in female goats were significantly (p<0.05) higher for 3 months (70.20±2.54 ng ml^{-1}) and 6 months (74.10±6.54 ng ml^{-1}) of age than that at different ages till the age of two years. There was no statistically significant difference between sexes, but in female goats, the values were found to be non-significantly higher than male goats during respective ages.

Thyroid hormones are known to be important modulators of developmental processes and general metabolism in mammals (Kaneko et al., 2008). These have been shown to be crucial for growth, development, energy metabolism and reproduction (Eiler, 2005) and may induce molt in hens (Gulde et al., 2010). There are different factors which regulate thyroid hormone levels in different species of animals like seasonal and age-related variations have been reported in buffalo (Sharma et al., 1985; Rose et al., 2012). In the present study, the higher level of thyroid hormones (T_3 and T_4) in early age group in Beetal goats are in close agreement with those reported in goats (Colavita et al., 1983; Bhooshan et al., 2010) and buffalo (Sharma et al., 1985). This is the first report that explains the age associated variations in thyroid hormones in Beetal goats. The thyroid hormones (T_3 and T_4) levels in Beetal goats were found to be highest at 15 days of age, decreased at one month of age and increased at 2-6 months (pre-pubertal growing period) of age and thereafter decreased and remained almost constant until 24 months of age.

The exact significance of higher thyroid hormone levels in young age is not known. However, it is worth mentioning that in early age the lambs are under considerable stress and the higher levels of thyroid hormones may be one of the mechanisms to counteract the stress by elevating basal metabolic rate. The pre-pubertal rise in thyroid hormones have been reported in buffaloes (Sharma et al., 1985). The thyroid hormones are also involved in lipogenesis in goats (Yao et al., 2016) and amino acid metabolism (Carew et al., 1998). The higher levels of thyroid hormones in pre-pubertal growing period may be having role in enhanced synthesis of proteins andgain in body weight. The insignificantly higher levels of thyroid hormones in female goats than male goats during respective ages are in accordance with the findings of Polat et al. (2014) in goats.

The growth hormone and thyroid hormones are involved in metabolism of carbohydrates, lipidsand proteins (Pineda and Dooley, 2008). Previously, the occurrence of higher levels of growth hormone during young and growing stage in cattle (Rose, 2012) has been reported. Kaminsky et al. (2012) suggested that growth hormone potentiates thyroxine effects on oxidative metabolism. Seven out of ten female goats showed estrus signs and were pregnant during the collection of blood samples at the age of 18 months and 21 months, but no significant changes in thyroid hormones levels were observed during these reproductive changes. Thus, it issuggested that higher levels of thyroid hormones during young and growing stage in Beetal goats have metabolic regulatory role in growth and development, probably through synergistic action with growth hormone. Moreover, earlier studies have proved that thyroid function is interrelated closely with the growth hormone/insulin-like growth factor-I (IGF-I), consequently, thyroid hormone levels may influence feed intake, which in turn, affects IGF-I levels, and may modify IGF-I concentrations through effects on GH secretion or receptor levels (Nikolič et al., 1997; Svanberg et al., 2001).

4. Conclusion

The results from present investigation indicated that T_3 and T_4 concentrations remained similar for either of sex in Beetal goats. The higher concentrations of these hormones during early stage of development indicated role in growth and development by altering the cellular metabolism. Thyroid hormones may be used to induce the body development, as it works through growth hormone, however, study is warranted to confirm the mechanism of synergistic action in both male and female goats.

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