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Physiological Responses of Indigenous Sheep under Water Restriction

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ABSTRACT

Eighteen farm born indigenous hoggets were selected on the basis of body weight (25-30kg) and randomly divided in to three treatment groups viz. T_1 (Control), T_2 (WR_1:20%WR) and T_3 (WR_2:40%WR) and each treatment comprised of six animals to evaluate physiological responses. The pulse rate (per min) recorded at 7.30 am significantly ($P < 0.05$) elevated in 40% WR group as compared to 20 and 0% WR groups whereas respiration rate (per min) and rectal temperature (^0F) recorded at 2.30 pm significantly ($P < 0.05$) elevated when animals were subjected to 40% WR as compared to 20 and 0% WR indicated that the 40% water restriction was more stressful to the animals.

Keywords: sheep, water restriction, physiological responses, Gujarat climate

Rainfall pattern in Middle Gujarat is quite erratic which leads to infrequent supply of water to livestock. The maximum rainfall was in South Gujarat (1359 mm) followed by Middle Gujarat (807 mm) and North Gujarat (665 mm) (Anonymous, 2012). There is scanty information about sheep and goats living under sub tropical arid conditions and coping with shortage of water and food. Hence, to assess the real problem faced by the animals in the field conditions and to understand water crisis management, the best experimental model is dehydration and rehydration (Kataria, 2000). The present study was conducted with the objective to asses the effects of water restriction and rehydration on physiological responses of sheep in agro climatic condition of middle Gujarat.

MATERIALS AND METHODS

Eighteen indigenous hoggets of Marwari and Patanwadi breeds were selected having almost similar body weight (25-30 kg) and randomly divided in to three treatments groups viz. T_1 (control; 0% WR), T_2 (20% WR) and T_3 (40% WR) after assessing the water requirement in 15 days adaptation period and physiological responses were evaluated in two different months viz. October (S_1) and January (S_2). Season during October and January months were hot humid and winter, respectively. The animals were housed in asbestos roofed house and were fed a compound pelleted concentrate mixture (Amul Dana) and chaffed dry wheat straw as per ICAR (1998) feeding standard. The period of experiment was 32 days. The water restriction phase of 28 days was divided in to four periods (P_1, P_2, P_3 and P_4) each of seven days followed by four days of rehydration.

The reason for dividing water restriction phase into different periods was to prevent animal's life from severe dehydration and to assess the interaction effect among the periods. The animals of control group were offered *ad.lib* water after measuring by measuring cylinder in three installments i.e. 9.00 am, 2.00 pm and 4.00 pm while in water restriction groups, the whole day water requirement was measured once in morning and offered at 9.00 am and remaining left over water was offered at 2.00 pm to those animals which could not drink in single attempt. The amount of water offered during dehydration phase to the animals of T_1, T_2 and T_3 groups were 2.56±0.15, 2.04±0.11 and 1.54±0.08 litres, respectively. During rehydration phase all experimental animals were offered water in three installments i.e. 9.00 am, 2.00 pm and 4.00 pm. The physiological responses like pulse rate (PR),

respiration rate (RR) and rectal temperature (RT) were measured during dehydration phase only. The data of body weight during dehydration phase was analyzed by three factorial completely randomized designs while the data of rehydration phase was analyzed by one way ANOVA by standard methods.

RESULTS AND DISCUSSION

The THI value was higher in hot humid season than the winter season and higher at 7.30 am in both the season than at 2.30 pm (Table 1) which indicated that the morning time was more stressful than afternoon . The Temperature Humidity Index was calculated by using formula given by US weather bureau which is THI=0.72(C_{db}+C_{wb})+40.6, where, C_{db}= dry bulb temperature (C°) and C_{wb}=wet bulb temperature (C°).

Table 1. Temperature humidity index during the experiment

Periods	Hot Humid season		Winter season	
	7.30 am	2.30 pm	7.30 am	2.30 pm
P1	91.50 ±1.21	64.79± 1.05	70.14±1.06	32.71±0.88
P2	84.71±2.31	45.86±1.31	75.00±1.09	36.14±1.01
P3	84.86±2.03	43.43±1.03	64.29±1.33	35.14±1.06
P4	77.29±1.88	51.36±1.09	76.86±1.34	46.43±1.19
Average	87.11±1.02	49.44±1.01	77.22±1.10	45.9±1.03

The animals of T_3 group exhibited significantly ($P < 0.05$) higher pulse rate than the animals of T_1 group (6.6%) and T_2 group (3.9%) at 7.30 am but it did not differ significantly at 2.30 pm. Overall, at 7.30 am the pulse rate was non-significantly higher in hot humid season (69.77 ± 1.01) than winter season (67.02 ± 0.74) (Table 3). Overall, the pulse rate was significantly ($P < 0.05$) elevated in S1 (8.28%) and S2 (11.69%) at 2.30 pm than 7.30 am. Increase in pulse rate with 72 hrs water restriction was reported by Rajkhowa and Hazarika (2000) which supported the present findings. The pulse rate either at 7.30 am or at 2.30 pm during different experimental periods did not differ significantly (Table 3).

The RR was non-significant among all treatment groups at 7.30 am but it increased significantly ($P < 0.05$) at under T_2 group as compared to T_1 and T_2 group (Table 2). The RR was significantly ($P < 0.05$) higher at 7.30 am as well as at 2.30 pm in hot humid season as compared to winter season (Table 3) indicated hot humid season was more stressful. The RR varied significantly ($P < 0.05$) among the experimental periods (Table 3) which agreed with the observation of Kheir and Ahmed (2008). The RR at 7.30 am was significantly higher during P2 as compared to P3, P1 and P4. However, there was no significant difference in respiration rate among different periods at 2.30 pm.

The RT was significantly ($P < 0.05$) affected by treatments (Table 2) and seasons (Table 3). The rectal temperature recorded at 7.30 am did not differ due to water restriction. However, the RT observed at 2.30 pm in the animals of T_3 group (101.33 ± 0.12) was significantly ($P < 0.05$) higher than the animals of T_1 group (100.20 ± 0.12) and T_2 group (100.71 ± 0.14). The RT increased at 2.30 pm as compared to 7.30 am during both the season due to higher environmental temperature. The water restriction caused a rise in rectal temperature when Awassi sheep were subjected to 3 days of water dehydration (Abdelatif

Table 2. Influence of water restriction on physiological responses of experimental animals

	7.30 am			2.30 pm		
	T_1	T_2	T_3	T_1	T_2	T_3
Pulse rate (no. per min.)	66.37^a ± 1.08	68.08^a ± 0.97	70.75^b ± 1.15	75.12 ± 1.01	74.33 ± 1.57	76.16 ± 1.47
Respiration rate (no. per min.)	32.35 ± 2.59	32.60 ± 2.91	34.33 ± 3.20	39.00^a ± 2.58	39.27^a ± 2.74	44.46^b ± 2.66
Rectal Temperature (^{0}F)	99.91 ± 0.19	99.91 ± 0.22	100.22 ± 0.18	100.20^a ± 0.12	100.71^a ± 0.14	101.33^b ± 0.12

Superscripts (a and b) in a row among treatments within one time differed significantly ($P < 0.05$) showing treatment effect

Table 3. Influence of season of experiment on physiological responses of animals

	S_1		S_2	
	7.30	**2.30**	**7.30**	**2.30**
Pulse rate (no. per min.)	$69.77^{y} \pm 1.01$	$75.55^{x} \pm 1.34$	$67.02^{y} \pm 0.74$	$74.86^{x} \pm 0.84$
Respiration rate (no. per min.)	$45.15^{y} \pm 2.60$	$55.20^{y} \pm 1.84$	$20.97^{x} \pm 0.57$	$26.61^{x} \pm 0.62$
Rectal Temperature (^{0}F)	100.86 ± 0.15	101.59 ± 0.08	99.15 ± 0.10	100.56 ± 0.09

Superscripts (x and y) in a row between times within and between seasons differed significantly ($P < 0.05$) showing season effect

et al. 2010) and there was an increase in the evening values of rectal temperature compared to morning values (Kheir and Ahmed, 2008). Similarly, the increase in rectal temperature of water deprived goats in summer well supported the present findings because dehydration due to thirst period provoked physiological mechanisms in the body in a manner that helped the animals to survive (EI-Nouty *et al.* 1990 and Saini *et al.* 2013).

CONCLUSION

The physiological responses like pulse rate, respiration rate and rectal temperature in the animals of T_3 group had higher values than the animals of T_1 and T_2 groups indicated that the 40% water restriction was more stressful to the animals. All the physiological responses elevated significantly ($P < 0.05$) in hot humid season than winter season indicated hot humid season was more stressful. However, the period of experiment did not influence the physiological responses significantly except the respiration rate in morning hours.

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