Journal of Stress Physiology & Biochemistry, Vol. 9 No. 2 2013, pp. 15-20 ISSN 1997-0838
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ORIGINAL ARTICLE

Dehydration stress associated variations in rectal temperature, pulse and respiration rate of *Marwari* sheep

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Received September 17, 2012

The present investigation was carried out in adult female *Marwari* sheep to evaluate the dehydration stress associated variations in rectal temperature, pulse and respiration rate. The whole experiment was divided into control, thirst and drinking periods. The thirst period was of 5 days to find out the dehydration stress. The control mean values of rectal temperature (°F), pulse rate (min^{-1}) and respiration rate (min^{-1}) were 101.1 ± 0.198, 65.667 ± 2.028 and 25.167 ± 1.515 in the morning and 101.567 ± 0.174, 71.333 ± 1.229 and 27.833 ± 1.83 in the evening, respectively. With the advancement of thirst period the mean values of rectal temperature and pulse rate gradually increased while that of respiration rate increased first and then decreased. After drinking the mean values gradually decreased and on hour 72 of drinking, they differed non significantly (P>0.05) from their respective control values. Changes in rectal temperature, pulse rate and respiration rate indicated the adaptability of the animals to increased thirst periods. Dehydration due to thirst period provoked physiological mechanisms in the body in a manner that helped the animals to survive. Although dehydration was a stress to the animals, but the changes brought about by five days of dehydration were reversible.

Key words: Marwari sheep, pulse, rectal temperature, respiration, thirst

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Adaptability to water deficiency in animals can be assessed by the rate of fluid turnover with a pattern of compartmental water movement during dehydration, which is a major problem in arid tracts arising due to intermittent watering, particularly in drought periods. Dehydration is considered as a potent cause of stress to the sheep (Kataria and Kataria, 2007). Stress free management of sheep essentially include assessment of water balance and related aspects.

Estimation of water requirements of sheep must be coupled with physiological responses to understand the underlying physiological mechanisms for water balance in the body. An understanding of water turnover in relation to thermoregulation in sheep requires the evaluation of variation in rectal temperature, pulse and respiration rate. *Marwari* is the important breed of sheep in semiarid and arid tracts. These animals face frequent droughts and scarcity of feed and water leading to lowered production and poor health status. The unavailability of water induces thirst periods thereby altering the physiological status of the animals. At this time many interrelated reactions work to maintain homeostasis (Kataria *et al.*, 2002). The ability to tolerate a moderate water shortage can be assessed by observing several physiological mechanisms and behavioural strategies. Recording of rectal temperature, pulse rate and respiratory rate are considered as simple parameters to assess health status of the animals. Extensive research has been carried out to find out the adaptability of sheep by recording rectal temperature during heat stress and thermoneutral conditions (Alhidary *et al.,* 2012). However, studies to assess stress due to increased thirst periods are scanty in sheep particularly in *Marwari* breed. Therefore, the present study was conducted to investigate the effect of stress due to thirst period on physiological responses like rectal temperature, pulse and respiratory rate.

MATERIALS AND METHODS

Six apparently healthy adult female Marwari sheep (*Ovis aries*) ageing 1-2 years were used in the present investigation to study the effect of thirst and drinking on rectal temperature, pulse rate and respiration rate under the permission of Institutional Animal Ethical Committee (IAEC), College of Veterinary and Animal Science, Bikaner, Rajasthan, India. The animals were kept in well ventilated pens under standard management, feeding and stress free conditions. The whole experiment was divided in 4 periods i.e. control, thirst and drinking periods and in each period same animals were used. Each animal served as its own control. The control period comprised of 30 days during which the animals were provided feed and water *ad libitum.* Thirst period was of 5 days. The animals were kept under same feeding conditions but with complete water restriction to induce thirst mechanism. After the end of thirst period the drinking period started and it was of 10 days during which water was provided *ad libitum* to each animal. Rectal temperature, pulse and respiration rate were recorded daily in the morning at 8 am and 5pm in evening through out the experiment. Rectal temperature was recorded by using digital temperature indicator (Centuary) having rectal probe. Pulse rate was recorded from coccygeal artery. The respiration rate was noted down when animal was in standing position by observing the movement of flank, ribs and sternum. For each parameter mean ± SEM values were determined in every period and their subsets. The mean values for every parameter in each period were compared with respective mean values in control period by using student 't' test (Snedecor and Cochran, 1967 and Steel and Torrie, 1980).

Table 1 : Rectal temperature, pulse and respiration rate of *Marwari* sheep during control , thirst and drinking periods (Mean ± SEM, N = 6)

Main Effect		Rectal temperature (°F)		Pulse Rate (min^{-1})		Respiration rate (min^{-1})	
		Morning	Evening	Morning	Evening	Morning	Evening
Control		101.1 ±0.198	101.567 ±0.174	65.667 ±2.028	71.333 ±1.229	25.167 ±1.515	27.833 ±1.83
Thirst period (Days)	1	101.33 ±0.112	101.8 ±0.179	69.667^b ±0.615	73.667 ±0.955	26.5 ±1.5	29.5 ±1.258
	2	101.733^b ±0.084	102.067^b ±0.152	73.333^b ±0.813	75.333^b ±1.43	27.5 ±0.806	32.167^b ±0.749
	3	102.1^b ±0.086	102.267^b ±0.161	75.667^b ±0.08	77.333^b ±1.33	28.0^b ±0.258	34.667^b ±0.615
	4	102.53^b ±0.084	102.633^b ±0.131	78.0^b ±1.033	78.333^b ±1.2	28.0^b ±0.856	35.0^b ±0.365
	5	102.83^b ±0.095	102.9^b ±0.086	80.0^b ±0.73	80.0^b ±1.54	27.5^b ±1.057	31.5^b ±0.957
Drinking period (Hours)	½	102.3^b ±0.184	102.5^b ±0.124	77.667^b ±0.615	78.333^b ±1.202	28.5^b ±1.232	32.0^b ±0.775
	24	101.93^b ±0.204	102.067^b ±0.084	75.333^b ±0.422	74.667^b ±1.22	30.0^b ±1.065	27.333 ±0.715
	72	101.54 ±0.176	101.87 ±0.086	70.264 ±1.048	73.0 ±0.856	26.833 ±0.7	27.0 ±1.115

N = Number of animals
Subclass means within a given parameter superscribed by letter "b" differ significantly (p≤0.05) from control-I mean value.

RESULTS AND DISCUSSION

The mean ± SEM values of cardinal physiological parameters *viz*. rectal temperature (°F), pulse rate (min^{-1}) and respiration rate (min^{-1}) are presented in table 1. During control period, the mean value of each parameter was higher during evening than respective morning mean value. However, the difference was significant (P≤0.05) only for pulse rate being higher during evening. During thirst period as the days advanced the significant (P ≤0.05) increase was observed in the mean values of all the three parameters during morning and evening. On day 5 of thirst period the percent increases were 1.17 and 1.312, 21.827 and 12.15, and 9.27 and 13.175 during morning and evening in rectal temperature, pulse rate and respiration rate, respectively as compared to respective control mean values.

Increase in rectal temperature during thirst period was presumably because of increased basal metabolic rate. Thirst period resulted in decrease feed intake which necessitated the demand for energy therefore basal metabolic rate could have increased. Dehydration limits a wide range of cardiovascular and thermoregulatory responses culminating in an increase in core temperature. One of the physiological explanations for the impairment in cardiovascular and thermoregulatory responses due to dehydration is the reduction in skin blood flow and sweating rate which inevitably leads to a rise in core temperature. Earlier workers have also observed that sheep had higher respiratory rates and rectal temperatures due to water restriction (Al-Ramamneh *et al.,* 2012). Many other earlier workers have reported variations due to water restriction in rectal temperature, respiration and pulse rate in small ruminants (Singh *et al.*,1976; Kaushish *et al.*,1976; Purohit *et al.*,1972 and Rajkhowa and Hazarika, 2000).Researchers had carried out many tests to show the significance of physiological parameters. In an experiment, stress was assessed on the basis of measuring plasma cortisol concentrations along with recording changes in rectal temperature after exposure to the open field test in sheep (Villalba *et al*., 2012). Vihan and Sahni (1981) reported respiration rate as a most sensitive index than other parameters to assess physiological changes of animals.

During drinking period a decline was observed in the mean values of rectal temperature and pulse rate at ½ hour, when compared from respective mean values at day 5 of thirst period. The mean values of respiration rate at ½ hour were higher than those at day 5 of thirst period. However, the mean values of all the three parameters were still significantly ($P \leq 0.05$) higher than the respective control mean values. The mean values of all the three parameters at hour 72 of drinking period showed non-significant ($P > 0.05$) differences when compared to their respective control mean values. It indicated the restoration of normal values. The restoration of rectal temperature seemed to be a part of adaptive mechanism. The regulation of body temperature served as an efficient mechanism for water conservation (Schmidt-Nielsen *et al.*, 1957).

Findings of present study have important implications in stress free management of sheep. This gives an understanding regarding physiological responses during stress condition. Changes in rectal temperature, pulse rate and respiration rate indicated the adaptability of the animals to increased thirst periods. Dehydration provoked physiological mechanisms in the body in a manner that helped the animals to survive. Although dehydration was a stress to the animals the changes brought about by five days of dehydration were reversible.

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