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Dynamics of Thyroid Hormones in Growth and Development of South Indian Sheep (Bannur)

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A B S T R A C T

From the data bank of livestock census in India, the total sheep in the country is 65 million numbers in 2012, declined by about 9.09% over census 2007. The total sheep contributes around 12.7% of the total livestock population. Karnataka (South Indian province) contributes second highest in sheep population first is Andra Pradesh. Growth and development are continuous and dynamic processes require integration of numerous physiological functions, they influenced by nutrition, efficiency of metabolism, respiration, hormonal regulation, immune responses, physiological status, and maintenance of homeostasis. The physiological and endocrinological events involved in the onset of puberty and estrus cycle are of primary importance. Appropriate thyroid glands function and activity of thyroid hormones (TH) are considered crucial to sustain the productive performance in domestic animals (growth, milk, hair fiber production) and circulating TH can be considered as indicators of the metabolic and nutritional status of the animals. A total of 24 female Bannur sheep (age from 3.5 month to 11 month) were used in this study. Blood samples were collected from the jugular vein of 24 clinically healthy animals in four groups along with body weight also recorded (GI (>3-5 m), GII (>5-7m), GIII (>7-9m) and GIV (>9-11)). Triidothyroxine and Thyroxine estimation was done using immunoassay test kit method. In the present study, the mean serum Triidothyronine (ng/mL) levels ranged from 1.17 ± 0.01 to 1.80 ± 0.01 ng/mL. Positive correlation was observed between the levels of thyroid hormones (T_3) and the age of animal and body weight gain in Bannur ewes. The mean serum thyroxin (µg/dl) levels ranged from 3.98 ± 0.18 to 7.61 ± 0.05 µg/dl. T_4 concentrations elevated at premature phase, where during fattening period growing lambs needed to increase the basal metabolic rate, protein synthesis in their muscles and more of energy to achievements these biological functions, therefore plasma T_4 and glucose concentrations increased in the two last months of fattening period. The age of sheep influenced statically significantly all the investigated parameters. Blood thyroid hormones levels are considered to be good indicators of the nutritional status of an animal.

Introduction

Thyroid function and its diseases are less known in small ruminants, Appropriate activity of thyroid hormones (TH) are considered crucial to sustain the productive performance in ewes (growth, milk, hair fiber production) and circulating TH can be considered as indicators of the metabolic and nutritional status of the sheep (Riis and Madsen, 1985).

Different physiological stages such as puberty, gestation, parturition, postpartum period, and lactation in one year of life cycle in ewes. Some of the major hormones having effect on the metabolism in animals are thyroid hormones, Thyroid hormones have been found to influence the reproduction, growth, milk and fiber properties of domestic animals (Noyan, 1988). The lowest values of these hormones were reported in elderly animals (Lucaroni and Todini, 1989).

The thyroid hormones maintain the homeostasis of energy and protein metabolism, thermoregulation, growth and productivity parameters (Huszenicza *et al.*, 2002). The thyroid hormones, tetraiodothyronine or thyroxine (T_4) and triiodothyronine (T_3) act on different target tissues, stimulating oxygen utilization and heat production in every cell of the body.

The overall effect of these hormones are to increase the basal metabolic rate, to make more glucose available to cells, to stimulate protein synthesis, increase lipid metabolism and to stimulate cardiac and neural functions. The thyroid gland as such secretes mostly T_4, that is monodeiodinated to T_3, prior to interacting with the target cells, in order to exert its biologic effect. The content hormone T_3 ($P < 0.01$) was very significantly lower with increasing the age of lamb, while the content of T4 is not varied depending on the age of lamb ($P > 0.05$) (Autunovic *et al.*, 2012).

T_3 directly stimulates feed intake at the hypothalamic level, while on the other hand, the quantity and quality of food eaten is a major factor determining plasma concentrations of TH (Dauncey, 1990). Body weight of lambs has a major role in achieving profitable results. Initial body weight affects not only growth, but also vitality and mortality of lambs (Petrovic *et al.*, 2009).

Body weight is only one of the limiting factors in determining the age at onset of puberty in ruminants. After a certain critical level, variation in weight gain has little or no effect on age at onset of puberty (because when animals are subjected to an adequate diet, differences on weight gain are not very relevant) (Dantas *et al.*, 2016)

In the present investigation, attempt was made to determine the influence of age on serum hormones status in Bannur sheep. The information on sheep hormones in relation to growth in Bannur sheep is not adequate.

Materials and Methods

This study was conducted to determine certain hormonal profile in different growth stages of Bannur ewes maintained at Bandur Breeding Farm, Danagur Village, Malavalli Taluk, Mandya District, Karnataka, India. A total of 100 ewes with uniform body weight were randomly selected and were divided into 4 groups viz., Group I (3 to 5 months), Group II (5 to 7 months), Group III (7 to 9 months) and Group IV (9 to 11 months) as per the age, with six animals in each group. The animals were maintained under standard feeding and managemental condition. The blood samples were collected from jugular vein at fortnightly intervals for two months (*i.e.*, 15^{th}, 30^{th}, 45^{th} and 60^{th} day) from all the animals. Blood

samples collected in clot activator coated vacutainer were allowed to clot by keeping them undisturbed for 30 minutes at room temperature. Clotted blood samples were centrifuged at the rate of 700 × g for 15 min to obtain the serum. The assay is based on one step competitive method. When the sample, antigen coated micro wells and enzyme labeled T_4 / T_3 are combined. There will be a competition between enzyme labeled T_4 / T_3 and T_4 / T_3 present in the sample for binding to the antibodies coated on micro wells.. Immune complex was generated between the solid phase and enzyme linked antigens by immunological reactions. Substrate solution was then added and catalyzed by immune complex, resulting in chromogenic reaction. The resulting chromogenic reaction is measured was absorbents. The color intensity was inversely proportional to amount of T_4 / T_3 in serum sample. Every 15 days, each group's animals were individually weighed on a digital scale before blood collection weight was measured in kilograms (kg) and average daily gain expressed in grams (g).

Results and Discussion

In the present study, the mean serum Triidothyronine (ng/mL) levels ranged from 1.17 ± 0.01 to 1.80 ± 0.01 ng/mL and the mean serum thyroxin (µg/dl) levels ranged from 3.98 ± 0.18 to 7.61 ± 0.05 µg/dl in different groups. It is observed that the T_3 level increased from 15th day collection in G-I to G-III at 45th day collection then afterwards level was decreasing. T_3 concentration was increased gradually with increasing LBW (Live Body Weight) throughout the study. T_3 shown in Table the results indicated that serum T_3 concentrations peaked in day 45th collection of G-III then slight decreasing the level. The highest values in T_3 levels were observed in all lambs during fattening period (Table 1 and Fig. 1). Our result in accordance with Fattah *et al.,* (2013) reported that positive correlation was observed between the levels of thyroid hormones (T_3) and the age of animal and body weight gain in Barkin lambs.

Similar results observed by Lucorni and Todini, (1989) and Todini *et al.,* (2007) Growing goat kids displayed higher TH levels than adults and the lowest values were found in elderly animals. Ingole *et al.,* (2012) observed that in buffaloes, the triiodothyronine concentration was significantly increased at puberty which could be required to enhance the protein synthesis and weight gain.

This study results not agreement with Chilliard *et al.,* (2005) and Eshratkhah *et al.,* (2010) they observed that neonatal lambs had higher levels of T_3 and T_4 compared with growing lambs and ewes. Present study found that both will increases as lambs grows and after certain age T4 will over took the T3 in its concentration. Similarly Antunovic *et al.,* (2012) reported that the content of hormone T_3 ($P < 0.01$) was very significantly lower with increasing the age of lamb. These variations were probably related to the differences in the basal metabolism rates. In fact, several other conditions could also affect the metabolism, especially the reproductive status (El-Barody *et al.,* 2002; Antunović *et al.,* 2004; Roubies *et al.,* 2006; Karapehlivan *et al.,* 2007; Novoselec *et al.,* 2009).

The increased T_3 level during growing stage to increase the T_3 might be due to the deiodination of T_4 into T_3 which would have an additive effect on T_3 concentration. And higher T_3 concentrations are proportionally positive with growth in lambs. It concluded that T_3 level increased as age advance and peak level noticed at puberty. Increased serum T_3 level could be due to increased metabolic activity during growing period. Serum total T_3 concentrations significantly correlated with energy and nitrogen balances.

Table.1 Mean ± SE values of serum Tri iodothyroxine (ng/ml) in growing female Bannur sheep at different blood collection intervals

	15 days(3.5m)	30 days(4m)	45 days(4.5m)	60 days(5m)
Group I (>3-5 m)	1.17 ± 0.01^{a}	1.19 ± 0.01^{a}	1.24 ± 0.01^{a}	1.33 ± 0.01^{a}
Group II (>5-7 m)	1.45 ± 0.01^{b}	1.57 ± 0.02^{b}	1.68 ± 0.08^{b}	1.68 ± 0.01^{b}
Group III (>7-9 m)	1.71 ± 0.01^{c}	1.79 ± 0.17^{c}	1.8 ± 0.01^{c}	1.66 ± 0.01^{b}
Group IV (>9-11 m)	1.58 ± 0.01^{d}	1.44 ± 0.04^{d}	1.37 ±0.01^{d}	1.33 ± 0.01^{a}

The values with different superscripts within a column differ significantly (P<0.05).

Table.2 Mean ± SE values of serum thyroxin (µg/dl) in growing female Bannur sheep at different blood collection intervals

	15 days	30 days	45 days	60 days
Group I (>3-5 m)	4.60 ± 0.01^{a}	4.68 ± 0.01^{a}	4.98 ± 0.01^{a}	5.12 ± 0.01^{a}
Group II (>5-7 m)	5.46 ± 0.02^{b}	5.34 ± 0.23^{b}	3.98 ± 0.18^{b}	4.58 ± 0.02^{b}
Group III (>7-9 m)	4.85 ± 0.01^{c}	4.86 ± 0.02^{ac}	4.79 ± 0.01^{ac}	4.73 ± 0.03^{c}
Group IV (>9-11 m)	7. 61 ± 0.05^{d}	7.26 ± 0.01^{d}	5.22 ± 0.06^{d}	5.05 ± 0.03^{a}

The values with different superscripts within a column differ significantly (P<0.05).

Table.3 Mean ± SE values of body weight (kg) in growing female Bannur sheep at different intervals

Days Groups	15 days	30 days	45 days	60 days
Group I (>3-5 m)	5.98 ± 0.05^{a}	6.88 ± 0.10^{a}	7.85 ± 0.13^{a}	8.80 ± 0.14^{a}
Group II (>5-7 m)	9.13 ± 0.04^{b}	10.05 ± 0.11^{b}	10.88 ± 0.07^{b}	11.85 ± 0.08^{b}
Group III (>7-9 m)	13.45 ± 0.12^{c}	14.57 ± 0.10^{c}	15.67 ± 0.11^{c}	16.48 ± 0.12^{c}
Group IV (9-11 m)	17.5 ± 0.09^{d}	18.62 ± 0.06^{d}	19.6 ± 0.14^{d}	20.70 ± 0.18^{d}

The values with different superscripts within a column differ significantly (P<0.05).

Fig.1 Mean ± SE values of serum Tri iodothyroxine (T_3) in growing female Bannur sheep at different blood collection intervals

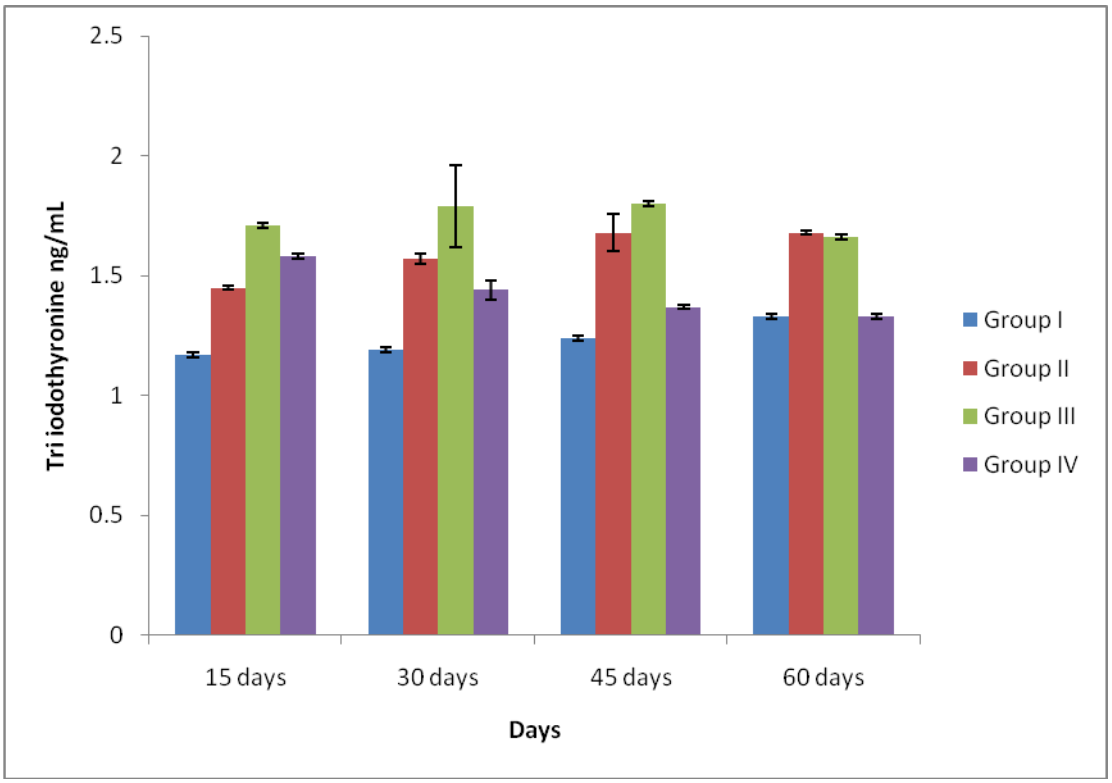


Fig.2 Mean ± SE of serum thyroxin (T_4) (µg/dl) in growing female Bannur sheep at different blood collection intervals

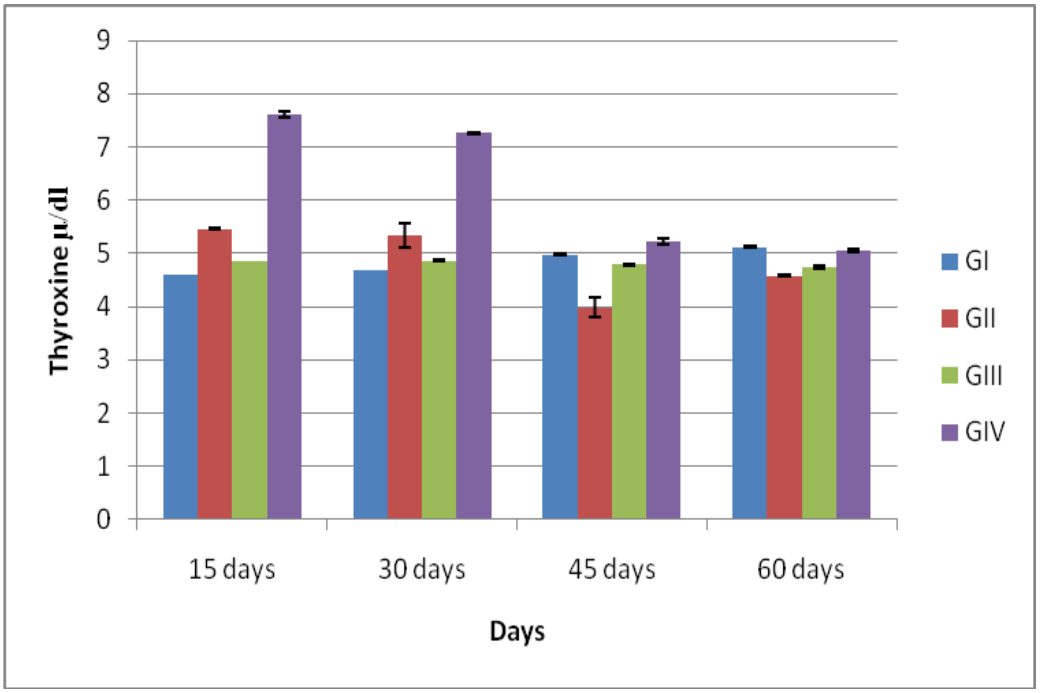
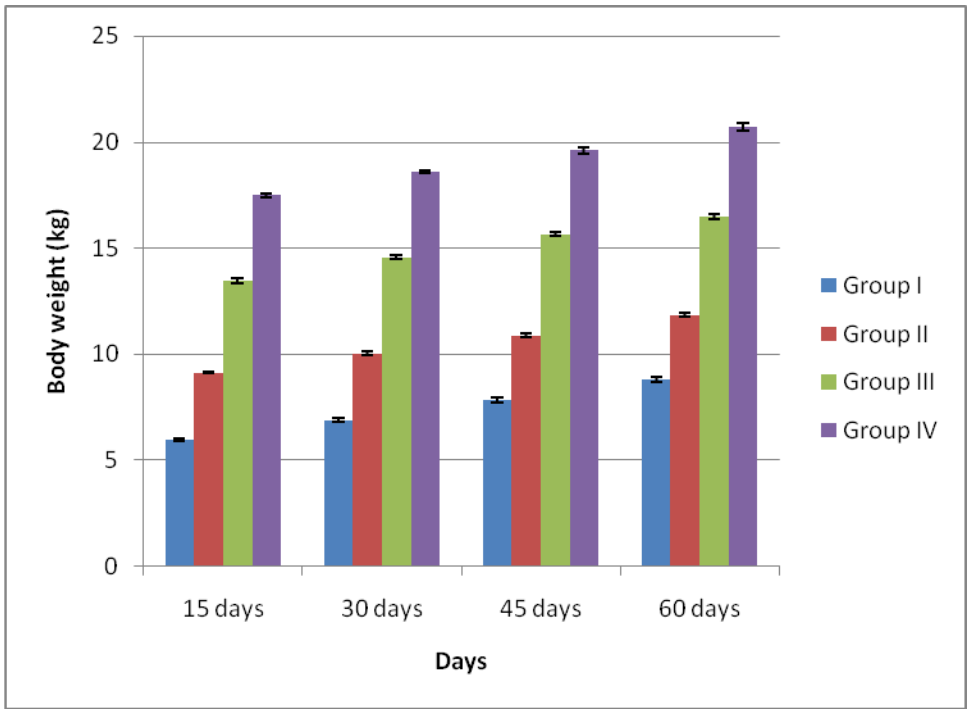


Fig.3 Mean ± SE valves of body weight (kg) in growing female Bannur sheep at different intervals



This increase in T_3 might be due to the deiodination of T_4 into T_3 which would have an additive effect on T_3 concentrations. Blood thyroid hormone levels are considered to be good indicators of the nutritional status of an animal and were correlated with feed intake in ruminant species, including those that exhibit very marked seasonal cyclicity in feed intake, body weight and reproductive activity.

Significantly lower serum thyroxin (µg/dl) levels recorded at 15th collection in G-I and highest level 15th collection at G-IV. The result revealed that the serum T_4 concentrations peaked in the GIV (Table 2 and Fig. 2.)

In accordance with Capen and Martin (2010) and Fattah *et al.*, (2013) they reported that T_4 concentrations elevated at premature phase, where during fattening period growing lambs needed to increase the basal metabolic rate, protein synthesis in their muscles and more of energy to achievements these biological functions, therefore plasma T_4 and glucose concentrations increased in the two last months of fattening period. A similar result was reported by Irmak *et al.*, (2004) that serum T_4 level was higher in premature lambs than in newborn lambs. But this study results not favors statement of T4 is not varied depending on the age of lamb ($P > 0.05$), it also support the T4 requirement in growth and development of lamb.

In the present study, the mean body weight level ranged from 6.0 ± 0.05 to 20.7 ± 0.18 kg in different groups. Differences in LBW were observed with increase in age and maximum body weight was noticed in adult lambs as they grown (Table 3 and Fig. 3.)

The results was in accordance with Fattah *et al.*, (2013) he found that increase weight with increase in age and by the influence of sex hormones on animal development affecting

body dimensions and fat deposits, as wells, muscle and bone tissue.

In conclusion, increased serum levels of T_4 might be due to increase the basal metabolic rate at the premature period. Therefore T_4 level not related to age in sheep but were affected by climatic conditions and live body weight (LBW). These values of T_4 may increase with low and decreased with high climatic conditions. In general, serum levels of T4 were not related with age in all female sheep but were affected by climatic condition and LBW. Weight gain of sheep depends on birth weight, nutrition, balance feeding, diseases conditions, available milk from mother and management of kids.

In ewes, normal growth and development occur only in the presence of thyroid hormone, indicating that the TH plays a permissive role in growth regulation. Since they are necessary for normal growth, thyroid hormones are classified as growth stimulators when present in optimal amounts. Weight gain of sheep depends on birth weight; balance feeding, presence or absence of diseases, available milk from mother and management of kids.

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