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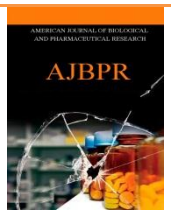

HEAT LOAD INDEX *VIS-À-VIS* CHANGES IN LIVER FUNCTIONS OF *NALI* SHEEP FROM ARID TRACTS OF RAJASTHAN

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ABSTRACT

Heat load index (HLI) *vis-à-vis* changes in liver functions of *Nali* sheep from arid tracts of Rajasthan were evaluated. Apparently healthy male and female *Nali* sheep of different age groups from unorganized sector (Churu and Sri Ganganagar districts, Rajasthan) were assessed. Obtaining of blood samples was carried out during environmental periods (EPs) of the year encompassing intervening EP (October-November); dry-hot EP(April, May and June); humid-hot EP (July, August and September) and cold EP (December and January). The range of average HLI values acquired during intervening or congenial period was 61.00-83.00. Dry-hot and humid-hot periods divulged greater values of HLI. Liver functions were assessed on the basis of serum OCT and serum GGT enzymes. The mean values of both the serum enzymes were observed to be significantly ($p \leq 0.05$) greater during dry-hot, humid-hot and cold EPs as compared to intervening or control mean value. Both the enzymes exhibited maximum activities during humid-hot EP and the maximum per cent change in the mean value of serum OCT was found to be +154.52, whereas maximum per cent change in the mean value of GGT was instituted to be +64.00, as compared to equivalent intervening EP values. Outcome has shown bang of humid-hot EP and alteration of liver functions greatly. This enlightened a change in functions of liver owing to HLI. It is important that pattern of change in liver functions coincided that of HLI. It can be concluded that abiotic stressors can impinge stimulation of liver activity. It is worth mentioning that *Nali* sheep of all physiological states were affected.

INTRODUCTION

The thermal ambience has a stalwart impact on native breeds with environmental temperature coupled with humidity being the pinnacle of adverse stimuli. Environmental periods are known to have in general a husky dangle on production of animals along with managemental and reproductive aspects. Focused combination of physiological parameters in serum is of solemn involvement for assessment of organ triumphs. Physiological-ecology is the scrutiny of the squat and long-term changes in behavior and physiology of animals making organizations to keep lively for reproduction profitably in their ever changing ambiences. Explorations concerning native breeds of animals can ease in comprehending the explicit physical condition of the animals [1]. To appreciate the disquiet of animals to their

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physical atmosphere is the main point of investigations in the dome of physiological-ecology. Many arid-tract animals have to fumble when ambient periods are extremely hot. They have to encounter water and energy equanimity. The pursuance of high environmental temperatures can fine-tune the behavior of animals. Stress produces misery and distress. Stress is principally associated to their ambience. An understanding of stress is vital, hence, use of liver functions becomes an authoritative contrivance which can help in exposing very low level of fracas in animals along with other facets of stress and responses [2-4].

In view of above outlook, it can be instituted that heat load index should be measured in native breeds for launching future management gambits.

Serum ornithine carbamoyl transferase (OCT) and gamma-glutamayl transferase (GGT) are important enzymes of liver functions. Serum OCT is an imperative enzyme of urea cycle [1]. Looking towards the dearth of work on this aspect in *Nali* breed of sheep from Rajasthan, the present investigation was designed for the assessment of heat load index *vis-à-vis* changes in liver functions of *Nali* sheep from arid tracts of Rajasthan.

Materials and methods

For the assessment of heat load index *vis-à-vis* changes in liver functions of *Nali* sheep from arid tracts of Rajasthan, 1280 apparently healthy male and female *Nali* sheep of different age groups were explored. Animals belonged to unorganized sector in and around Churu and Sri Ganganagar districts, Rajasthan. Blood sample collection was carried out during the course of slaughtering from the *Nali* sheep with the permission of Institutional Animal Ethics Committee (IAEC), College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan. Blood was collected to harvest serum during various environmental periods (EPs) of the year incorporating intervening EP (October-November); dry-hot EP(April, May and June); humid-hot EP (July, August and September) and cold EP (December and January). In each environmental period (EP), *Nali* sheep were grouped as male (160) and female(160). Age wise, animals were classified as 3-7 months (40 male and 40 female); 7-11months (40 male and 40 female); 11-15 months (40 male and 40 female) and 15-19 months (40 male and 40 female) in each EP.

Environmental elements to calculate heat load index [5] were obtained from areas of Churu and Sri Ganganagar districts, Rajasthan. Liver functions were assessed by determining serum ornithine carbamoyl transferase (OCT) and gamma-glutamyl transferase (GGT) enzymes. Serum ornithine carbamoyl transferase was measured by colorimetric method [6] and gamma-glutamyl transferase (GGT) was measured by spectrophotometric method [7]. Primary analytes of present exploration involved heat load index and liver function enzymes. Setting up of the main impacts were as overall values of environmental period, overall mean values of male sheep and overall mean values of female sheep. Age wise categorization was also there. For each analyte, collection of values was made from *Nali* sheep during different environmental periods i.e. intervening, dry-hot, humid-hot and cold. Further classification included males, females and age groups (3-7 months, 7-11 months, 11-15 months and 15-19 months). Data were depicted in the tables as mean ± SE of mean and significance of the effects was measures [8].

RESULTS AND DISCUSSION

For the assessment of heat load index *vis-à-vis* changes in liver functions of *Nali* sheep from arid tracts of Rajasthan, computation of HLI values was conducted along with measurement of serum OCT and serum GGT.

Heat load index (HLI)

Heat load index (THI) values acquired at maximum environmental temperature were 76.95± 0.46, 81.33 ± 0.50, 92.78 ± 0.67 and 52.38 ± 0.58, respectively at the time of intervening, dry-hot, humid-hot and cold EPs from Churu and Sri Ganganagar districts of Rajasthan.

Heat load index (THI) values were acquired by computing fundamental environmental elements from Churu and Sri Ganganagar districts of Rajasthan. The basics of heat load index (HLI) were minimum, maximum and average. The values among various EPs mottled significantly ($p \leq 0.05$). Humid-hot EP exhibited maximum values of HLI as compared to corresponding values during intervening, dry-hot and cold EPs.

The heat load index (HLI) can be employed as a tool to appraise the environmental heat load which is transferred to sheep. The working out of HLI needs black globe temperature which exhibits radiation influences in addition to air temperature. Therefore, HLI is considered as a marker of physiological stress to the animals [1]. Scientists [9] understand that revelation of animals to tremendously high environmental temperatures and lofty relative humidity for protracted periods can reduce the ability to disperse heat. Hence, gratuitous heat load can give rise to significant reduction in production thereby affecting animal wellbeing. Towering heat loads are generated when animal's heat production and higher environmental temperature combine together considerably influencing decadence of heat from animal. During dry-hot EP, the mean value of maximum HLI substantiated the earlier observations from the Bikaner region, Rajasthan [10].

Serum ornithine carbamoyl transferase (OCT)

Mean± SEM values of serum OCT of male and female *Nali* sheep of different age groups are presented in table 1.

Significantly ($p \leq 0.05$) higher overall mean value of serum OCT was acquired during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. Utmost level of serum OCT was discerned during humid-hot EP. The per cent variation in the value of serum OCT was monitored to be maximum (+154.52) during humid-hot. Female sheep divulged significantly ($p \leq 0.05$) higher value in each EP than the corresponding overall mean value of male sheep. Highest mean value was found in humid-hot EP in male and female categories. Comparatively, least value was observed in 3-7 months age group of *Nali* sheep and greatest value was observed in 15-19 months age group of sheep in each gender, in each EP. The age wise alterations, irrespective of gender, revealed an enhancing archetype of the mean values which were observed to be least in 3-7 months age group and greatest in 15-19 months age group.

In a study, sheep were examined by Healy (11) to measure serum OCT activity. In an exploration, brunt of alterations in ambient temperatures with sex and age on serum OCT values in goat was evaluated by Kour [12] and the mean value of OCT was observed to be increased during hot . Results of present study corroborated the earlier work (1,12). Observations regarding effect of physiological states also substantiated the earlier research [1,12,13].

Serum gamma-glutamyl transferase (GGT)

Table 2 represents mean± SEM values of serum GGT of male and female *Nali* sheep of different age groups. Significantly ($p \leq 0.05$) higher overall mean value of serum GGT was obtained during dry-hot, humid-hot and cold as compared to intervening EP mean overall value. Utmost activity of serum GGT was found during humid-hot EP. The per cent change in the value of serum GGT was observed to be maximum (+64.00) during humid-hot. Female sheep divulged significantly ($p \leq 0.05$) higher overall mean value of than the relevant overall mean value of male sheep. In male and female class, in each category, the greatest mean value was found in humid-hot EP. In each gender and in each EP, the least value was found in 3-7 months age group and greatest value was observed in 15-19 months age group. Age wise changes irrespective of gender revealed a rising pattern of the mean values which were observed to be least in 3-7 months age group and greatest in 15-19 months age group.

Higher values in present study can be attributed to stress [14]. Alterations owing to summer and winter months were observed in the activity of γ- glutamyl transferase in sheep by earlier workers [15]. Results corroborated the earlier findings [1]. Several workers associated higher GGT activity with the oxidative stress in animals [1,16].

It can be avowed that *Nali* sheep native to arid tracts of Rajasthan living under native husbandry conditions are importunate quarry of harsh environment resulting in vast economical losses to deprived sheep raisers. The environmental force during humid-hot tended to modulate the liver functions maximally as observed by the changes in serum OCT and GGT. The data collected through this study will assist in generating reference data for forthcoming research in the arena of Veterinary Clinical Physiology granting diagnostic matter-of-factness for this native breed of sheep.

Table 1: Mean ± SEM values of serum ornithine carbamoyl transferase (OCT, UL^{-1}) in the *Nali* sheep during varying environmental periods (EPs)

S. No.	Effects	Mean ± SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	41.03^{b} ±0.40	84.34^{b} ±0.43	104.43^{b} ±0.45	52.49^{b} ±0.41
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c& d				
	Overall mean values of males (160)	35.28^{bc}±0.10	71.94^{bd}±0.11	84.40^{bd}±0.12	45.32^{bd}±0.10
a.	3-7 months (40)	30.88^{bd}±0.05	60.41^{bd}±0.06	71.31^{bd}±0.06	40.21^{bd}±0.06
b.	7-11 months (40)	33.91^{bd}±0.04	66.15^{bd}±0.05	79.20^{bd}±0.05	44.10^{bd}±0.06
c.	11-15months (40)	36.21^{bd}±0.05	78.13^{bd}±0.04	$88.+98^{bd}$±0.05	47.00^{bd}±0.05
d.	15-19 months (40)	40.22^{bd}±0.04	83.07^{bd}±0.05	98.11^{bd}±0.05	49.98^{bd}±0.05
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females (160)	46.78^{bc}±0.10	96.75^{bc}±0.10	124.46^{bc}±0.12	60.69^{bc}±0.10
a.	3-7 months (40)	42.90^{bd}±0.05	89.17^{bd}±0.06	110.21^{bd}±0.06	58.18^{bd}±0.06

b.	7-11 months (40)	45.22^{bd}±0.04	93.11^{bd}±0.05	119.31^{bd}±0.05	59.18^{bd}±0.06
c.	11-15months (40)	47.88^{bd}±0.05	99.13^{bd}±0.04	128.11^{bd}±0.05	61.12^{bd}±0.05
d.	15-19 months (40)	51.13^{bd}±0.04	106.14^{bd}±0.05	140.21^{bd}±0.05	64.30^{bd}±0.05
3.	Categorization according to age as a, b, c & d irrespective of gender				
a.	3-7 months (80)	36.90^{bd}±0.05	74.17^{bd}±0.06	90.21^{bd}±0.06	49.18^{bd}±0.06
b.	7-11 months (80)	39.91^{bd}±0.04	79.15^{bd}±0.05	99.20^{bd}±0.05	52.10^{bd}±0.06
c.	11-15months (80)	42.88^{bd}±0.05	89.13^{bd}±0.04	108.11^{bd}±0.05	54.12^{bd}±0.05
d.	15-19 months (80)	46.22^{bd}±0.04	94.60^{bd}±0.05	119.11^{bd}±0.05	57.98^{bd}±0.05

Figures in the parenthesis = Number of *Nali* sheep
EP = Environmental period
'b' = Significant ($p \leq 0.05$) differences among mean values for a row.
'c' = Significant ($p \leq 0.05$) differences between overall mean values of males and females for an EP
'd' = Significant ($p \leq 0.05$) differences among mean values of different gender specific age groups for an EP
'e'= Significant ($p \leq 0.05$) differences among mean values of different age groups for an EP irrespective of gender

Table 2: Mean ± SEM values of serum gamma-glutamyl transferase (GGT, UL^{-1}) in the *Nali* sheep during varying environmental periods (EPs)

S. No.	Effects	Mean ± SEM values during environmental periods			
		Intervening	Dry-hot	Humid-hot	Cold
1.	Environmental period Overall values (320)	63.28^{b} ±0.63	87.90^{b} ±0.95	103.78^{b} ±1.27	74.74^{b} ±0.81
2.	Categorization as male and female (I & II categories)				
I.	Male (160), categorization according to gender specific age groups as a, b, c& d				
	Overall mean values of males (160)	54.41^{bc}±0.69	73.91^{bd}±0.68	84.16^{bd}±0.70	63.15^{bd}±0.71
a.	3-7 months (40)	47.39^{bd}±0.71	62.40^{bd}±0.69	70.38^{bd}±0.67	52.37^{bd}±0.70
b.	7-11 months (40)	52.41^{bd}±0.70	70.39^{bd}±0.67	78.40^{bd}±0.69	58.38^{bd}±0.71
c.	11-15months (40)	56.42^{bd}±0.69	77.41^{bd}±0.71	89.39^{bd}±0.70	67.37^{bd}±0.69
d.	15-19 months (40)	61.42^{bd}±0.68	85.40^{bd}±0.71	98.39^{bd}±0.69	74.41^{bd}±0.70
II.	Female (160), categorization according to gender specific age groups as a, b, c & d				
	Overall mean values of females(160)	72.40^{bc}±0.68	101.90^{bc}±0.70	123.39^{bc}±0.71	86.89^{bc}±0.69
a.	3-7 months (40)	65.41^{bd}±0.71	90.39bd±0.70	108.40bd±0.68	78.38^{bd}±0.69
b.	7-11 months (40)	70.40^{bd}±0.70	97.41bd±0.69	119.38bd±0.67	83.37^{bd}±0.71
c.	11-15months (40)	75.41^{bd}±0.70	104.39bd±0.68	128.37bd±0.71	88.40^{bd}±0.69
d.	15-19 months (40)	78.40^{bd}±0.69	115.39±0.71	137.38bd±0.67	95.41^{bd}±0.70
3.	Categorization according to age as a, b, c & d irrespective of gender				
a.	3-7 months (80)	56.37^{be}±1.12	76.41^{be}±1.65	89.39^{be}±2.19	65.40^{be}±1.54
b.	7-11 months (80)	60.90^{be}±1.77	83.91^{be}±1.59	98.87^{be}±2.35	70.88^{be}±1.49
c.	11-15months (80)	65.91^{be}±1.17	90.90^{be}±1.59	108.88^{be}±2.24	77.89^{be}±1.28
d.	15-19 months (80)	69.90^{be}±1.07	100.40^{be}±1.75	117.87^{be}±2.24	84.88^{be}±1.28

Figures in the parenthesis = Number of *Nali* sheep
EP = Environmental period
'b' = Significant ($p \leq 0.05$) differences among mean values for a row.
'c' = Significant ($p \leq 0.05$) differences between overall mean values of males and females for an EP
'd' = Significant ($p \leq 0.05$) differences among mean values of different gender specific age groups for an EP
'e'= Significant ($p \leq 0.05$) differences among mean values of different age groups for an EP irrespective of gender.

CONCLUSION

Conclusion can be drawn that dry-hot, humid-hot and cold environmental periods influenced *Nali* sheep from Churu and Sri Ganganagar districts of Rajasthan including male, female, 3-7 months ,7-11 months, 11-15 months and 15-19 months old age groups. The force of dry-hot and humid-hot environmental periods was greater as reflected by HLI values and the maximum intonation in serum

enzymes was also observed during humid-hot indicating liver stimulation. In the present study, influence was observed to be greater on female *Nali* sheep and 15-19 months old group. The data obtained through this exploration will assist in producing reference data for future research in the field of Veterinary Clinical Physiology.

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