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Effect of different farming systems on physiological response, blood parameters and endocrinological profiles in Deccani sheep

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The sheep has the capacity to withstand high temperatures, ability to convert available inferior quality crop residues, stubble and grasses into quality animal protein (Shinde and Sejian 2013). The total sheep population in India is 65.06 million (19th Livestock census 2012). In the dry lands of western parts of India, the Deccan Plateau Nomadic pastoralism is still predominant (Roy *et al*. 2013). Most of the farmers in these regions maintain their animals on wastelands, uncultivated natural vegetation on common grazing lands and harvested crops. High ambient temperature and long distance walking in search of feed resources and water restriction play important role in productive potential of sheep and goat (Sejian *et al*. 2012). The increases in body temperature and respiration rate in response to high environment temperature are the important signs for heat stress in sheep (Rana *et al*. 2014). Extensive system of sheep rearing is followed in areas where the carrying capacity of grazing land is poor. This system is usually followed in very low rainfall areas. Therefore, the present study was conducted to access the effect of different farming systems on body physiology, blood parameters and hormonal profiles in Deccani sheep.

Deccani ewes (36) of 9–12 months of age were selected; the animals were grouped into 3 groups intensive farming system (T1), semi intensive farming system (T2) and extensive farming system (T3). Each group consisted of 12 ewes in completely randomized design. The mean body weight of animals in T1, T2 and T3 group was 18.41 ± 0.89, 18.53 ± 1.33 and 18.88 ± 1.20 kg, respectively. The sheep in intensive group were reared with the floor space area of $1m^2$/animal in the animal shed. Zero grazing was practiced. The ewes in intensive farming system were fed with 300 g of concentrate mixture and *ad lib*, quantity of green fodder. The animals in semi-intensive system of farming were maintained for 4 h in the shed and 4 h on grazing. The animals in semi-intensive system were fed with 150 g of concentrate inside the shed + 4 h of grazing and *ad lib*. quantity of green fodder. The group of animals in extensive farming system were allowed to graze between 8.00 am to 4.00 pm for 8 h in summer. After that the animals were moved into night shelter in the animal shed with a floor space of $1m^2$/animal. Green fodder was provided *ad lib.* for maintenance. Physiological responses of all 3 groups of Deccani ewes were recorded twice a day at 7.30 am to 8.30 am hours and 4.00 to 4.30 pm for 3 weeks (before and after transportation of animals from place of grazing to animal sheds). Blood biochemical profiles such as total protein, glucose SGOT and SGPT were analyzed commercially available diagnostic kit. Endocrinological profiles such as triiodothyronine (T_3) and thyroxine (T_4) hormones were estimated using radio immunoassay (RIA) kits and cortisol was estimated with enzyme immunoassay (EIA) kit. The data were subjected to analysis of variance (Snedecor and Cochran 1989). Comparison of means was made by Duncan's multiple range tests as described by Kramer (1957) using SPSS 15 statistical software.

There was a significant ($P<0.05$) difference between the T1 and T3 groups, T3 group has significantly ($P<0.05$) higher respiration rate than T1 and it was comparable between T3 and T2 and between T2 and T1 in morning (Table 1). Similarly, T3 group have significantly higher respiration rate than T1 and T2 and between T1 and T2 group were comparable in the evening hours. Higher respiration rate in T3 group might be due to the exposure to high ambient temperature which body has reacted to dissipate body heat. These findings were in agreement with Marai *et al*. (2007). The sheep need to walk for long

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Table 1. Comparative physiological response of Deccani ewes reared in different farming systems

Experimental groups	Respiration rate (morning)	Respiration rate (evening)	Pulse rate (morning)	Pulse rate (evening)	Rectal temperature (morning)	Rectal temperature (evening)
T1	21.42±0.38^{b}	59.58±0.77^{b}	50.42±0.74^{b}	64.42±0.87^{b}	100.25±0.30^{b}	101.75±0.13^{b}
T2	22.33±0.53^{ab}	60.08±0.83^{b}	58.67±0.95^{a}	66.25±0.59^{b}	101.17±0.30^{a}	102.17±0.21^{ab}
T3	23.17±0.47^{a}	64.25±0.65^{a}	57.50±1.06^{a}	68.75±0.86^{a}	101.42±0.19^{a}	102.33±0.14^{a}

Means with different superscripts in a column differ significantly (P<0.05).

Table 2. Comparative means of blood parameters in Deccani ewes in different farming systems

Experimental groups	Hb (g/dl)	PCV (%)	Glucose (mg/dl)	Total protein (g/dl)	SGOT (IU/ dl)	SGPT IU/ dl)
T1	10.18±0.16^{a}	30.08±0.37^{b}	44.67±0.61^{a}	6.76±0.10^{a}	41.25±.73^{c}	7.60±0.14^{b}
T2	9.18±0.09^{b}	31.17±0.84^{b}	45.00±0.78^{a}	7.07±0.08^{a}	42.91±.46^{b}	8.30±0.15^{a}
T3	8.96±0.12^{b}	33.92±0.55^{a}	41.17±0.87^{b}	6.33±0.13^{b}	44.66±.48^{a}	8.53±0.13^{a}

Means with different superscripts in a column wise differ significantly (P<0.05).

distances while grazing resulted in enhanced respiration rate in T3 and T2 groups, indicating these groups might have experienced more stress. The findings of the present study are in concurrence with the earlier findings of Hooda and Upadhyay (2014). It is evident from the data that T2 and T3 groups were having higher pulse rate than T1 and between T2 and T3 was comparable in morning observation. Similarly, T3 group have significantly (P<0.05) higher pulse rate than T1 and T2 groups and between T1 and T2 groups were comparable in the evening observation. The experimental animals in extensive farming system were put into grazing resulted in higher heart beat and metabolic rate resulted in higher pulse rate. The study results are in concurrence with findings of Sejian *et al*. (2010). Rectal temperature in T2 and T3 groups was comparable in the morning observation. T3 group have significantly (P<0.05) higher rectal temperature than T1 and between T3 and T2 were comparable in the evening observation. Rectal temperature is a good indicator for thermal stress and these values were marginally lower during morning observation than in the evening hours in the different experimental groups. These observations are in agreement with the findings of Sejian *et al*. (2010).

T1 group have significantly (P<0.05) higher haemoglobin content as compared to T2 and T3 groups and nonsignificant difference between T3 and T2 groups was observed (Table 2). Similar findings were reported by Nayak *et al*. (2013) in Ganjam sheep. T1 group have significantly (P<0.05) higher packed cell volume than T2 and T3 groups, whereas packed cell volume in T3 and T2 were comparable. Nouty *et al*. (1986) also reported that significant variation of packed cell volume might be due to heat induced reduction in metabolic rate of animals. T3 and T2 groups during thermal stress suffer from dehydration resulted in haemo-concentration of blood and higher packed cell volume. It was observed that T1 and T2 groups have significantly (P<0.05) higher glucose levels than T3 group. Glucose levels in T1 and T2 were comparable. This might be due to the less availability of substrate for glucose formation in the body as the energy depleted ewes in semi-intensive and extensive systems of farming. Kulkarni *et al*. (2010) also reported similar findings in Deccani sheep. T1 and T2 groups have significantly higher total protein content than T3 group. Total protein values in T1 and T2 were comparable. Higher total protein content in serum of T1 group could be the result of greater efficiency of converting non-protein nitrogenous substances into amino acids and protein. Similar values were reported for Mechari sheep (Ram Kumar *et al*. 2003).

T3 group have significantly (P<0.05) higher SGOT than T1 and T2 groups and the level was significantly higher in T2 thanT1 (Table 2). Sarvana Kumar (2003) reported significant increase of SGOT levels during active migration of Nellore sheep. This might be attributed to increase gluconeogenesis from protein sources. T3 and T2 groups have significantly higher SGPT levels than T1 and its levels in T2 and T3 were comparable. These findings are indicative of higher activity of liver in the conversion of feed resources while grazing coupled with thermal stress.

T1 group have significantly (P<0.05) higher T_3

Table 3. Comparative T3, T4 and Cortisol levels in Deccani ewes in different farming systems

Experimental groups	T_3 (nmol/L)	T_4 (nmol/L)	Cortisol (nmol/L)
T1	2.65±0.07^{a}	54.17±1.08^{a}	21.42±0.68^{b}
T2	1.93±0.06^{b}	42.42±0.99^{b}	20.08±0.43^{b}
T3	1.41±0.02^{c}	29.17±1.47^{c}	31.08±1.00^{a}

Means with different superscripts in a column differ significantly (P<0.05)

concentration than in T2 and T3 groups. T2 had significantly ($P<0.05$) higher T_3 level than T3 group. Similarly, T1 group have significantly ($P<0.05$) higher T_4 level than in T2 and T3 groups (Table 3). T2 group had significantly ($P<0.05$) higher T_4 concentration than in T3 group. Significantly ($P<0.05$) higher cortisol was recorded in T3 than T2 and T1 groups, whereas its value in T2 and T1 groups was similar. Exposure of animals to higher environmental temperature will depress the activity of thyroid gland, which will decrease the concentration of thyroid hormones (Prakash and Rathore 1991). In the present study, lower production was observed in extensive system, that might be due to the thermal and physical stress was more and it was reflected significantly in T3 group. Mader *et al*. (2009) reported that the animals when exposed to the environment stressors especially heat stress, will result into significant depression of thyroid gland activity, which will result in low the thyroid hormones levels.

SUMMARY

The result from revealed that T3 group have significantly ($P<0.05$) higher respiratory rate, pulse rate and rectal temperature than T1 and T2 groups. Similarly T1 group has significantly ($P<0.05$) higher Haemoglobin concentration than T2 and T3 groups. Packed cell volume revealed, T3 group has significantly ($P<0.05$) higher value than T2 and T1 groups. T1 and T2 groups have significantly higher glucose concentration than in T3 group. Similar observation was reported in total protein content. SGOT concentration revealed that significant ($P<0.05$) difference was observed among the groups and T3 group has significantly higher value than other groups whereas SGPT level was significantly higher in T3 and T2 groups than in T1 groups. Endocrinological profiles such as (T_3) triiodothyronine and (T_4) thyroxine revealed that T1 group have significantly higher level than T2 and T3 groups and T2 group had significantly ($P<0.05$) higher T_3 and T_4 value than in T3 group. Similarly, significantly ($P<0.05$) higher cortisol was recorded in T3 group over T2 and T1 groups and T2 and T1 groups were comparable. It was found that the intensive system of rearing has higher beneficial effect on comfort and productive performance for sheep farming in the tropical conditions. In the other 2 systems, the stress need to be reduced by supplementation of higher plane of nutrition, electrolyte supplementation during extreme summer and creation of waterbodies in the path of grazing and provision of shade and shelter for the sheep flocks while on long hours of grazing are essential.

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