

CHANGES OF THYROID HORMONES IN DIFFERENT PHYSIOLOGICAL PERIODS IN WHITE GOATS

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ABSTRACT

The levels of thyroid hormones are important indicator of metabolic activity. The knowledge of the metabolic activity in different physiological periods, animals readjusted dietary regimen. Therefore, in this study, changes of triiodotironine (T3) and thyroxine (T4) hormones in the blood serum of female (n=14) and male (n=9) white goats were studied for a duration of one year through different physiological periods [breeding (September-October), gestation (November to March), postpartum-sucking (April-May) and milking (June to August)]. Results show that the differences in T3 and T4 hormone levels between sexes are statistically unimportant in breeding, gestation, postpartum-sucking and milking periods, while the changes for each sex between the physiological periods are important ($p < 0.05$). Also, it has been found out that the thyroid hormone levels in different physiological periods are under the influence of the environmental temperature changes.

Keywords: White goat; thyroid hormone; breeding; gestation; postpartum-sucking; milking

INTRODUCTION

Adult farm animals have different physiological stages (breeding, gestation, parturition, postpartum period, lactation) in one year of life cycle. During these periods, there are changes in the levels of hormones affecting the farm animals. Some of the major hormones having effect on the metabolism in animals are thyroid hormones. The main effect of the thyroid hormones is the increase in the metabolism speed of almost all tissues (Noyan, 1988; Yilmaz, 1999).

Thyroid hormones have been found to influence the reproduction, growth, milk and fiber properties of domestic animals (Riis and Madsen 1985; Emre and Garmo 1985; Nicholls *et al.* 1988; Lucaroni *et al.* 1989; Karsch *et al.* 1995; Yilmaz 1999; Puchala *et al.* 2001; Neville *et al.* 2002; Anderson *et al.* 2002; Rhind *et al.* 2004; Todini *et al.* 2005; Todini 2007). However, various factors like breed, age, sex and physiological condition affect blood thyroid hormone concentrations by modulating the hypothalamus-pituitary-thyroid axis in small ruminants (Todini 2007). A body of evidences is available showing the changes in blood thyroid hormone levels for different physiological periods like breeding (Colavita and Malfatti 1989; Peters *et al.* 1989; Blaszczyk *et al.* 2004), gestation (Manalu *et al.* 1997; Todini *et al.* 2007), postpartum and lactation periods (Riis and Madsen 1985; Emre and Garmo 1985; Lucaroni and Todini 1989; Okab *et al.* 1993; Tucker 1994, 2000).

Therefore, the present project was aimed at determining the T3 and T4 hormonal changes in the

blood serum of White Goats in different physiological phases.

MATERIALS AND METHODS

Animals: The research was carried out on White goats, reared at the Animal Department, Agriculture Faculty, Ankara University, Turkey. The animals included in the study (female, n: 14 and male, n: 9) at the same nutritional conditions, the natural photoperiod, natural environment, humidity, and the temperature was allowed.

Blood sampling and hormone analyses: Blood samples (10.0 ml) were regularly collected from vena jugulars after every month in a one-year period. The samples were centrifuged (4000 rpm) to collect serum and stored at -20°C until analyzed. The T3 and T4 hormones were analyzed at the Endocrinology and Animal Reproduction Laboratory, Agricultural Faculty, Ankara University, Ankara, Turkey using ELISA kits (Diagnostic System Laboratories Inc. Texas, USA).

Different physiological periods and temperature values: On account for the effects on different physiological periods of animals, the climatic values between December 2005 and November 2006 have been supplied from the General Directorate of Meteorology (Anonymous 2006). The calculation of the average temperature in different physiological periods, the periods were included in each day's temperature. The average environmental temperatures in the periods of breeding, gestation, postpartum-sucking and milking, are

14.20 °C, 2.06 °C, 14.65 °C and 23.60 °C respectively.

Statistical analyses: In order to determine any possible differences in the observed hormone levels with respect to sexes and periods, a variance analysis of two factors has been performed for 'sex vs. period'. Duncan Multiple Comparison test has been utilized to determine the averages of different periods with respect to the results of the variance analysis. The statistics packet programs of SPSS 15 and MSTAT-C have been used for the variance analyses and Duncan multiple comparison tests respectively. (Düzgünes *et al.* 1987; Gürbüz *et al.* 2003).

RESULTS

T3 and T4 hormone changes between sex groups in different physiological periods: The findings for T3 and T4 hormone levels in female and male White Goats during the periods of breeding, gestation, postpartum-

sucking and milking are given in Table 1 and Figure 1. The highest T3 and T4 secretion in female and male White Goats, is in the period of breeding, followed by the periods of gestation, postpartum-sucking and milking respectively and the differences between periods with regards to these values are statistically important ($p < 0.05$). However, the differences between sexes in the same periods are statistically unimportant.

Change of thyroid hormones with respect to environmental temperature in different physiological periods: Figure 1 shows the findings of the changes in T3 and T4 levels with respect to environmental temperature for female and male White Goats in different physiological periods. As can be seen from Figure 1, in each physiological period, there is a decrease in T3 and T4 levels related to an increase in environmental temperature and vice versa.

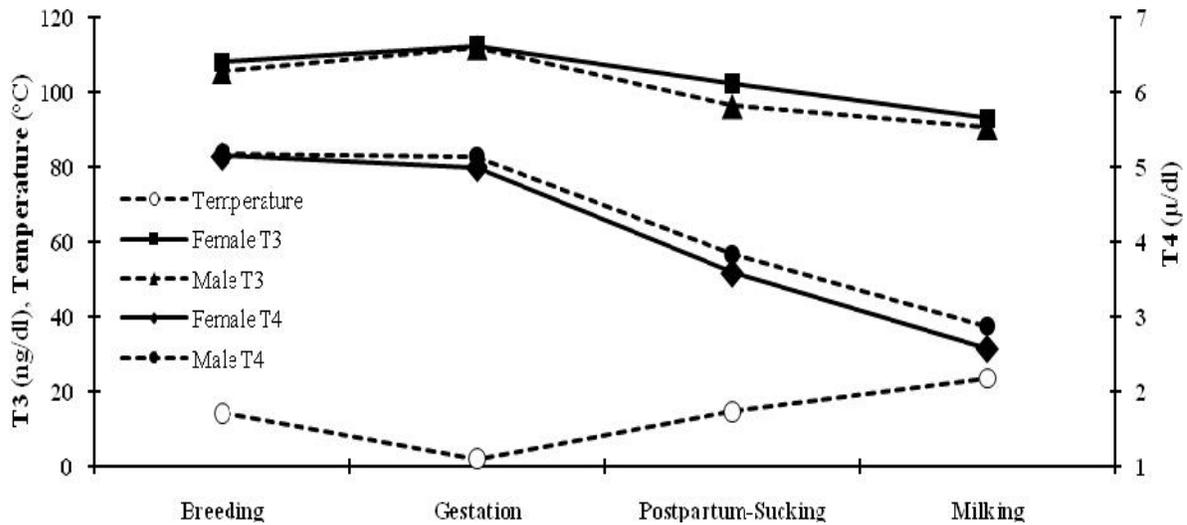


Figure 1. In female and male White Goats, changes in T3 (ng/dl) and T4 (µg/dl) levels with respect to temperature in different physiological periods.

Table 1. Serum concentration of T3 (ng/dl) and T4 (µg/dl) hormones in White Goats of different sex during different physiological periods.

Periods	Female (n:14)		Male (n:9)		
	Mean	SE	Mean	SE	
T3	Breeding	114.02 a*	5.90	111.44a*	11.40
	Gestation	109.96b	4.80	110.03b	9.04
	Postpartum-Sucking	103.11c	8.11	99.27c	5.46
	Milking	92.82d	4.09	90.53d	4.84
T4	Breeding	5.57a	0.16	5.60 a	0.39
	Gestation	4.73ab	0.12	4.87ab	0.47
	Postpartum-Sucking	3.83bc	0.08	4.09 bc	0.32
	Milking	2.57c	0.12	2.87c	0.27

*: Differences between different letters in the same column are important ($p < 0.05$).

DISCUSSION

Change of T3 and T4 Levels with respect to Sex in Different Physiological Periods: In this research for White Goats, the differences between changes of thyroid hormone levels with respect to sex are unimportant for each period. In researches on determining the differences between sex groups with regards to thyroid hormones, Wentzl *et al.* (1979) state that there is no difference in the thyroid hormone levels between female and male Angora goats. Castro *et al.* (1975) in their research on pigmy goats of different sex and age, have determined that the sex factor do not constitute an important difference with regard to T3 and T4 hormone levels. Todini *et al.* (1992) conclude that there is no difference with regard to sex in young animals, and the average plasma thyroid hormone level (which is important for T4) in adult female goats, is higher than that of bucks. In Cashmere goats older than 8 months of age, the male T3 levels are lower than the female T3 levels, but the T4 levels show no effect of sexes (Celi *et al.* 2003).

T3 and T4 Changes between Different Physiological Periods: As can be seen from Table 1, the differences of T3 and T4 hormone levels between the periods of breeding, gestation, postpartum-sucking and milking in female and male White Goats, are statistically important ($p < 0.05$). The highest T3 and T4 secretion in female and male White Goats is in the period of breeding, followed by the periods of gestation, postpartum-sucking and milking respectively.

In researches on determining the thyroid hormone levels of goats in different physiological periods, Koser Elicin (2008) states that the levels for female White Goats are highest in breeding period; the total plasma T4 (Colavita and Malfatti 1989) and the freeT4 (Blaszczyk *et al.* 2004) levels in goats increase during natural breeding and induced oestrus. The plasma T4 levels are reported to be higher during oestrus in sheep (Peeters *et al.* 1989). Our findings for T3 and T4 levels in White Goats during the breeding period are in conformance with the results stated above.

In researches on determining the change of thyroid hormones of goats and sheep during gestation period: Todini *et al.* (2007) state that the plasma T3 and T4 levels in goats around the middle of the gestation period have been higher with respect to the oestrus period and, probably due to the negative energy balance, the mother's thyroid hormone levels are in constant decrease through the second half of the gestation period; McDonald *et al.* (1988) state that a decrease in the maternal plasma T4 concentrations of goats has been observed towards the end of the gestation period. As in goats, the plasma thyroid hormone concentrations in sheep during postpartum period have been reported to be lower than the gestation period (Okab *et al.* 1993). Our

findings for the changes in T3 and T4 levels of White Goats in gestation period show similarity to the conclusions above.

In researches on goats during postpartum-sucking period, Elicin (2008) states that the thyroid hormone levels in gestation period of female White Goats are high with respect to the postpartum-sucking period; Okab *et al.* (1993) state that the plasma T3 and T4 hormone levels of sheep in postpartum-sucking period show lower values with respect to the gestation period. Our findings for the changes of T3 and T4 hormone levels of White Goats in postpartum-sucking period show similarity to these conclusions.

In this research, our findings for the changes of T3 and T4 levels of female White Goats in the milking period, also show similarities to the reported findings for goats (Emre and Garmo 1985; Riis and Madsen 1985; Todini 2007; Koser Elicin 2008) and sheep (Mitin *et al.* 1986).

Thyroid Hormones in Different Physiological Periods and the Environmental Temperature: As can be seen from Figure 1, while in each physiological period there is decrease in T3 and T4 levels along with an increase in environmental temperature, there is increase in T3 and T4 levels as the environmental temperature decreases. The environmental temperature, being the most important external factor in regulating the activity of the thyroid gland (Dickson 1993), has an inverse proportionality with the blood thyroid hormone concentrations in goats (Colavita *et al.* 1983; Todini *et al.* 1992) and sheep (Valtorta *et al.* 1982; Webster *et al.* 1991; Starling *et al.* 2005). It can be stated for our research that the changes in T3 and T4 hormone levels are under the influence of environmental temperature as mentioned in the reports above. Additionally, it has been reported that the physiological condition has also an effect on the activity of the thyroid gland (Todini 2007).

As the result of this research we conclude that the environmental temperature has a predominant effect on the thyroid gland activity of the White Goats in different physiological periods. Therefore we must take into consideration the influences of environmental temperature in the evaluation of the thyroid gland activity in different physiological periods.

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