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# Studies of Some Hormonal Parameters in Rambouillet Sheep during Seasonal Migration in Jammu Region

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**ABSTRACT**

The investigation was undertaken to study some hormonal parameters in migratory Rambouillet sheep of Jammu (India) during seasonal uphill and downhill migration. Thyroid hormons and cortisol concentrations were analysed in male and female sheep of 1-2 years (young) and 2-4 years (adult) of ages. Non-significant increase of thyroid hormones ($T_3$ and $T_4$) levels were recorded during uphill migration. Highest thyroid hormones concentrations were found immediately after reaching the high altitude in all groups. During downhill migration, thyroid hormone levels increased non-significantly at mid station and remained high at base station as compared to the values of high altitude. Again, non-significant increase of cortisol level was recorded in both uphill and downhill migration in all the groups. The cortisol and thyroid hormone levels were found higher in young as compared to adult sheep. The cortisol levels were found higher in female animals, whereas non-significantly higher thyroid hormone levels were recorded in male animals.

**Keywords:** Cortisol, thyroid hormones, migratory sheep

Migratory sheep rearing is very common practice in the economically weaker sections of the society in the tribal hilly areas like Jammu and Kashmir, India. The tribes in the state extensively practice migratory pastoralism. The sheep migrate from foothills of the Himalayas to high altitude alpine ranges during the summer months and to foothills and plains during the winter season (CSWRI, 2001; Pandey *et al*., 2002). The stress factors during migration are numerous and the responses of the animal on them are complex, non-specific and often detrimental to their health and productivity. Migration induces changes in the blood composition as well as other bodily parameters like hormones, enzymes and live weight. The present study is mainly confined to migration in the region of district Kathua, Jammu (J&K). The sheep flock in Government Sheep Breeding Farm, Billawar, migrates to Sarthal pastures every year. Rambouillet breed of sheep of this farm was investigated for some studies in term of some hormonal profile as it is an important and easy means to evaluate stress condition of animals which influences productive efficiency. Since enough literature is not available on scientific study of adaptational aspects of migratory livestock, therefore the present study was planned.

## MATERIALS AND METHODS

A total of 24 Rambouillet sheep were included in this experiment. They were divided into four groups of six sheep each**,** as mentioned as: Group A: Male Rambouillet sheep, 1-2 years of age; Group B: Male Rambouillet sheep, 2-4 years of age; Group C: Female Rambouillet sheep, 1-2 years of age and Group D: Female Rambouillet sheep, 2-4 years of age. All these animals were maintained under semi-grazed and semi-stall fed conditions at farm and on complete grazing-during migration period of five and half months. The sheep flock maintained at State Government Sheep Breeding Farm, Billawar was migratory. Out of 12 months in a year, animals were maintained at Sheep Breeding Farm, Billawar only for 6 - 7 months. During

summer season, they migrate to high altitude pasture in search of nutritious grasses and favorable environmental conditions. Towards mid of May the migration starts from Sheep Breeding Farm, Billawar and these animals continue moving uphill, covering a distance of 4-5 kilometers in a day up to mid-station, Mandhar, making night halts at several places on the migratory route. In a period of 6-9 days, sheep reach the mid-station, Mandhar, where they stay for 8 to 10 days. Finally, after leaving Mandhar, flock reach at high altitude pasture, Sarthal within 10-15 days. The flocks then stay the high altitude pasture till October first week. During the downhill journey, sheep followed the same path as for uphill journey and finally reached the Billawar farm in November first week.

Dry and wet bulb thermometer was used to record the environmental temperature and relative humidity at different stations (Table 1).

**Table 1: Average environmental temperature (ºC) and relative humidity (%) at different stations during uphill and downhill migration**

| Sampling month | Stations | Temperature (ºC) | Relative Humidity (%) |
|---|---|---|---|
| 10th May | Billawar | 35.5 | 57 |
| 18th May | Mandhar | 16.3 | 41 |
| 14th June | Sarthal | 13.0 | 45 |
| 15th September | Sarthal | 12.0 | 22 |
| 04th October | Mandhar | 22.0 | 36 |
| 24th October | Billawar | 28 | 37 |

Blood samples were collected at base station (1st collection), 30 minutes after leaving base station (2nd collection); at mid station, on the day of reaching (3rd collection), day of leaving (4th collection) and 30 minutes of leaving (5th collection) and at high altitude (6th collection) during uphill and at high altitude before starting (7th collection), at mid station (8th collection) and on the day of reaching the base station (9th collection) in downhill migration. About 6 ml of blood was collected from each animal by venipuncture with aseptic measures. Serum was separated and transferred to the storage vials and kept in liquid nitrogen container at -196ºC and then transferred to the laboratory and then stored at -20ºC in deep freeze for analysis of various hormones. Triiodothyronine ($T_3$), thyroxine ($T_4$) and cortisol concentrations were estimated by using RIA kits supplied by Immunotech, Czech Republic. All the recorded data of the present experiment have been analyzed statistically by the method described by Snedecor and Cochran (1994).

## RESULTS AND DISCUSSION

### Thyroid hormones

As presented in Table 2, increasing trend of thyroid hormones (triiodothyronine, $T_3$ and thyroxine, $T_4$) were recorded from base station to high altitude during uphill migration. Similarly, during downhill migration, increased level of $T_3$ & $T_4$ were found at mid station as compared to those at high altitude at starting of migration (7th collection), however, the variation was statistically non-significant. At 9th collection, $T_3$ level remained high, whereas, $T_4$ level decreased. Migratory stress might be the contributing factor for increasing trend of thyroid hormones from base station to high altitude. At high altitude, highest thyroid hormone ($T_3$ and $T_4$) concentrations were recorded (6th collection) which might be due to the fact that shortest duration of exposure to the lower environmental temperature (Table 1) increased the thyroid hormonal level to increase BMR in order to maintain body temperature constant (Prakash and Rathore, 1991; Kataria *et al.*, 1993).

Similar observations were also reported in cattle (Ramirez *et al.*, 1992). Stojevic *et al.* (2000) reported that $T_3$ concentration is inversely related to environmental temperature. However, Kumar (1999) reported that $T_3$ concentration was significantly higher ($P<0.05$) at base station (1.07+0.13ng/ml), at the start of migration as compared to the corresponding values at the end of migration in uphill migration and the level decreased during downhill migration in migratory crossbred sheep of Himachal Pradesh. They found a significant increased of thyroxine level at high altitude in exotic ewes. Prolonged cold exposure suppresses the thyroid activity (Aarif, 2010). At alpine pasture, decreased thyroid hormones concentrations (from 6th to 7th collection) in all the groups indicated acclimatization of the animals to the cold climatic environment at high altitude.

Table 2 depicted that thyroid hormone levels were insignificantly higher in young as compared to adult sheep during migration. Different workers have also reported

**Table 2: Triiodothyronine ($T_3$) and Thyroxine ($T_4$) level (ng/ml) (Mean + S.E.) in different groups of Rambouillet sheep during migration**

| Groups \ Collections | Uphill Migration | | | | | | | | Downhill Migration | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6[t] | P Value (Col.) | CD (Col.) | 7 | 8 | 9[th] | P Value (Col.) | CD (Col.) |
| **$T_3$:** | | | | | | | | | | | | | |
| Gp A (Young male) | 1.90 ± 0.13 | 1.98 ± 0.17 | 2.58 ± 0.43 | 2.22 ± 0.39 | 2.28 ± 0.58 | 2.62 ± 0.42 | 0.37 | N.S. | 1.85 ± 0.25 | 2.05 ± 0.56 | 1.98 ± 0.28 | 0.93 | N.S. |
| Gp B (Adult male) | 1.73 ± 0.10 | 1.84 ± 0.08 | 2.26 ± 0.40 | 2.10 ± 0.38 | 2.26 ± 0.39 | 2.47 ± 0.48 | 0.83 | N.S. | 1.68 ± 0.35 | 1.98 ± 0.36 | 1.87 ± 0.35 | 0.84 | N.S. |
| Gp C (Young female) | 1.40 ± 0.12 | 1.66 ± 0.11 | 1.92 ± 0.36 | 1.72 ± 0.41 | 1.83 ± 0.38 | 2.04 ± 0.54 | 0.36 | N.S.. | 1.66 ± 0.36 | 1.89 ± 0.64 | 1.76 ± 0.56 | 0.95 | N.S. |
| Gp D (Adult female) | 1.28 ± 0.09 | 1.48 ± 0.21 | 1.84 ± 0.56 | 1.66 ± 0.28 | 1.79 ± 0.35 | 1.86 ± 0.45 | 0.72 | N.S. | 1.61 ± 0.37 | 1.68 ± 0.53 | 1.62 ± 0.33 | 0.99 | N.S. |
| P Value (Gps) | 0.00 | 0.14 | 0.64 | 0.65 | 0.77 | 0.65 | | | 0.96 | 0.95 | 0.90 | | |
| CD (Gps) | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. . | | | N.S. | N.S. | N.S. | | |
| **$T_4$:** | | | | | | | | | | | | | |
| Gp A (Young male) | 35.33 ± 1.82 | 36.89 ± 2.23 | 43.24 ± 3.13 | 41.05 ± 3.89 | 41.59 ± 4.46 | 44.74 ± 5.60 | 0.46 | N.S. | 39.40 ± 3.12 | 41.87 ± 6.22 | 38.09 ± 2.51 | 0.82 | N.S. |
| Gp B (Adult male) | 27.38 ±1.87 | 28.10 ± 1.60 | 35.32 ± 3.65 | 33.22 ± 4.82 | 34.59 ± 3.97 | 36.63 ± 4.40 | 0.35 | N.S. | 32.03 ± 4.06 | 32.65 ± 3.57 | 29.90 ± 4.25 | 0.88 | N.S. |
| Gp C (Young female) | 24.18 ± 2.80 | 25.80 ± 3.78 | 34.31 ± 3.92 | 32.48 ± 3.29 | 33.24 ± 3.81 | 35.18 ± 6.13 | 0.29 | N.S.. | 30.93 ±2.29 | 31.29 ± 3.16 | 28.04 ± 3.29 | 0.70 | N.S. |
| Gp D (Adult female) | 20.63 ± 1.81 | 21.82 ± 1.64 | 27.47 ± 3.60 | 25.24 ± 3.11 | 27.68 ± 3.88 | 30.55 ± 5.25 | 0.33 | N.S. | 27.88 ±4.78 | 29.83 ± 5.02 | 25.14 ± 3.00 | 0.75 | N.S. |
| P Value (Gps) | 0.00 | 0.00 | 0.13 | 0.06 | 0.14 | 0.22 | | | 0.18 | 0.28 | 0.06 | | |
| CD (Gps) | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. . | | | N.S. | N.S. | N.S. | | |

that mean thyroid hormone concentration of aged goats were lower than that of young groups at all the seasons (Eswari *et al*., 1999; EL-Barody *et al*., 2002; Stockman, 2006). In the investigation, it was also found that the thyroid hormones were higher in male as compared to female sheep of both the age groups during migratory period. Todini *et al.* (2007) reported that there were no sex differences in blood thyroid hormone concentrations in young animals, whereas, in adult goats mean plasma thyroid hormone levels were higher (significantly for $T_4$) in does than in buck. Eswari *et al*. (1999) recorded higher values of thyroxin in female than male sheep.

**Cortisol**

In the study (Table 3), it was observed that the cortisol level was showing increasing trend from 2nd to 6th collection during uphill migration and from 7th to 9th collection during downhill migration. Highest cortisol level was found after 30 minutes (2nd collection) of migration from base station in all the groups of Rambouillet sheep. The serum cortisol level could be used as an indicator of stress. Ali *et al.* (2001) found that after 30 minutes of transport there was significant increase in plasma cortisol level (from 43.5 to 101.7 mmol/l) in desert Najdi sheep. Halla *et al*. (1998) and Aoyama *et al*. (2003) also reported that cortisol level was significantly increased during transportation. In the present study also cortisol level showing increasing trend during uphill and downhill migration. Highest cortisol level was found after 30 minutes of migration from base station in all the groups of Rambouillet sheep associated with the migratory stress. It might be concluded that the

**Table 3: Cortisol level (ng/ml) (Mean + S.E.) in different groups of Rambouillet sheep during migration**

| Groups \ Collections | Uphill Migration | | | | | | | | Downhill Migration | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | P Value (Col.) | CD (Col.) | 7 | 8 | 9 | P Value (Col.) | CD (Col.) |
| Gp A (Young male) | 0.70 ± 0.26 | 1.23 ± 0.23 | 0.88 ± 0.23 | 0.86 ± 0.21 | 1.32 ± 0.24 | 0.90 ± 0.21 | 0.37 | N.S. | 0.70 ± 0.13 | 0.71 ± 0.09 | 0.83 ± 0.12 | 0.71 | N.S. |
| **Gp B (Adult male)** | 0.49 ± 0.17 | 0.71 ± 0.23 | 0.57 ± 0.22 | 0.56 ± 0.19 | 0.89 ± 0.26 | 0.70 ± 0.23 | 0.83 | N.S. | 0.52 ± 0.15 | 0.54 ± 0.09 | 0.74 ± 0.15 | 0.46 | N.S. |
| **Gp C (Young female)** | 0.79 ± 0.21 | 1.32 ± 0.24 | 1.07 ± 0.24 | 0.99 ± 0.21 | 1.43 ± 0.22 | 0.92 ± 0.23 | 0.36 | N.S. | 0.79 ± 0.18 | 0.83 ± 0.11 | 0.92 ± 0.13 | 0.81 | N.S. |
| **Gp D (Adult female)** | 0.55 ± 0.22 | 0.92 ± 0.29 | 0.62 ± 0.23 | 0.62 ± 0.16 | 1.00 ± 0.31 | 0.77 ± 0.19 | 0.72 | N.S. | 0.58 ± 0.11 | 0.59 ± 0.08 | 0.80 ± 0.13 | 0.30 | N.S. |
| **P Value (Gps)** | 0.77 | 0.29 | 0.43 | 0.39 | 0.42 | 0.87 | | | 0.58 | 0.16 | 0.83 | | |
| **CD (Gps)** | N.S | N.S | . N.S | N.S | . N.S | N.S | | | N.S | N.S | . N.S | | |

starting phase was the most critical period for the animals to respond to the migratory stress. It was observed that at alpine pasture, cortisol level (ng/ml) decreased from 0.90±0.21 to 0.70±0.13, 0.70±0.23 to 0.52± 0.15, 0.92±0.23 to 0.79±0.18 and 0.77±0.19 to 0.58±0.11 in group A, B, C and D, respectively (at 6$^{th}$ and 7$^{th}$ collection). Mills *et al*. (1997) also reported that no elevation of cortisol level in blood occurred after prolonged stress condition which is in sync with our finding.

Table 3 depicted that the cortisol level was higher in young male and female sheep as compared to adult Rambouillet sheep. The values were estimated as 0.70±0.26 to 1.32±0.24 ng/ml and 0.79±0.18 to 1.32±0.24 ng/ml in young male and female, respectively; whereas, in adult male and female the values ranged between 0.49±0.0.17 to 0.74±0.0.15 ng/ml and 0.55±0.0.22 to 1.00±0.0.31 ng/ml, respectively. Young animals are more prone to stress condition as compared to adult, which might be the reason of higher cortisol level in young Rambouillet sheep. Kannan *et al*. (2003) also observed that younger animals had higher plasma cortisol concentrations than older ones after transport stress.

Cortisol levels were found higher in female animals of both the age groups during uphill migration whereas during downhill migration the cortisol level was higher in male animals of both the age groups; however the variations were statistically non-significant (Table 3). Higher cortisol levels in female sheep during uphill migration might be due to the fact that females are more susceptible to migratory stress as compared to their male counterpart. Similar finding was also reported by Carcangiu *et al*. (2007) in sheep and goat.

## CONCLUSION

Cortisol and thyroid hormonal levels increased during migration in all groups due to migratory stress. Higher concentration of cortisol and thyroid hormones were found in young groups as compared to the adult groups of sheep. Cortisol levels were recorded higher in female Rambouillet sheep. Among the groups, adult males were more adapted than female and young ones.

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