



MODULATIONS IN SERUM PEPSINOGEN ACTIVITY OF RATHI FEMALE CALVES, HEIFERS AND COWS FROM ARID TRACTS DURING VARIOUS AMBIENCES

Ashish Joshi¹ and Nalini Kataria^{2*}

Ph.D. scholar, Department of Veterinary Physiology, College of Veterinary and Animal Science, Bikaner, Rajasthan, India.
Professor & Head, Department of Veterinary Physiology, College of Veterinary and Animal Science, Bikaner, Rajasthan, India.

Corresponding Author

Article Info

Nalini Kataria

Email:- nalinikataria@rediffmail.com

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ABSTRACT

An investigation was carried out to assess physiological strategies in *Rathi* female calves, heifers and cows from arid tracts implying modulations in serum pepsinogen activity during various ambiances. The whole experiment was divided into moderate, extreme hot, rainy and extreme cold ambiances in the arid tract. Blood samples were collected from *Rathi* cattle belonging to Bikaner district, Rajasthan, India. The cattle were divided into calves, heifers and cows. The overall mean value of serum pepsinogen during moderate ambience was 150.00 ± 2.10 mU tyrosine, which was obtained from 300 *Rathi* cattle incorporating calves, heifers and cows. The overall mean values of serum pepsinogen were significantly ($p \leq 0.05$) higher during extreme hot, rainy and extreme cold ambiances in comparison to moderate mean overall value. During rainy ambience, the per cent variation in the value of serum pepsinogen was found to be maximum (+147.33). Based upon results, it can be reiterated that impact of rainy ambience was enormous on overall serum pepsinogen value followed by extreme hot and cold ambiances. This was irrespective of physiological states. Among physiological states, cows had higher overall value of serum pepsinogen as compared to overall value of calves and overall value of heifers during moderate conditions. This pattern was maintained during all the three extreme ambiances with respective remarkable elevations during rainy ambience. In order to

evaluate the magnitude of impact of ambiances and physiological states on serum pepsinogen, per cent variations were monitored. Overall value revealed highest per cent variation during rainy ambience as compared to extreme hot and cold ambiances indicating that serum pepsinogen was modulated maximally during rainy ambience followed by extreme hot and cold. Among calves, heifers and cows, per cent variations were highest in overall values of calves followed by heifers and cows. This pattern was maintained in all the three extreme ambiances, magnitude being greater, respectively during rainy ambience. These patterns indicated that calves were affected most and rainy ambience had greater impact on the animals. Pattern of per cent variation revealed that among calves, calf-yearling transition group showed maximum modulations. Pre-pubertal heifers were affected most in heifer group showing maximum per cent variation during rainy ambience. Among cows, non-pregnant milch and primipara divulged greater effect as compared to other members of respective group. Rainy ambience showed maximum temperature humidity index values. Extreme ambiances affected the abomasal functions of the animals.

Keywords: Serum Pepsinogen, *Rathi* Female Calves, Heifers and Cows.



INTRODUCTION

Environment-animal relationship incorporates the comprehension of variations in the environmental correlates of the area, stress physiology and animal behaviour. This is important to understand homeostasis which may help in better management to alleviate unnecessary stress on the animals. Stress causes suffering which is a state of mind that is difficult to measure and analyze in animals. It is largely related to their environment. By examining the stress and productivity responses of animals the management strategies can be modified for welfare practices. Scientific attention on animal welfare should focus on the ways animals react to their environment with the individual diversity of adaptive responses and psycho-physiological reactivity to enhance the production output and product quality [1,2].

Animals function most competently within their thermo-neutral zone. Above the upper and the lower critical temperatures, animals feel stressed. Harsh environment restricts the production and reproduction. It has been observed that the critical temperatures given are not fixed features for any species and they may vary with age, sex and physiological conditions. While observing these aspects, eco-physiological characteristics should be considered. Integrative evaluations have been developed to assess surrounding environment of animals in hot environmental conditions.

Pepsinogen is a proenzyme and an inactive form of pepsin which is considered as the most significant proteolytic enzyme of gastric juice. In the lumen of abomasums, enzyme pepsinogen is converted into pepsin in the presence of acid. A clear physiological level of pepsinogen exists in the blood of ruminants [3]. Blood levels of pepsinogen can be employed in the diagnosis of abomasal disorders [4]. The raised plasma pepsinogen could be owing to its leakage into blood vessels from insulted abomasal mucosa [5]. Higher activation of pepsinogen into pepsin by raised acidity of lumen contents can produce ulcers. Serum pepsinogen is a good marker of abomasal function in cows [6]. A challenging feature for scientists is to protect these animals and to implement health programmes so that decline in number of these animals can be checked with simultaneous efforts to increase the number of *Rathi* animals. Under natural husbandry conditions, it is inexorable to avert the contact of the cattle to extreme ambiances. Extreme ambiances put negative impact on the dairy animals diminishing growth, production, reproduction and health. Physical activity of the animals in extreme hot environments can enhance the risk of heat stress. Extensive direct contact period of animals with extreme hot ambient temperature tied with lofty relative humidity can negotiate the capacity of animals to dispel surplus body heat which influences physiological components of animal at daily basis like

feed intake, growth, production of milk and reproduction. Eventually, loss is of farmers in terms of reduction in profitability from animals. Enormous economical thrashing owing to abiotic stress has turned the scientific attention towards measurement aspects which can be instrumental in rearing of *Rathi* animals in a better way [7]. On the basis of these contemplations, the aim of this study was to appraise the physiological strategies in *Rathi* female calves, heifers and cows implying modulations in serum pepsinogen activity during various ambiances of a year by determining temperature humidity index values.

MATERIALS AND METHODS

To accomplish the objectives of the study, 1200 apparently healthy *Rathi* female calves, heifers and were screened from private dairies located in and around Bikaner district, Rajasthan. To achieve the goals of the study, *Rathi* female animals ageing two weeks old to 12 years of age were sampled during moderate, extreme hot, extreme cold and rainy ambiances. Samples for experiment were comprised of blood to harvest serum. Clean and dried test tubes were employed for blood collection without any anticoagulant to harvest the serum. In each ambience, 300 blood samples were collected in the morning hours from clinically healthy animals. Experiment was carried out with the permission of Institutional Animal Ethics Committee (IAEC), College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India. Temperature humidity index (THI) values of sample collection periods in and around Bikaner district, Rajasthan, India during moderate, extreme hot, extreme cold and rainy ambiances were measured [8]. Moderate ambience comprised of October-November, extreme cold comprised of December- January, extreme hot ambience of May and June and rainy ambience comprised of July-August-September. Animals were grouped according to age in three categories as category I, II and III in each ambience. Category I included *Rathi* female calves ageing from two weeks to one year. This was based on the physiological basis [9] of involving type of digestion [10] and weaning practices opted by private dairy owners of the area [11]. Therefore, grouping included 2 to 3 weeks old (Pre-ruminant phase), 3 to 8 weeks old (Transitional phase), 8 to 16 weeks old (Pre-weaning), 16 to 32 weeks old (Post- weaning) and 32 to 48 weeks old (Calf-yearling transition) female *Rathi* calves. Each group was consisted of 30 animals. Though pre-ruminant phase involves the calves from birth to 3 weeks of age, however, in the study only 2-3 weeks old calves were incorporated. Category II incorporated female animals (heifers) ageing from one year to 3.5 years of age. This classification was based on the observation of time of onset of puberty in *Rathi* heifers [12, 13] and reproductive pattern followed by private



dairies and marginal owners in and around Bikaner district, Rajasthan, India. Grouping of female animals included 1-2.5 years and 2.5 to 3.5 years of age group. This classification was purely on the basis of behavioural and other observations associated with the onset of puberty [14] and history from the animal owners. These animals were categorised as prepubertal and postpubertal, respectively [12,13,15, 16]. All post pubertal animals were non pregnant. Each category comprised of 30 animals. Category III incorporated *Rathi* cows ageing 3.5-12 years. They were broadly divided into group A and group B according to physiological states [17]. Animals of group A involved non-pregnant milch [30]; pregnant milch [30] and pregnant dry [30] cows. To maintain similarity, all milch animals were sampled between 3 and 4 months of gestation period. Animals of group B were classified according to parity and included primipara and multipara cows. This was irrespective of states like pregnancy and milch. All primipara were between 3.5 and 6 years whereas all multipara were between 6 and 12 years of age. To accomplish the objectives regarding dynamics of environmental correlates *vis-a-vis* appraisal of physiological strategies in *Rathi* female calves, heifers and cows implying modulations in endocrine, organ and tissue functions, energy metabolism and cellular oxidative stress responses, the result of various parameters analyzed were compared with those analyzed during moderate months serving as control.

Functions of abomasum was measured by determining serum pepsinogen activity by the standard method as described by [18]. Measurement incorporated standard colorimetric method [19] with modification [20]. Addition of serum was done to a substrate mixture. After proper mixing, an aliquot of this mixture was incubated in a water bath at 37°C for 24 hours. Substrate mixture was prepared by dissolving 0.9 g of bovine albumin fraction V in glycine buffer to make the final volume 100 ml. Termination of reaction was done by the addition of 4 % trichloroacetic acid solution. Trichloroacetic acid (4%) solution was prepared by dissolving 4 g trichloroacetic acid in enough distilled water to make final volume 100 ml. Protein precipitate was filtered and the concentration of acid soluble tyrosine was measured by Folin Coicalteau's reagent. Folin Coicalteau's reagent was used readymade. For this purpose, 2 ml of filtrate was taken into a dried tube and 0.5 ml of Folin Coicalteau's reagent and 10 ml of 0.25N sodium hydroxide were added. Sodium hydroxide (0.25N) was prepared by dissolving 1 g sodium hydroxide in enough distilled water to make final volume 100 ml. Two ml of tyrosine standard was also processed in the same way. The optical density was recorded at 680 mμ wave length using a spectrophotometer (Systronics). The

enzyme activity was expressed as milli-units (mU) tyrosine [21].

In the present exploration, primary analytes were to study dynamics of environmental correlates *vis-a-vis* appraisal of physiological strategies in female *Rathi* cattle implying modulations in endocrine, organ and tissue functions, energy metabolism and cellular oxidative stress responses. Establishment of the main effects were as ambience overall values, overall values of calves, overall values of heifers and overall values of cows. For each overall value of effect, mean values were observed during moderate, extreme hot, rainy and extreme cold ambiances. Additionally, the subgroups of overall values of calves were pre-ruminant, transitional, pre-weaning, post-weaning and calf-yearling transition; overall values of heifers were pre-pubertal and post-pubertal; and overall values of cows were pregnancy and milch status (non-pregnant milch, pregnant milch and pregnant dry) and parity (primipara and multipara). For each sub group data were expressed as mean \pm SE of mean. Special computer programmes were employed to compute means and standard error (<http://www.miniwebtool.com>) and analyses of variance (www.danielsoper.com) to verify the significance of the impacts [22]. The adaptations in the means were evaluated by Duncan's new multiple range test [23]. Interactions were measured for each parameter as Cows group A X Cows group B; Ambiences X Calves; Ambiences X Heifers; Ambiences X Cows group A; Ambiences X Cows group B; and Calves X Heifers X Cows group A X Cows group B. They have been shown in the analysis of variance table of each parameter in results and discussion section. Per cent variations were also worked out in comparison with respective moderate value. The data have been presented in table for each parameter. A per cent variation quantitatively explains a change in a specific parameter. An absolute variation is merely the difference between the control (moderate) value and the new one for example any extreme ambience value. Per cent variation is a ratio of the absolute variation to the control or moderate value. Researchers have observed it to be an appropriate means to assess specific changes in a parameter (24.Saini, 2017).

RESULTS AND DISCUSSION

Mean \pm SEM values of serum pepsinogen of *Rathi* female cattle i.e. calves, heifers and cows during moderate, extreme hot, rainy and extreme cold ambiances are presented in table 1. Table 2 shows the per cent variations in serum pepsinogen of *Rathi* female cattle during extreme hot, rainy and extreme cold ambiances as compared to moderate ambience. Portrayal of changes in the mean values of serum pepsinogen are done in figures 1 and 2. The overall mean value of serum pepsinogen during moderate ambience was 150.00 \pm 2.10 mU tyrosine which



was obtained from 300 Rathi cattle incorporating calves, heifers and cows. The range was 138.90-158.20 mU tyrosine during moderate ambience. Rainy ambience showed maximum temperature humidity index (THI) values. At average ambient temperature, THI values were 71.07 ± 0.10 , 85.00 ± 0.15 , 86.00 ± 0.15 and 62.32 ± 0.10 , respectively during moderate, extreme hot, rainy and extreme cold ambiances.

The range and overall mean value of serum pepsinogen obtained during moderate ambience in present exploration corroborated the earlier reportings in dromedaries [25]; in goat [26]; in cattle [6] and in sheep [18]. Changes of serum pepsinogen during subclinical infection in calves during their first grazing season were described in literature [27]. Bauer et al. [28] found that the pasture grazed by the control calves from late August onwards revealed a marked rise in faecal egg counts with increased plasma pepsinogen. Mesaric et al. [29] investigated the activity of serum pepsinogen of cows with abomasal ulcers. Kataria and Kataria [6] measured higher serum pepsinogen in pica affected cattle. Kataria et al. [18] appraised the role of pepsinogen in the diagnosis of abomasal parasitism in sheep. They reported that the sampling time and feeding did not influence the pepsinogen levels and advocated its use as a diagnostic indicator in animals affected with abomasal dysfunctions. Lejeune et al. [30] investigated healthy cattle reared outdoors and the cattle with gastrointestinal nematode infection revealed higher serum pepsinogen. In the present investigation, morning time sampling was carried out which corroborated the earlier findings regarding one time random sampling for the measurement of plasma pepsinogen in animals [18,26]. The data obtained in the present investigation can be used as a base line for the future investigations in this direction in Rathi animals.

Description of changes in values of serum pepsinogen during varying ambiances

The overall mean values of serum pepsinogen were significantly ($p \leq 0.05$) higher during extreme hot, rainy and extreme cold ambiances in comparison to moderate mean overall value. During rainy ambience, the per cent variation in the value of serum pepsinogen was found to be maximum (147.33). Extreme ambience related rise in the serum pepsinogen levels can be due to increased acidity or gastrin hormone. Pepsinogen is a proenzyme and is an inactive form of pepsin enzyme. It is the most crucial proteolytic enzyme present in gastric juice. In the ruminants, in the presence of acid the abomasal lumen pepsinogen is converted into pepsin. In blood a certain physiological level of pepsinogen occurs. Therefore, pepsinogen levels in blood can be employed in the diagnosis of abomasal disorders or parasitism. The raised plasma levels of pepsinogen are owing to its leakage into blood vessels from insulted abomasal mucosa. Increased

activation of pepsinogen into pepsin by raised acidity of gastric contents can produce ulcers [18]. Earlier researchers have reported increased levels of serum pepsinogen in cattle with abomasal ulcers or parasitism [6,29,31], however, literature is almost silent about the fluctuations in serum pepsinogen levels owing to changes in environmental temperatures. The pattern of changes in pepsinogen activity reflected the effect of ambient temperature on abomasal functions. In the present investigation, rainy ambience marked maximum impact on the pepsinogen activity and concurrently revealed highest THI values.

The upshot of present investigation regarding serum pepsinogen status in Rathi animals during extreme ambiances will certainly help the clinicians to set the reference range keeping in view the fluctuations occurring due to abiotic stressors along with physiological states. Results of present study demonstrated that impact of rainy ambience was maximum in terms of pepsinogen modulations followed by extreme hot and cold ambiances. Out of these three extreme ambiances, it can be stated that rainy and extreme hot ambiances were able to modulate pepsinogen effectively as compared to cold ambience, which though showed a rise but magnitude was lower. Upshot clearly showed stimulation of abomasum during extreme ambiances.

Effect of physiological states of Rathi female cattle on serum pepsinogen

In the present investigation, Rathi female cattle had three major groups in all the four ambiances. In broader terms, animals were divided into three categories as calves, heifers and cows. Statistical analysis depicted significant ($p \leq 0.05$) variations among all the three overall mean values (calves, heifers and cows) in each ambience. The moderate mean value in each case was considered as control. The variations due to extreme ambiances (extreme hot, rainy and extreme cold) were found significant ($p \leq 0.05$). Overall mean value of calves was minimum and of cows was maximum significantly ($p \leq 0.05$). This pattern was akin for all the ambiances. Per cent variation in the overall mean values of calves was maximum and was least in cows. This trend was similar for all the ambiances. Rainy ambience marked maximum per cent variation in each category. This pattern remained similar in extreme hot and cold ambiances. Mean values were also compared within each category from statistical point of view. Category of calves incorporated pre-ruminant (2 weeks-3 weeks), transitional (3 weeks-8 weeks), pre-weaning (8 weeks-16 weeks); post-weaning (16 weeks-32 weeks) and calf-yearling transition (32 weeks-48 weeks). In each ambience, variations among all the type of calves were significant ($p \leq 0.05$). Pre-ruminants revealed maximum serum pepsinogen value and calf-yearling transition group showed minimum value in each ambience. All the types of



calves revealed maximum per cent variation during rainy ambience as compared to respective moderate ambience mean value. This exhibited that effect of rainy ambience incorporated pre-pubertal (1-2.5 years) and post-pubertal (2.5 to 3.5 years) animals. All post pubertal animals were non pregnant. Post-pubertal had significantly ($p \leq 0.05$) higher values of serum pepsinogen in each ambience in comparison to pre-pubertal. In both the types, maximum mean values were observed in rainy ambience as compared to moderate ambience followed by extreme hot and extreme cold ambiences. In comparative terms, both the groups exhibited higher per cent variations during rainy ambience. However, maximum per cent variation was exhibited by pre-pubertal animals in all the extreme ambiences. Cows incorporated group A (non-pregnant milch, pregnant milch and pregnant dry) and group B (Primipara and multipara) animals. In group A animals, pregnant-dry had significantly ($p \leq 0.05$) higher values of serum pepsinogen in each ambience in comparison to others. In all the three types, maximum mean values were observed in rainy ambience as compared to moderate ambience followed by extreme hot and extreme cold ambiences. In comparative terms, all the types exhibited higher per cent variations during rainy ambience. Maximum per cent variations were exhibited by non-pregnant milch as compared to pregnant milch and pregnant dry in all the extreme ambiences. In group B animals, multipara had significantly ($p \leq 0.05$) higher values of serum pepsinogen in each ambience in comparison to primipara. In both the types, maximum mean values were observed in rainy ambience as compared to moderate ambience followed by extreme hot and extreme cold ambiences. Primipara animals showed higher per cent variations in extreme hot, rainy and extreme cold ambiences as compared to multipara. The incidence of abomasal mucosal diseases in dairy cows suffering from gastrointestinal disorders is becoming more frequent in modern intensive production. Therefore, researchers [32] are recommending the diagnostic use of serum pepsinogen. Al-Rawashdeh et al. [33] found higher serum pepsinogen levels in lactating cows having left displacement of the abomasum. Merlin et al. [34] determined serum pepsinogen as an indicator in infested

was greatest on all the calves followed by extreme hot and cold ambiences. Per cent variation in calf-yearling transition group was maximum in rainy ambience. Heifers animals with GI parasites in cattle. Interactions of ambience with physiological states.

The interactions were computed as Cows, group A X Cows, group B; Ambiences X Calves; Ambiences X Heifers; Ambiences X Cows group A; Ambiences X Cows, group B; and Calves X Heifers X Cows, group A X Cows, group B. They were found to be highly significant ($p \leq 0.01$) which revealed the impact of extreme ambiences on the Rathi animals of all physiological states.

Based upon results, it can be reiterated that impact of rainy ambience was enormous on overall serum pepsinogen value followed by extreme hot and cold ambiences. This was irrespective of physiological states. Among physiological states, cows had higher overall value of serum pepsinogen as compared to overall value of calves and overall value of heifers during moderate conditions. This pattern was maintained during all the three extreme ambiences with respective remarkable elevations during rainy ambience. In order to evaluate the magnitude of impact of ambiences and physiological states on serum pepsinogen, per cent variations were monitored. Overall value revealed highest per cent variation during rainy ambience as compared to extreme hot and cold ambiences indicating that serum pepsinogen was modulated maximally during rainy ambience followed by extreme hot and cold. Among calves, heifers and cows, per cent variations were highest in overall values of calves followed by heifers and cows. This pattern was maintained in all the three extreme ambiences, magnitude being greater, respectively during rainy ambience. These patterns indicated that calves were affected most and rainy ambience had greater impact on the animals. Pattern of per cent variation revealed that among calves, calf-yearling transition group showed maximum modulations. Pre-pubertal heifers were affected most in heifer group showing maximum per cent variation during rainy ambience. Among cows, non-pregnant milch and primipara divulged greater effect as compared to other members of respective group.

Table 1: Mean \pm SEM values of serum pepsinogen (mU tyrosine) in the female Rathi cattle during varying ambiences.

S. No.	Effects	Mean \pm SEM values during ambiences			
		Moderate	Extreme hot	Rainy	Extreme cold
1.	Ambience Overall values (300)	150.00 ^b \pm 2.10	320.00 ^b \pm 2.00	371.00 ^b \pm 2.32	281.00 ^b \pm 2.20
2.	Age group categorization (I, II & III categories)				
I.	Calves, 2-48 weeks (150), categorization as a, b, c, d & e				
	Overall values of calves	145.00 ^{bg} \pm 0.41	316.00 ^{bg} \pm 0.49	366.00 ^{bg} \pm 0.44	278.00 ^{bg} \pm 0.44



	(150)				
	Pre-ruminant (30)	151.00 ^{bc} ±0.10	320.60 ^{bc} ±0.10	372.00 ^{bc} ±0.07	283.00 ^{bc} ±0.07
	Transitional (30)	148.00 ^{bc} ±0.10	318.00 ^{bc} ±0.09	369.00 ^{bc} ±0.07	280.00 ^{bc} ±0.09
	Pre-weaning (30)	145.00 ^{bc} ±0.10	316.00 ^{bc} ±0.08	366.00 ^{bc} ±0.09	277.00 ^{bc} ±0.09
	Post -weaning (30)	142.00 ^{bc} ±0.10	314.00 ^{bc} ±0.08	363.00 ^{bc} ±0.07	274.00 ^{bc} ±0.10
	Calf-yearling transition (30)	139.00 ^{bc} ±0.09	312.00 ^{bc} ±0.10	360.00 ^{bc} ±0.07	271.00 ^{bc} ±0.09
II.	Heifers, 1-3.5 years (60), categorization as a & b				
	Overall values of heifers (60)	150.00 ^{bg} ±0.43	320.40 ^{bg} ±0.40	371.00 ^{bg} ±0.44	281.00 ^{bg} ±0.43
	Pre-pubertal (30)	148.00 ^{bd} ±0.09	318.20 ^{bd} ±0.08	369.00 ^{bd} ±0.07	279.00 ^{bd} ±0.10
	Post-pubertal (30)	152.00 ^{bd} ±0.10	322.60 ^{bd} ±0.10	373.00 ^{bd} ±0.07	283.00 ^{bd} ±0.10
III.	Cows, 3.5-12 years (90), categorization as group A & B				
	Overall values of cows (90)	155.00 ^{bg} ±0.42	324.40 ^{bg} ±0.44	376.00 ^{bg} ±0.41	285.00 ^{bg} ±0.40
	Group A (90), Physiological states: Pregnancy and milch status				
	Non-pregnant milch (30)	152.00 ^{bc} ±0.06	322.10 ^{bc} ±0.10	374.80 ^{bc} ±0.10	283.60 ^{bc} ±0.09
	Pregnant milch (30)	155.00 ^{bc} ±0.08	324.50 ^{bc} ±0.07	376.00 ^{bc} ±0.07	285.10 ^{bc} ±0.09
	Pregnant dry (30)	158.00 ^{bc} ±0.06	326.40 ^{bc} ±0.08	379.20 ^{bc} ±0.07	287.30 ^{bc} ±0.09
	Group B (90), Physiological states: Parity				
	Primipara (45)	153.00 ^{bf} ±0.06	322.00 ^{bf} ±0.07	374.00 ^{bf} ±0.08	283.00 ^{bf} ±0.06
	Multipara (45)	157.00 ^{bf} ±0.07	326.80 ^{bf} ±0.08	378.00 ^{bf} ±0.08	287.00 ^{bf} ±0.06

Figures in the parenthesis = Number of *Rathi* animals

^{'b'} = Significant (p≤0.05) differences among mean values for a row.

^{'c'} = Significant (p≤0.05) differences among mean values of calves for an ambience

^{'d'} = Significant (p≤0.05) differences between mean values of heifers for an ambience

^{'e'} = Significant (p≤0.05) differences among mean values of Group A for an ambience

^{'f'} = Significant (p≤0.05) differences between mean values of Group B for an ambience

^{'g'} = Significant (p≤0.05) differences among overall values of calves, heifers and cows for an ambience

Table 2: Per cent variations in the serum pepsinogen mean values in the female *Rathi* cattle during extreme hot, rainy and extreme cold in comparison to moderate ambience

S.No.	Effects	Per cent variations		
		Extreme hot	Rainy	Extreme cold
1.	Ambience Overall Variations (300)	+113.33	+147.33	+87.33
2.	Age group categorization (I, II & III categories)			
I.	Calves, 2-48 weeks (150), categorization as a,b,c,d&e			
	Overall values of calves (150)	+117.93	+152.41	+91.72
	Pre-ruminant (30)	+111.90	+146.35	+87.41
	Transitional (30)	+114.86	+149.32	+89.18
	Pre-weaning (30)	+117.93	+152.41	+91.03
	Post -weaning (30)	+121.12	+155.63	+92.95
	Calf-yearling transition (30)	+124.46	+158.99	+94.96
II.	Heifers, 1-3.5 years (60), categorization as a&b			
	Overall values of heifers (60)	+113.60	+147.33	+87.33
	Pre-pubertal (30)	+115.00	+149.32	+88.51
	Post-pubertal (30)	+112.23	+145.39	+86.18
III.	Cows, 3.5-12 years (90), categorization as group A & B			



Overall values of cows (90)	+109.29	+142.58	+83.87
Group A (90), Physiological states: Pregnancy and milch status			
Non-pregnant milch (30)	+111.90	+146.57	+86.57
Pregnant milch (30)	+109.35	+142.58	+83.93
Pregnant dry (30)	+106.58	+140.00	+81.83
Group B (90), Physiological states: Parity			
Primipara (45)	+110.45	+144.44	+84.96
Multipara(45)	+108.15	+140.76	+82.80

+ = Increase in the value from respective moderate ambience mean value

Fig. 1: Portrayal of changes in the overall mean values of serum pepsinogen (mU tyrosine) in the female *Rathi* cattle during varying ambiances.

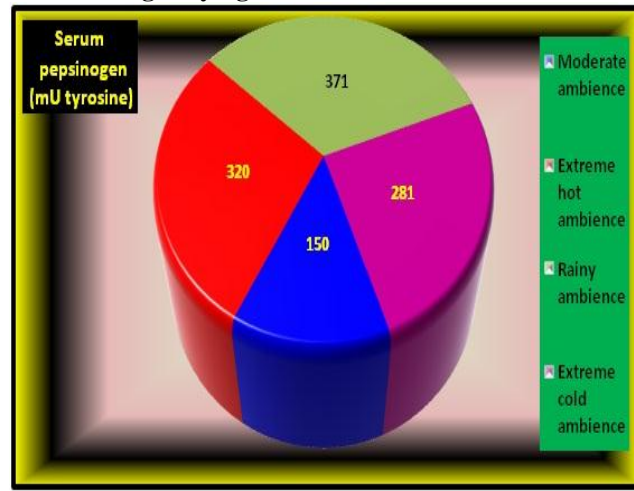
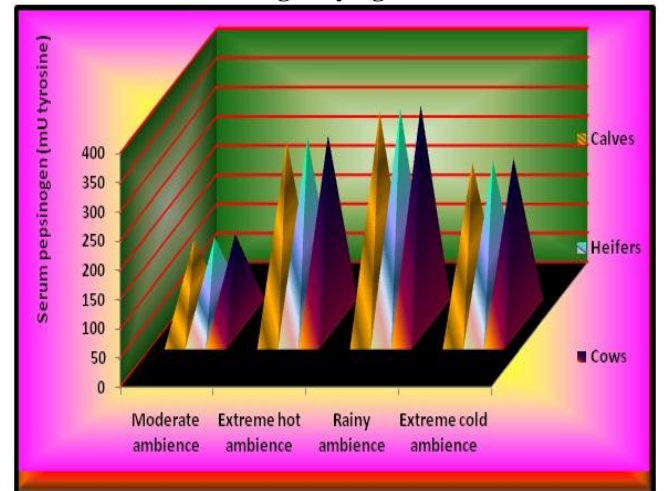


Fig. 2: Portrayal of changes in the overall mean values of serum pepsinogen (mU tyrosine) in the *Rathi* calves, heifers and cows during varying ambiances



CONCLUSION

Extreme ambiances affected the animal of all physiological states, however, magnitude was different. It can be concluded that extreme ambiances tended to modulate abomasum functions in the *Rathi* animals. Maximum impact was observed during rainy ambience.

Temperature humidity index values were found maximum during rainy ambience. Impact of rainy ambience was maximum on calves. Interactions among animals of various physiological states were significant for serum pepsinogen activity.

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