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Original Research

Effect of Improved Shelter and Nutrition on Pulse Rate of Magra Lambs in Two Lambing Seasons Under Arid Zone

T. Bothra[1]*, A. K. Patel[2], Vijay Kumar[3], Dinesh Jain[4], H. K. Narula[5] and Umesh Kumar Prajapat[6]

[1]Assistant Professor, Livestock Production Management, College of Veterinary and Animal Science, Bikaner, Rajasthan, INDIA
[2]Principal Scientist, LPM, ICAR-CAZRI, Jodhpur, Rajasthan, INDIA
[3]Professor and Head, Livestock Production Management, College of Veterinary and Animal Science, Bikaner, Rajasthan, INDIA
[4]Assistant Professor, Animal Nutrition, College of Veterinary and Animal Science, Bikaner, Rajasthan, INDIA
[5]Principal Scientist and Head, Animal Breeding and Genetics, Central Sheep and Wool Research Institute, Bikaner, Rajasthan, INDIA
[6]Ph.D. Scholar, Animal Nutrition, College of Veterinary and Animal Science, Bikaner, Rajasthan, INDIA

*Corresponding Author: tarabothra76@gmail.com

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Abstract

An attempt was made to assess the effect of improved nutrition and improved shelter on pulse rate in lambs either alone or in combination. An experiment was conducted at ICAR-ARC-CSWRI, Bikaner in two phases. In each phase, forty male Magra lambs of 15 days old age were taken from ARC-CSWRI, Bikaner; ten lambs in each group were used in a randomized block design up to the six months of age, born during season 1 and season 2. Physiological variable viz, pulse rate of lambs was recorded twice a day (morning and afternoon) at fortnightly intervals. The obtained results about meteorological variables collected through datalogger indicated that there was wide variation in temperature and THI and because of this; there were fluctuations in pulse rate of lambs which varied with the changes in the environmental temperature. In treatment groups there were no fluctuations in pulse rate of lambs which indicate that lambs were comfortable. At the end, it appears that incorporation of both improved nutrition and improved shelter is better strategy for mitigation of thermal stress in animals.

Keywords: Improved Nutrition, Improved Shelter, Pulse Rate, Season

Introduction

Stress is the condition where there is interruption of the normal functioning of an individual due to aversive environmental stressors and cause deformations, which can be identified through physiological disequilibrium. Temperature stress causes physical and economical losses to livestock production in arid zone of Rajasthan. When environmental temperatures move out of the thermo-neutral zone, animal begin to experience heat stress. The productivity of animals is less due to availability of poor vegetation, high ambient temperature and wide variation in climatic conditions in the arid zone of Rajasthan. Climate is characterized by severe summer and intense winter where the maximum temperature goes beyond 48°C and minimum temperature can decrease below 3°C in these regions.The biological activity and productivity of an animal depends on its adaptability to the environment (Chauhan *et al.*, 2012). When animal is under environmental stress it causes different physiological and biochemical alteration in the body, which reduces the immunity and ultimately decreases overall production from animals (Broucek *et al.*, 2007). Animals respond to adverse environment conditions in different manner in order to maintain homeostasis. Extremes in the environmental conditions cause a great effect on physiology and productivity of farm animals (Singh and Upadhyay, 2009) Heat stress associated with high humidity negatively impacts on pulse rate of animal and consequently affecting animal production. Keeping the aforesaid facts in view,the present investigation was planned to study the effect of improved shelter and improved nutrition either alone or in combination on pulse rate of lambs, which is indicator of heat stress.

Materials and Methods

Phased experiment was conducted on Magra lambs at the sheep farm of Arid region campus of the Central Sheep and Research institute (ARC-CSWRI) Bikaner. In phase-I, fifteen days old Magra lambs (n=40) born in autumn-winter season were used for study. Four groups of 10 lambs (T_1-T_4) up to 6 months age were arranged by using randomized block design up to the six months of age during the period from September 2016 to Feb-March 2017 i.e. Autumn-Winter season (Season-1). In Phase-II, similar experiment was followed with the similar numbers of lambs born in spring-summer season (Season-II) during the period from early February 2017 to early August 2017. Groups included were T_1-Sole grazing with traditional shelter; T_2-improved shelter with grazing; T_3-improved nutrition and traditional shelter and T_4- improved nutrition and improved shelter. The traditional shelter means an enclosure without roof structure under tree shade. Improved shelter was in the form of asbestos sheet-thatched roof. Additional protection to lambs kept in improved shelter was provided with curtains in winter period to save the lambs from direct cold waves. The lambs of T_3 and T_4 was supplemented with creep mixture @1% of their body weight from 15 days of age to weaning while multi-nutrient mixture @1% of their body weight was provided from weaning upto six month of age in both seasons. Lambs were kept in their respective sheds with their dams upto weaning and thereafter they were separated from their dams and let loose for 8 hours grazing in all groups. The lambs of all groups were supplemented with *ad lib* groundnut haulms during the whole trial. All experimental lambs reared under standard management and proper hygienic conditions throughout the study period. Deworming was carried out for both ecto and endoparasites using suitable anthelmintics before the beginning of the experiment. A digital data logger was used to record air temperature and relative humidity inside and outside the shed. The data logger was hanged at 1.5 meter above the ground in the middle of inside and outside the shed. Climatic variables were observed from September 2016 to August 2017. THI values were calculated from recorded meteorological variables as per standard formula given (Marai *et al.*, 2007). Physiological variable *viz.* pulse rate of lambs was recorded twice a day (morning and afternoon) at fortnightly intervals. Pulse rate of the animals was recorded by observing the pulsation of femoral artery with the help of finger. The pulse rate was expressed per minute.

Statistical Analysis

The data obtained in the present experiment were analysed statistically for main effect of treatment or season alone as well as interaction (Treatment x Season) in factorial design (4x2) as per Snedecor and Cochran (2004) and significance of mean differences was tested by Duncan's New Multiple Range Test (DNMRT) as modified by Kramer (1956).

Results and Discussion

The monthly mean values of average temperature, relative humidity and temperature humidity index (THI) of different months of inside and outside shed of both seasons are presented under in Table 1.

Table 1: Monthly mean values of temperature, relative humidity and THI of season 1 and 2 (inside and outside shed)

Period (months)	Average Temperature (ºC)		Average Relative Humidity (%)		Average THI	
	In	Out	In	Out	In	Out
Season 1						
September	31.65	32.33	49.63	49.16	28.94	29.49
October	27.8	27.81	44.83	45.64	25.56	25.6
November	19.31	19.01	43.27	44.95	18.45	18.22
December	18.76	17.87	48.62	48.05	18.06	17.31
January	14.73	12.84	65.3	65.51	14.72	13.02
Feb.-Mar. (up to 5th march)	18.59	20.19	42.91	39.07	17.74	19.05
Season 2						
February (From 12th Feb.)	20.64	21.88	33.65	33.47	19.16	19.95
March	25.26	26.15	33.43	33.83	22.96	23.67
April	32.84	33.31	23.45	23.8	28.47	28.84
May	34.96	34.93	32.41	33.82	30.61	30.66
June	34.44	34.52	49.43	49.63	31.26	31.32
July-Aug (Up to 12th Aug.)	32.58	32.44	59.47	59.5	30.29	30.17

The monthly mean values of temperature, relative humidity and THI of daytime (7 a.m.-7 p.m.) and night time (7 p.m.-7 a.m.) during different months of inside and outside shed of both seasons presented in Table 2.

Table 2: Monthly mean values of temperature, relative humidity and THI of day and night of season 1 and 2 (inside and outside shed)

Period (months)	Temperature (ºC)				Relative humidity (%)				THI			
	Day		Night		Day		Night		Day		Night	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
Season 1												
September	35.06	37.01	28.22	27.67	40.9	37.86	58.38	60.44	31.24	32.58	26.42	26.02
October	30.72	31.32	24.81	24.23	37.88	37.82	51.84	53.55	27.54	28.01	23.23	22.78
November	20.44	21.04	18.18	16.97	41.5	41.39	45.06	48.52	19.34	19.82	17.53	16.55
December	23.17	24.96	14.3	10.73	37.65	33.72	59.85	62.64	21.39	22.65	14.3	11.13
January	17.95	17.24	11.48	8.39	58.26	54.83	72.45	76.32	17.44	16.78	11.71	8.82
Feb.-Mar.	20.92	24.35	16.27	16.04	37.95	31.66	47.83	46.44	19.65	22.2	15.95	15.77
Season 2												
February	23.17	25.38	18.11	18.39	27.87	25.9	39.43	41.04	21.09	22.63	17.22	17.27
March	29.06	31.52	21.52	20.84	26.17	24.62	40.65	42.98	25.68	27.47	20.19	19.68
April	37.14	38.9	28.54	27.71	18.18	17.22	28.79	30.44	31.35	32.59	25.4	24.81
May	38.9	39.14	30.97	30.68	25.61	27.24	39.44	40.6	33.23	33.55	27.84	27.66
June	37.28	37.84	31.6	31.2	41.98	41.5	56.91	57.8	33.14	33.56	29.29	28.99
July-Aug	34.54	34.87	30.61	30	52.56	52.17	66.39	66.83	31.56	31.82	28.91	28.39

The mean values of pulse rate (morning and afternoon) of lambs under different treatment groups at fortnightly intervals of experiment presented in Table 3 a & b. The statistical analysis of variance due to main effect of treatment revealed highly significant ($P<0.01$) effect on mean pulse rate for both morning and afternoon period during all fortnights. Likewise, statistical analysis of variance due to main effect of season revealed highly significant ($P<0.01$) effect in both morning and afternoon period at 1st, 2nd, 5th, 6th, 11th and 12th fortnights, whereas, it was observed only in morning hours at 3rd and 7th fortnights but remained non-significant during rest fortnights. Interaction (Treatment x Season) effect revealed highly significant ($P<0.01$) effect for mean pulse rate of both morning and afternoon period from 1st to 3rd, 5th, 6th, 10th, 11th and 12th fortnights of trial, while, it was also observed in morning period of 4th fortnight and afternoon period of 7th to 9th fortnight. Whereas, significant ($P<0.05$) effect was observed in morning period of 7th and 9th fortnights but remained non-significant in afternoon period of 4th fortnight and morning period of 8th fortnight.

Table 3 (a): Effect of different treatment groups on pulse rate (per minute) at fortnight intervals in two lambing seasons

Treatment groups		Period (Fortnights) 1 M.	1 A.	2 M.	2 A.	3 M.	3 A.	4 M.	4 A.	5 M.	5 A.	6 M.	6 A.
Interaction (Treatment X Season)													
Treatment	**Season**												
T_1	**1**	86.56^{b} ±1.29	102.11^{d} ±2.63	80.78^{c} ±2.15	101.8^{c} ±1.74	79.44^{b} ±2.17	87.33^{d} ±1	77.44^{c} ±1.19	81.78± 0.91	67.89^{b} ±2.24	73.33^{a} ±1.46	62.56^{ab} ±0.58	74.33^{a} ±1.22
T_2	**1**	65.10^{a} ±0.82	91.50^{c} ±0.43	63.90^{b} ±0.72	90.40^{b} ±1.16	64.00^{a} ±1.04	76.30^{c} ±1.47	62.20^{a} ±1.1	74.20± 0.96	63.80^{a} ±1.13	73.00^{a} ±0.8	60.80^{a} ±0.73	74.00^{a} ±0.84
T_3	**1**	64.80^{a} ±1.05	89.70^{c} ±1.33	63.00^{ab} ±0.7	89.20^{b} ±1.12	63.50^{a} ±0.89	75.10^{bc} ±1	61.10^{a} ±1.27	73.6±0. 67	60.70^{a} ±0.65	72.60^{a} ±0.43	60.90^{a} ±0.74	72.00^{a} ±0.77
T_4	**1**	64.20^{a} ±1.04	88.60^{c} ±0.79	63.90^{b} ±0.72	87.30^{b} ±1.18	62.60^{a} ±1.01	73.50^{ab} ±0.69	61.40^{a} ±0.56	71.8±0. 42	60.40^{a} ±0.5	71.50^{a} ±1.07	60.40^{a} ±0.45	71.80^{a} ±0.49
T_1	**2**	65.30^{a} ±1.71	81.70^{b} ±1.28	63.40^{ab} ±0.87	79.40^{a} ±2.28	65.40^{a} ±1.18	92.10^{e} ±1.02	67.50^{b} ±1.34	87.9±1. 22	77.20^{c} ±1.85	101.3^{d} ±1.56	74.30^{c}± 0.86	97.60^{d} ±2.09
T_2	**2**	64.90^{a} ±1.49	79.70^{ab} ±1.33	62.20^{ab} ±0.85	77.40^{a} ±1.91	64.10^{a} ±1.66	72.40^{ab} ±0.76	64.80^{ab} ±1.5	75.70± 0.63	62.70^{a} ±1.13	86.50^{c} ±0.79	63.80^{b} ±1.43	86.90^{c} ±1.13
T_3	**2**	64.10^{a} ±1.53	78.30^{ab} ±1.16	61.80^{ab} ±0.98	75.60^{a} ±1.42	63.10^{a} ±1.16	72.00^{a} ±0.42	64.60^{ab} ±1.75	74.6±1. 03	61.90^{a} ±0.31	82.10^{b} ±1.22	62.00^{ab} ±1.02	84.10^{bc} ±0.86
T_4	**2**	62.30^{a} ±0.67	76.40^{a} ±1.16	60.40^{a} ±0.91	78.10^{a} ±1.22	62.60^{a} ±1.01	72.00^{a} ±0.82	62.90^{a} ±0.77	73.8±0. 95	61.30^{a} ±0.45	80.80^{b} ±0.57	61.70^{ab} ±0.62	81.10^{b} ±0.66
Main effect of Treatment													
T_1		75.37^{b} ±2.72	91.37^{c} ±2.77	71.63^{b} ±2.31	90.05^{b} ±3	72.05^{b} ±2.02	89.84^{b} ±0.89	72.21^{b} ±1.46	85.00^{c} ±1.04	72.79^{b} ±1.78	88.05^{c} ±3.45	68.74^{b} ±1.47	86.58^{c} ±2.99
T_2		65.00^{a} ±0.83	85.60^{b} ±1.51	63.05^{a} ±0.58	83.90^{a} ±1.85	64.05^{a} ±0.95	74.35^{a} ±0.92	63.50^{a} ±0.95	74.95^{b} ±0.59	63.25^{a} ±0.79	79.75^{b} ±1.64	62.30^{a} ±0.85	80.45^{b} ±1.63
T_3		64.45^{a} ±0.91	84.00^{ab} ±1.57	62.40^{a} ±0.6	82.40^{a} ±1.79	63.30^{a} ±0.71	73.55^{a} ±0.64	62.85^{a} ±1.13	74.10^{ab} ±0.61	61.30^{a} ±0.38	77.35^{a} ±1.26	61.45^{a} ±0.63	78.05^{a} ±1.5
T_4		63.25^{a} ±0.64	82.50^{a} ±1.56	62.15^{a} ±0.69	82.70^{a} ±1.34	62.60^{a} ±0.7	72.75^{a} ±0.55	62.15^{a} ±0.49	72.80^{a} ±0.56	60.85^{a} ±0.34	76.15^{a} ±1.22	61.05^{a} ±0.4	76.45^{a} ± 1.14
Main effect of Season													
Season 1 (S1)		69.74^{b} ±1.58	92.74^{b} ±1.1	67.56^{b} ±1.3	91.95^{b} ±1.1	67.08^{b} ±1.27	77.82± 1.01	65.23± 1.2	75.18^{a}± 0.71	63.08± 0.77a	72.59^{a} ±0.49	61.13^{a} ±0.33	73.00^{a} ±0.45
Season 2 (S2)		64.15^{a} ±0.7	79.03^{a} ±0.67	61.95^{a} ±0.47	77.63^{a} ±0.87	63.8^{a} ±0.64	77.13± 1.43	64.95± 0.72	78.00^{b} ±1.04	65.78± 1.19b	87.68^{b} ±1.41	65.45^{b} ±0.96	87.43^{b} ±1.18

Means with different superscripts in a column differ significantly; M-Morning A-Afternoon

Results of present findings showed that the calculated temperature humidity index (THI) for both seasons was observed to be in wide variation, which were either higher or lower than recommended values *i.e.* <22.2 is absence of heat stress, 22.2 to < 23.3 is moderate heat stress, 23.3 to< 25.6 is severe heat stress and 25.6 and more is extreme severe heat stress as reported for sheep by Marai *et al.* (2007). Looking into the results of meteorological variables of day-night it is indicated that there was diurnal variation in temperature and THI, when animals were exposed to severe climatic stress in almost all daytime hours in extreme summer and in almost all night time hours during extreme winter. Wide variation in temperature and THI as evident from present findings indicated that lambs were under stress during various months of both seasons of study period. The obtained results indicated that there were fluctuations in pulse rate which varied with the changes in the environmental temperature. The observed results of fluctuations in physiological responses of lambs are in line with findings of Singh *et al.* (2001) and (Singh and Upadhyay 2009). These changes are however, necessary for adaptability and survivability of lambs, which is in accordance with (Chirstopherson and Kennedy 1983) who stated that changes in the thermal environment caused by variation in temperature, wind, humidity, precipitation and radiation induce a variety of physiological responses in animals. Present study showed that there was seasonal variation in pulse rate, which could be explained because of basal metabolic rate (Blaxter and Boyne 1982) and the amount of feed intake per day (Kay, 1979).

Table 3 (b): Effect of different treatment groups on pulse rate (per minute) at fortnight intervals in two lambing seasons

Treatment groups		Period (Fortnights) 7		8		9		10		11		12	
		M.	A.	M.	A.	M.	A.	M.	A.	M.	A.	M.	A.
Interaction (Treatment X Season)													
Treat ment	**Season**												
T$_1$	**1**	81.22^{d} ±0.55	90.62^{d} ±0.88	81.33 ± 1.62	84.78^{e} ±1.22	80.22^{c} ±1.24	91.33^{c} ±2.04	75.44^{b} ±0.71	95.56^{d} ±3.12	60.78^{a} ±1.35	76.33^{b} ±0.85	65.11^{c} ±1.81	73.00^{a} ±0.55
T$_2$	**1**	66.00^{b} ±0.73	81.00^{bc} ±0.97	65.60 ± 1.57	80.80^{d} ±1.11	65.20^{b} ±0.79	81.60^{b} ±1.19	64.40^{a} ±0.87	78.60^{bc} ±1.12	60.30^{a} ±0.37	73.30^{ab} ±0.72	61.40^{ab} ±0.73	69.10^{a} ±1.78
T$_3$	**1**	62.40^{a} ±1.21	82.00^{c} ±1	61.90 ± 0.89	79.10^{cd} ±1.46	63.80^{ab} ±0.88	82.40^{b} ±0.85	63.20^{a} ±0.96	82.10^{c} ±0.74	60.50^{a} ±0.64	71.70^{a} ±0.9	61.70^{ab} ±0.73	72.10^{a} ±0.38
T$_4$	**1**	61.90^{a} ±0.72	78.20^{ab} ±1.09	60.20 ± 0.87	78.00^{bcd}± 0.87	62.80^{ab} ±1.14	75.90^{a} ±0.74	62.40^{a} ±0.88	76.90^{ab} ±0.81	60.30^{a} ±0.72	72.90^{a} ±0.57	60.10^{a} ±0.8	72.70^{a} ±0.47
T$_1$	**2**	78.20^{c} ±1.48	99.10^{e} ±2.03	80.00 ± 1.22	102.60^{f} ±1.28	83.80^{d} ±1.67	104.90^{d} ±0.72	84.40^{c} ±0.96	97.80^{e} ±1.07	83.90^{c} ±0.96	102.30^{e} ±1.66	75.60^{d} ±0.86	103.30^{d} ±0.65
T$_2$	**2**	60.30^{a} ±1.11	81.80^{c} ±0.66	61.10 ± 1.22	76.90^{abc}± 1.25	63.60^{ab} ±0.62	82.50^{b} ±1.61	62.30^{a} ±1.27	78.40^{bc} ±0.76	64.90^{b} ±0.81	88.10^{d} ±1.55	63.40^{bc} ±0.95	86.70^{c} ±1.59
T$_3$	**2**	60.10^{a} ±1.22	76.50^{a} ±1.16	60.20 ± 1.11	75.10^{ab} ±1.27	61.50^{a} ±0.85	76.10^{a} ±0.86	61.30^{a} ±1.81	76.40^{ab} ±1.13	61.50^{a} ±0.58	82.80^{c} ±1.37	60.40^{ab} ±1.41	84.90^{c} ±1.98
T$_4$	**2**	60.00^{a} ±0.49	75.50^{a} ±0.83	60.00 ± 0.93	74.10^{a} ±0.85	60.60^{a} ±0.67	72.90^{a} ±0.69	60.90^{a} ±0.6	73.00^{a} ±0.37	60.50^{a} ±0.62	81.10^{c} ±0.9	59.80^{a} ±0.65	80.60^{b} ±1.27
Main Effect of Treatment													
T$_1$		79.63^{c} ±0.88	95.09^{c} ±1.5	80.63^{c} ±0.99	94.16^{c} ±2.27	82.11^{c} ±1.11	98.47^{d} ±1.89	80.16^{b} ±1.21	96.74^{c} ±1.56	72.95^{c} ±2.83	90.00^{c} ±3.20	70.63^{c} ±1.55	88.94^{b} ±3.59
T$_2$		63.15^{b} ±0.92	81.40^{b} ±0.58	63.35^{b} ±1.1	78.85^{b} ±0.93	64.40^{b} ±0.52	82.05^{c} ±0.98	63.35^{a} ±0.79	78.50^{b} ±0.66	62.60^{b} ±0.68	80.70^{b} ±1.89	62.40^{b} ±0.63	77.90^{a} ±2.33
T$_3$		61.25^{ab} ±0.88	79.25^{b} ±0.98	61.05^{ab} ±0.72	77.10^{ab} ±1.05	62.65^{ab} ±0.65	79.25^{b} ±0.93	62.25^{a} ±1.02	79.25^{b} ± 0.96	61.00^{a} ±0.44	77.25^{a} ±1.50	61.05^{ab} ±0.79	78.50^{a} ±1.77
T$_4$		60.95^{a} ±0.48	76.85^{a} ±0.74	60.10^{a} ±0.62	76.05^{a}± 0.73	61.70^{a} ±0.69	74.40^{a} ±0.6	61.65^{a} ±0.55	74.95^{a} ±0.63	60.40^{a} ±0.46	77.00^{a} ±1.07	59.95^{a} ±0.5	76.65^{a} ±1.12
Main Effect of Season													
Season 1 (S1)		67.54^{b} ±1.31	82.76± 0.88	66.90 ±1.46	80.56±0.7	67.69±1 .22	82.59± 1.07	66.13 ±0.93	82.97± 1.4	60.46^{a} ±0.39	73.49^{a} ±0.46	62.00^{a} ±0.59	71.69^{a} ±0.54
Season 2 (S2)		64.65^{a} ±1.37	83.23± 1.64	65.33 ±1.46	82.18±1.9 8	67.38±1 .61	84.10± 2.06	67.23 ±1.7	81.4±1. 6	67.70^{b} ±1.56	88.58^{b} ±1.49	64.80^{b} ±1.13	88.88^{b} ±1.55

Means with different superscripts in a column differ significantly; M-Morning A-Afternoon

Recorded higher pulse rate in afternoon hours than morning hours are well supported by findings of Lowe *et al.* (2001), Barkai *et al.* (2002) and Sejian *et al.* (2014) who also recorded a clear diurnal pattern in pulse rate in sheep with the highest value during the middle of the day. Changes in physiological responses in cold stress found in present study are in agreement with Maurya *et al.* (2013) who concluded that the changes in physiological responses in cold stress is due to the reason that the homoeothermic animals react to cold stress by enhancing the thermoregulatory mechanism. With respect to main effect of treatment or season alone and interaction, there was observed significant changes in pulse rate in treatment groups in comparison to control group, which shows that animal need stress alleviation. Better thermoregulation in treatment groups may be explained due to inclusion of improved shelter and improved nutrition in adverse climatic condition, which is in accordance with De *et al.* (2017) who stated that better microenvironment keeps the lambs in better comfortable condition that lead to significant positive effect on physiological responses in animals. Further, the results are also supported with Hooda and Naqvi (1990) who reported that physiological responses were found lower in sheep, which were under shade or supplemented with nutrition in comparison to those, which were under solar exposure.

Conclusion

It can be concluded that environmental challenges were found to cause negative effects in lambs by fluctuations the pulse rate. It can be reduced by supplementation of creep mixture and multinutrients @1% BW and providing improved shelter.

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Conflict of Interests

There is no conflict of interest.

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References

1. Barkai, D., Landau, S., Brosh, A., Baram, H. and Molle, G. (2002). Estimation of energy intake from heart rate and energy expenditure in sheep under confinement or grazing condition. *Livestock Production Science,* 73: 237-246.
2. Blaxter, K. L. and Boyne, A. W. (1982). Fasting and maintenance metabolism of sheep. *The Journal of Agricultural Science*, 99(3): 611-620.
3. Broucek, J. Ryba, S., Mihina, S., Uhrincat, M. and Kisac, P. (2007). Impact of thermal-humidity index on milk yield under conditions of different dairy management. *Journal of Animal Feed Science*, 58: 329-345.
4. Chauhan, H. D., Patel, H. A. and Priyadarshi, B. H. (2012). Feeding and resting behaviour of lactating Kankrej cows under different housing systems. *Ruminant Science*, 1(2): 173-176.
5. Christopherson, R. J. and Kennedy, P. M. (1983). Effect of thermal environment on digestion in ruminants. *Canadian Journal of Animal Science*, 63: 447-55.
6. De, K., Kumar, D., Singh, A. K., Kumar, K., Sahoo, A., and Naqvi, S. M. K. (2017). Effect of protection against hot climate on growth performance, physiological response and endocrine profile of growing lambs under semi-arid tropical environment. *Tropical Animal Health and Production*, 49(6): 1317-1323.
7. Hooda, O. K. and Naqvi, S. M. K. (1990). Effect of thermal load and feed restriction on the relative adaptability of Malpura and Avikalin sheep in semi-arid region. *Indian Journal of Animal Science*, 60: 608-611.
8. Kay, R. N. B. (1979). Seasonal changes of appetite in deer and sheep. *ARC Research Review*, 5: 13-15.
9. Kramer, C. Y. (1956). Extension of multiple range tests to group means with unequal numbers of replications. *Biometrics*, 12(3): 307-310.
10. Lowe, T. E., Cook, C. J., Ingram, J. K. and Harris, P. J. (2001). Impact of climate on thermal rhythm in pastoral sheep. *Physiology and Behaviour*, 74(4-5): 659-664.
11. Marai, I. F. M., El-Darawany, A. A., Fadiel, A. and Abdel-Hafez, M. A. M. (2007). Physiological traits as affected by heat stress in sheep. *Small Ruminant Research*, 71: 1-12.
12. Maurya, V. P., Sejian, V. and Naqvi, S. M. K. (2013). Effect of cold stress on growth, physiological responses, blood metabolites and hormonal profile of native Malpura lambs under hot semi-arid tropics of India. *Indian Journal of Animal Science*, 83(4): 370-373.
13. Sejian, V., Singh, A. K., Sahoo, A. and Naqvi, S. M. K. (2014). Effect of mineral mixture and antioxidant supplementation on growth, reproductive performance and adaptive capability of Malpura ewes subjected to heat stress. *Journal of Animal Physiology and Animal Nutrition*, 98(1): 72-83.
14. Singh, P., Dixit, V. P., Singh, B. and Georgie, G. C. (2001). Plasma aldosterone and major circulatory and urinary electrolytes in buffalo calves as affected by peak summer and winter stress. *International Journal of Animal Science*, 16: 161-166.
15. Singh, S. V. and Upadhyay, R. C. (2009). Thermal stress on physiological function, thermal balance and milk production in Karan Fries and Sahiwal cows. *Indian Veterinary Journal*, 86: 141-144.
16. Snedecor, G.W. and Cochran, W.G. (2004). Statistical methods. 8th Edn., Oxford and IBH publishing company, Kolkata.

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