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Extreme ambience vis-à-vis plasma glucose and malondialdehyde level in non-descript goat of arid tract

Archita Singh and Nalini Kataria

Abstract
To examine the impact of heat stress on non-descript goat of arid tract, present investigation was carried out. To execute the objectives, blood samples were collected from non-descript male (N=60) and female (N=60) goats (Post pubertal) of 5-11 months of age from private slaughter houses of arid tract. The samples were collected during moderate environmental temperature period (October to November) and extreme hot environmental temperature period (May to June), from age group 5-7 months (N=20); 7-9months (N=20); and 9-11 months (N=20) of each sex. The magnitude of glucose and malondialdehye concentration in plasma assessed during extreme hot environmental temperature period were compared to those analyzed during moderate environmental temperature period. Upshot of present study reflected the effect of hot ambient temperature on plasma glucose and malondialdehyde in the goats of all age groups and sexes. The mean value of plasma glucose and malondialdehyde obtained during moderate environmental temperature period was considered as control value and was found to decreased and increased for glucose and malondialdehyde respectively, under bang of heat stress irrespective of age and sex. Significant ($p \leq 0.05$) changes in mean values of plasma glucose and malondialdehyde were observed due to sex and age in both moderate and extreme hot ETPs. In both the ETPs, mean value of plasma glucose and malondialdehyde were found to be significantly ($p \leq 0.05$) higher in male goats as compared to female goats. Mean values assessed for glucose during both the ETPs were found to be highest in goats of 5-7 months age group and lowest in 9-11 months of age group, however mean value assessed for malondialdehyde found to be highest in 9-11 months age group and lowest in 5-7 month age group. All the changes were significant ($p \leq 0.05$). Present investigation was done to know precautionary measure to be taken for the survival of goat of arid tract without compromising production.

Keywords: Non-descript goat, heat stress, environmental temperature period (ETS), plasma malondialdehyde level and plasma glucose level

Introduction
Arid tract has renowned many harsh features including scarcity of water and drastic variableness in the ambient temperatures, produces condition called oxidative stress. Oxidative stress results from increased production of oxidants, or from decreased dietary intake, de novo synthesis or increased turnover of antioxidants. In such circumstances, physiology of the animals has to show greater extent of modulations, specially energy status of cells which affects growth, production (Silanikove *et al.*, 1997) [21] and reproduction. High temperature, humidity, and radiations are reported as the potential hazards in the growth and production which in turn resulted in depression of the physiological and metabolic activities of these animals. Therefore timely detection of oxidative stress due to extreme ambiences need to be investigation to explore adaptive physiological measures of the animals and their use in health management.

Heat stress modulates metabolic reactions through free radicals and produces oxidative stress (Kataria *et al*., 2010b) [14]. Reactive oxygen species (ROS) are produced by cellular metabolic reactions and found to be involved in several physiological functions (Nordeberg and Arne´r, 2001) [16]. If ROS are produced in quantities more than they efficiently can be removed by antioxidant pool of body then can result to the state called oxidative stress (Sies, 1991) [20]. To prevent oxidative damage, the organism is packed with a scavenging system called antioxidant. The metabolic activity and the level of reactive oxygen species (ROS) tot up under the impact of extreme temperatures in summer periods and possible infections with pathogens (Yang *et al.*, 2013) [23]. The excess of ROS, which cannot be quenched by the endogenous antioxidant system can attack the unsaturated lipids present in biological membranes leads to the lipid peroxidation where malondialdehyde is produced as an advanced oxidation product and is recognized as an oxidative stress biomarker (Lykkesfeldt and Svendsen, 2007) [13] Antioxidants can defend the animals form peril of oxidative stress since

diminished status of antioxidants has been linked to development of oxidative stress. Bisbal *et al.* (2010) [5] reported positive role of antioxidants in metabolism of glucose so superior blood antioxidant level supposed to uphold energy levels. Gluconeogenesis is an important metabolic process in ruminants to make the supply of glucose continuous. Blood glucose level in ruminants does not depend largely on the feeding status as does in non-ruminants. Therefore it becomes imperative to monitor the level of glucose, as season affects glucose level (Bhosrekar *et al*., 1967) [4]. In view of the above-mentioned fact, the present investigation was done on non-descript goat

Materials and Method

The study was conducted on 120 non-descript goats of age group 5 to 11 month in each environmental temperature period. To assess the plasma glucose and malondialdehyde level, sample were collected from male (N=60) and postpartum female goat (N=60) from private slaughter house of arid tract, during months of October-November (moderate ETP) and May-June (extreme hot ETP). In each ETP, males and females were classified on basis of age i.e. 5-7 months (N=20); 7-9 months (N=20) and 9-11 months (N=20) age groups. The value recorded during period of moderate ETP was considered as control value. In order to assess the upshot of plasma glucose and malondialdehyde level, these were analyzed during moderate ETP and then compared to level recorded during extreme hot ETP.

Plasma glucose level

Plasma glucose level was quantified by Folin-Wu method (Oser, 1976) [17]. After harvesting, plasma, protein free filtrate was made. Heating of protein free filtrate was done with alkaline copper solution in a Folin –Wu tube, which leads to formation of cuprous oxide. Then it was mixed with phosphomolybdic acid solution, resulted in Blue color solution whose optical density was obtained by employing a spectrophotometer (Systronics) at 420 mμ.

Plasma malondialdehyde level

Method as described by Rao *et al.* (2014) [19] was employed to quantify malondialdehyde in plasma. The reaction of malondialdehyde with thiobarbituric acid in acidic medium causes the development of a pink color complex. The color intensity can be determined at 532 nm using a distilled water blank by using a spectrophotometer.

Result and Discussion

The Mean± SEM values of plasma glucose and plasma malondialdehyde in non-descript goat in both ETP with respect to sex and age group as well as irrespective of age and sex are presented in table-1 and table-2.The mean value of plasma glucose obtained during moderate environmental temperature period was 3.72±0.02 mmolL^{-1} irrespective of sex and age. The range obtained was 3.53-3.95 mmolL^{-1}. The mean value of plasma malondialdehyde obtained during moderate environmental temperature period was 2.95± 0.040 μmolL^{-1} irrespective of sex and age. The range obtained was 2.59-3.41 μmolL^{-1}

The findings obtained in the present study for glucose corroborated the earlier research work of (Chikwanda and Muchenje, 2016) [7] in goat; (Kataria and Kataria, 2016) [11] in heifers and (Bhartendu, 2017) [3] in goat. Bartos *et al.* (1975) [2] stated the impact of glucagon on glucose level in goats. Probably low food intake in summer and low availability and distant movement of goats in search of scarcely available vegetation during hot ambient temperature in arid tracts resulted in low glucose level (Banerjee *et al*., 2015; Indu *et al*., 2014; Suhair and Abdalla, 2013) [1, 8, 22]. Gluconeogensis is important in ruminants for maintenance of glucose level therefore lower availability of fuel molecules for gluconeogenesis supposed to reduce the glucose level. (Kataria and Kataria, 2016) [11] endeavoured serum glucose in heifers to appraise heat load index *vis-à-vis* hormone *milieu*. Higher value of plasma glucose in male animals and comparatively younger age groups were suggestive of greater ability to fight against oxidative stress in them.

Stress was found to be associated with enhanced cortiosl (Kataria and Kataria, 2016) [11], as cortisol is hormone associated with gluconeogenesis and increase of glucose level thereby, despite of which lowering of glucose was noticed. This can be explained that thyroid activity is also affected due to higher ambient temperature in animals (Kataria, 2000) [12].

Attack of ROS on unsaturated lipid present on cell membrane causes lipid peroxidation by forming malondialdehyde as an advanced oxidation product, resulted in increased level of plasma malondialdehyde. Nielsen *et al.* (1997) [15] harangued that plasma malondialdehyde is a pointer of oxidative stress in humans

Consistent result reported by Pandey, (2012) [18] Age and sex related changes were obtained. Castillo *et al.* (2006) [6] appraised oxidative stress that was observed to be contributed to reactions incorporated in metabolic disorders in dairy cows. Upshot of present investigations were suggestive of oxidative stress in goats of both the sexes and age groups during extreme hot ETP. Higher value of plasma MAD in male animals and comparatively older age groups were suggestive of development of greater degree of oxidative stress in them.

Table 1: Mean ± SEM values of plasma glucose (P_{GIC} mmol $^{-1}$) in non-descript goats during moderate and extreme hot environmental temperature periods (ETPs) and percent change during extreme hot environmental temperature period.

S. No	Effect	Mean ± SEM values		Percent change (Extreme hot ETP)
		Moderate ETP	Extreme Hot ETP	
1	Environmental temperature periods (ETPS) (120)	$3.72^{b\pm}0.02$	$3.10^{b\pm}0.02$	-16.66
2	Sex			
(I)	Male(60)	$3.84^{bd}\pm0.004$	$3.20^{bd}\pm 0.003$	-16.66
(II)	Female (60)	$3.60^{bd}\pm0.003$	$3.02^{bd}\pm0.004$	-16.65
3	Age			
(I)	5-7 months (40)	$3.94^{bf\pm}0.001$	$3.29^{bf\pm}0.001$	-16.49
(II)	7-9 months (40)	$3.68^{bf\pm}0.002$	$3.13^{bf\pm}0.001$	-14.94
(III)	9-11 months (40)	$3.54^{bf\pm}0.001$	$2.83^{bf\pm}0.001$	-18.64

Figures in the parenthesis indicate number of non-descript goats

[b,] markes significant ($p\leq0.005$) differences between moderate and hot ETPs for row.

[d,] markes significant ($p\leq0.05$) differences between male and female mean values within ETP.

[f,] marks significant ($p\leq0.05$) differences among mean values of the age groups within an ETP

Table 2: Mean ± SEM values of plasma malondialdehyde (MDA, µmolL^{-1}) in non-descript goats during moderate and extreme hot environmental temperature periods (ETPs) and percent change during extreme hot environmental temperature period.

S. No	Effect	Mean±SEM values		Percent change (Extreme hot ETP)
		Moderate ETP	Extreme Hot ETP	
1	Environmental temperature periods (ETPS) (120)	2.95$^{b\pm}$0.040	4.00$^{b\pm}$0.041	35.59
2	Sex			
(I)	Male(60)	3.20^{bd}±0.029	4.50^{bd}± 0.029	40.62
(II)	Female (60)	2.70^{bd}±0.030	3.50^{bd} ±0.030	29.62
3	Age			
(I)	5-7 months (40)	2.60$^{bf\pm}$0.030	3.10$^{bf\pm}$0.030	19.23
(II)	7-9 months (40)	2.85$^{bf\pm}$0.028	3.90$^{bf\pm}$0.029	36.84
(III)	9-11 months (40)	3.40$^{bf\pm}$0.030	5.00$^{bf\pm}$0.029	47.05

Figures in the parenthesis indicate number of non-descript goats

[b,] markes significant (p≤0.005) differences between moderate and hot ETPs for row.

[d,] markes significant (p≤0.05) differences between male and female mean values within ETP.

[f,] marks significant (p≤0.05) differences among mean values of the age groups within an ETP

Conclusion

It was concluded that extreme hot ETP is associated with significant increase in plasma malondialdehyde and decrease of plasma glucose level. Malondialdehyde an advanced oxidation product, as pointer of oxidative stress was found to be increase however difference in plasma glucose level was noticed due to altered feeding pattern, distant movement of goats in search of scarcely available vegetation and lower availability of fuel molecules for gluconeogenesis.

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