Biological Forum – An International Journal **15(5a): 01-05(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Antioxidants Profile Versus Hydration Status in *Tharparkar* Cows during various Environmental Periods from Arid Tracts of Rajasthan

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(Received: 11 March 2023; Revised: 27 April 2023; Accepted: 06 May 2023; Published: 16 May 2023)
(Published by Research Trend)

ABSTRACT: In a variety of environmental conditions, this study was aimed at investigating the antioxidant profile in relation to hydration status in *Tharparkar* cows from Rajasthan's dry plains. 180 *Tharparkar* cows from private dairies in and around the Bikaner region of Rajasthan were examined and determined to be in good health. The blood samples were taken under controlled conditions in three different climatic conditions: mild (October–November), dry (May–June), and humid (July–August). Results from the dry-hot and humid-hot conditions were compared to those from the moderate conditions. Group A and group B cows were created based on their physiological states in each environment. All groups saw their highest levels of antioxidants such vitamins A and C and their highest erythrocyte sedimentation rate in the middle of the day, while the highest levels of packed cell volume were seen in the humid-hot conditions. Group A pregnant dry cows had significantly (p0.05) lower plasma vitamin A and vitamin C values compared to group A pregnant milch cows and non-pregnant milch cows in both environments. Multipara cows in group B had significantly lower mean values of plasma vitamin A and vitamin C than primipara cows in both environments ($p \leq 0.05$). Both the A group pregnant cows and the B group multipara animals had a considerably ($p \leq 0.05$) larger packed cell volume. On the basis of the study that oxidative stress and hydration state are absolutely affected by various environmental periods. Exploration led to the conclusion that environmental conditions and physiological states profoundly alter oxidative stress and hydration status. Physiologically, pregnant dry, and multipara cows were more susceptible to the effects of high humidity and temperatures.

Keywords: *Tharparkar* cows, Vitamin A, Vitamin C, Erythrocyte sedimentation rate, Packed cell volume.

INTRODUCTION

The worst effects of seasonal shifts can be felt in Rajasthan's dry and semiarid regions. Physiological alterations have been linked to both environmental factors and water scarcity (Arora *et al*., 2022). Animal scientists have been working towards the goal of improving the biological fitness of animals in order to improve production for quite some time. Understanding the interplay between living and nonliving dynamics as a result of a wide range of environmental factors is crucial. When animals are placed in situations beyond their ability to maintain homeostasis, stress reactions can be used as a useful physiological outcome. Research on the time scales of environmental correlations and assessments of animals' physiological gambits are urgently required at this time (Kataria, 2019). *Sirohi* goats were studied by Arora and Kataria (2022), who found that the heat load index had a dramatic impact on blood parameters and metabolic controllers. They postulated that animals' metabolisms were altered at times of intense environmental stress. Animals are highly hit by the thermal environment, with temperature being the strongest trigger. Production of animals, as well as their management and reproduction, can fluctuate wildly with environmental changes. Careful juggling of physiological markers in serum is crucial for assessing organ successes. Kain *et al*. (2022) found that physiological systems can be affected by heat stress. Stress and oxidative stress are important aspects of animals residing in arid and semi-arid tracts (Kataria *et al*., 2010c). Oxidative rejoinders are regarded to be the collective cellular reactions owing to oxidant and antioxidant disparities. There are many more analytical tools like hematological variables, biochemical analytes and function tests for different organs, which are crucial for assessment of physiological and health monitoring of animals. Blood indices exhibit alterations in values during extreme ambiences (Kataria *et al*., 2001e). The determination of variations in hematological parameters and serum antioxidants can be used to evaluate the level of stress in animals and the production can be improved by modulation of surrounding environment of animals.

MATERIALS AND METHODS

Blood samples were taken from 180 cows in the unorganised sector in mild, dry-hot, and humid-hot environments to investigate indications of antioxidant profile and hydration status in *Tharparkar* cows from arid areas of Rajasthan. According to their physiological conditions, the cows in each environment were roughly classified into two groups, A and B. Group A includes animals such as non-pregnant milch, pregnant milch and pregnant dry cows. Primipara and multipara cows both made up Group B bovine population. All of the primipara were between the ages of 3.5 and 6 years, whereas the multipara ranged from 6 to 8.5 years. The average under normal conditions was used as a baseline against which the averages under dry-hot and humid-hot conditions could be evaluated. Various forms of statistical analysis were performed using specialised computer programmes i.e., (http://miniwebtool.com) and (www.danielsoper.com). Duncan's new multiple range test was used to analyses the changes in mean values.

Vitamin A: It was measured by the procedure (Varley, 1988) with some modifications (Abhimanu, 2013).

Vitamin C: It was measured by the procedure (Varley, 1988) with some modifications (Abhimanu, 2013).

Packed cell volume: It was determined using whole blood by the standard Wintrobe's technique (Jain, 1986).

Erythrocyte sedimentation rate (ESR): It was determined by using standard Westergren's technique (Jain, 1986).

RESULTS AND DISCUSSION

A. Plasma vitamin A and Vitamin C

Table 1 and 2 present the Mean± SEM values of plasma vitamin A and vitamin C in *Tharparkar* cows in groups A (non-pregnant milch, pregnant milch, and pregnant dry) and group B (multipara and primipara) during moderate, dry-hot, and humid-hot ambiences, respectively. The present study aimed to corroborate previous studies by obtaining results in a moderately humid environment Kataria *et al.* (2010c) in dromedaries; Kataria *et al*. (2012b) in buffaloes; Kataria *et al.* (2010b) in goats; Kataria and Kataria (2012e) in pigs; Maan, 2010 in sheep; Kataria and Kataria (2013b) in donkeys; Pandey *et al*., 2012 in goats; Singhal *et al.* (2016) in sow; Bhartendu, 2017 in goats; Joshi, 2018 in cow and Promila (2018) in sheep. In Plasma vitamin C findings are acquired in the present study attempted to support the earlier research (Kataria and Kataria 2012 in pigs; Kataria *et al*., 2012b in buffaloes; Pandey *et al*., 2012 in goats; Joshi, 2018 in cow and Kataria and Kataria, 2013b in donkeys).

(i) Impact of ambiences change on the values of plasma vitamin A and vitamin C. Dry-hot and humid-hot environments had considerably ($p \leq 0.05$) lower mean values of plasma vitamin A and vitamin C than the moderate environment. Vitamin A and vitamin C plasma levels were shown to be lowest in hot, humid conditions. Maximum percent fluctuation in plasma vitamin A and vitamin C values (-29.18 and -35.33, respectively) were seen during humid-hot.

The monitoring of present study rationally revealed function of vitamin A as an antioxidant and strained to support the earlier research during extreme ambiences (Kataria *et al*., 2010c in dromedaries; Joshi, 2012 in buffaloes; Kataria *et al*., 2010b in goats; Maan, 2010 in sheep and Kataria and Kataria 2013b in donkeys). In a study, Kataria *et al.* (2010) observed an incredible decrease in the serum vitamin A when ambient temperature was observed to be hot as compared to moderate in dromedaries. A large drop in value during highly hot ambient conditions was used by Kataria and Kataria (2013b) to infer the antioxidant effect of vitamin A in donkeys. Both dry and humid conditions were found to significantly influence vitamin A levels and antioxidant status.

Since vitamin C is known to help in hunting free radicals, it enjoys an important place in antioxidant system (Kataria *et al.*2010a). Coupling of environmental conditions with physiological states of the animals have long been observed along with influence on serum vitamin C (Joshi, 2012; Pandey, 2012 and Joshi, 2018). Vitamin C is important as a marker both in abiotic stress (Pandey *et al*., 2012) as well as in biotic stress (Kataria *et al.*, 2010c). Li *et al.* (2018) evaluated the oxidative status in cows having ketosis on the basis of plasma vitamin C. Findings substantiated the previous work regarding ambience associated changes (Kataria and Kataria 2012e in pigs; Pandey *et al*., 2012 in goats; Kataria *et al*., 2012b in buffaloes; Kataria and Kataria 2013b) in donkeys and Bhartendu, 2017 in goats). Depletion in serum vitamin C in goats during hot ambience was observed by Kataria *et al.* (2010b). Significantly reduced plasma vitamin C during extreme ambiences in present study was attributed to oxidative stress (Kataria *et al.*, 2010d).

(ii) Impact of physiological states of on the values of plasma vitamin A and vitamin C. The *Tharparkar* cows in this study were separated into two distinct groups (group A and group B) throughout all three habitats based on their physiological statuses. The three environment-specific mean values differed in statistically significant ways ($p \leq 0.05$). When compared to group A pregnant milch cows, non-pregnant milch cows, and pregnant milch cows in both environments, group A pregnant dry cows had significantly ($p \leq 0.05$) lower plasma vitamin A and vitamin C values. In both situations, group B multipara cows exhibited significantly ($p \leq 0.05$) lower plasma levels of vitamins A and C than group B primipara cows. Previous findings regarding the correlation between age and changes in plasma vitamin A were confirmed. The diagnostic value of vitamin A in calves has been debated by scientists (Jagos *et al.*, 1981). Yildiz *et al.* (2005) showed that vitamin A levels in cows dropped significantly after giving birth compared to prenatally. Pandey *et al*. (2012) found that the serum vitamin A value of goats was lower in hot and cold environments compared to mild environments. Female animals and younger goats had lower values.

B. Erythrocyte sedimentation rate and Packed cell volume

Table 3 and 4 display the Mean± SEM values of erythrocyte sedimentation rate and packed cell volume for *Tharparkar* cows from groups A and B in moderate, dry hot, and humid hot environments, respectively. There is a correlation between packed cell volume and hydration levels (Joshi, 2018).

(i) Impact of ambiences change on the values of packed cell volume and erythrocyte sedimentation rate. Overall, the packed cell volume was greater ($p\leq0.05$) in dry-hot and humid-hot ambiances than in the moderate ambiance, although the erythrocyte sedimentation rate was lesser ($p\leq0.05$) in both of those conditions. Erythrocyte sedimentation rate is lowest and packed cell volume is highest in a humid hot environment. Maximum percent changes in erythrocyte sedimentation rate (-47.46) and packed cell volume (+23.91) were seen in a humid-hot environment.

Lowering of ESR during extreme ambiences denoted lowering of plasma volume and haemoconcentration. Environmental temperature related changes were also observed by earlier workers (Kataria, 2000; Charan, 2002; Kataria and Kataria, 2005e; Kataria and Kataria, 2006d). ESR is taken as an indirect parameter of hydration status.

C. Impact of physiological states of on the values of packed cell volume (PCV) and erythrocyte sedimentation rate (ESR)

This study's statistical analysis showed that the three overall mean values varied significantly ($p\leq0.05$) between environments. Pregnant dry cows in group A had a greater average packed cell capacity than pregnant milch and non-pregnant milch cows in both conditions ($p\leq 0.05$). Despite this, pregnant milch cows had ESR that was significantly ($p\leq0.05$) higher than non-pregnant cows. In group B, multipara cows had a significantly ($p\leq0.05$) greater PCV than primipara cows in each environment.

Table 1: Mean ± SEM values of plasma vitamin A (µmol L^{-1}) in the *Tharparkar* cows during varying ambiences.

Sr. No.	Effects	Mean ± SEM values during varying ambiences		
		Moderate	**Dry hot**	**Humid hot**
1.	Overall values (60)	$2.33^{b}\pm0.014$	$1.84^{b}\pm0.012$	$1.65^{b}\pm0.013$
2.	Categorization according to physiological states (A & B groups)			
I.	**Group A cows (60), Physiological states: Pregnancy and milch status**			
a.	Non-pregnant milch (20)	$2.44^{bd}\pm0.022$	$1.95^{bd}\pm0.008$	$1.77^{bd}\pm0.008$
b.	Pregnant milch (20)	$2.34^{bd}\pm0.007$	$1.84^{bd}\pm0.006$	$1.65^{bd}\pm0.007$
c.	Pregnant dry (20)	$2.22^{bd}\pm0.006$	$1.74^{bd}\pm0.010$	$1.54^{bd}\pm0.007$
II.	**Group B cows (60), Physiological states: Parity**			
a.	Primipara (30)	$2.38^{be}\pm0.021$	$1.88^{be}\pm0.015$	$1.68^{be}\pm0.018$
b.	Multipara (30)	$2.29^{be}\pm0.016$	$1.81^{be}\pm0.016$	$1.62^{be}\pm0.017$”

i. “Figures in the parenthesis = Number of *Tharparkar* cows
ii. ‘b’ = “Significant ($p\leq0.05$) differences among mean values for a row.”
iii. ‘d’ = “Significant ($p\leq0.05$) differences among mean values for an ambience”
iv. ‘e’ = “Significant ($p\leq0.05$) differences between mean values for an ambience”

Table 2: Mean ± SEM values of plasma vitamin C(µmol L^{-1}) in the *Tharparkar* cows during varying ambiences.

Sr. No.	Effects	Mean ± SEM values during varying ambiences		
		Moderate	**Dry hot**	**Humid hot**
1.	Overall values (60)	$25.67^{b} \pm 0.24$	$19.57^{b} \pm 0.22$	$16.60^{b} \pm 0.23$
2.	Categorization according to physiological states (A & B groups)			
I.	**Group A cows (60), Physiological states: Pregnancy and milch status**			
a.	Non-pregnant milch (20)	$27.65^{bd} \pm 0.13$	$21.56^{bd}\pm0.11$	$18.59^{bd}\pm0.16$
b.	Pregnant milch (20)	$25.51^{bd} \pm 0.16$	$19.56^{bd} \pm 0.14$	$16.63^{bd} \pm 0.11$
c.	Pregnant dry (20)	$23.72^{bd} \pm 0.11$	$17.58^{bd} \pm 0.15$	$14.59^{bd} \pm 0.13$
II.	**Group B cows (60), Physiological states: Parity**			
a.	Primipara (30)	$26.18^{be} \pm 0.32$	20.08^{be} ± 0..35	$17.09^{be} \pm 0.30$
b.	Multipara (30)	$25.17^{be} \pm 0.29$	$19.06^{be} \pm 0.28$	$16.12^{be} \pm 0.30$

Table 3: Mean ± SEM values of packed cell volume (PCV, %) in the *Tharparkar* cows during varying ambiences.

Sr. No.	Effects	Mean ± SEM values during varying ambiences		
		Moderate	Dry hot	Humid hot
1.	Overall values (60)	$33.53^{b} \pm 0.22$	$40.54^{b} \pm 0.20$	$41.55^{b} \pm 0.19$
2.	Categorization according to physiological states (A & B groups)			
I.	**Group A cows (60), Physiological states: Pregnancy and milch status**			
a.	Non-pregnant milch (20)	$31.52^{bd} \pm 0.11$	$38.53^{bd}\pm0.10$	$39.51^{bd}\pm0.11$
b.	Pregnant milch (20)	$33.53^{bd} \pm 0.10$	$40.54^{bd} \pm 0.11$	$41.55^{bd} \pm 0.11$
c.	Pregnant dry (20)	$35.57^{bd} \pm 0.10$	$42.55^{bd} \pm 0.11$	$43.56^{bd} \pm 0.10$
II.	**Group B cows (60), Physiological states: Parity**			
a.	Primipara (30)	$33.05^{be} \pm 0.30$	$40.03^{be} \pm 0.29$	$41.05^{be} \pm 0.27$
b.	Multipara (30)	$34.04^{be} \pm 0.29$	$41.05^{be} \pm 0.30$	$42.03^{be} \pm 0.28$”

Table 4: Mean ± SEM values of erythrocyte sedimentation rate (ESR, mm $hour^{-1}$) in the *Tharparkar* cows during varying ambiences.

Sr. No.	Effects	Mean ± SEM values during varying ambiences		
		Moderate	Dry hot	Humid hot
1.	Overall values (60)	$0.712^{b} \pm 0.0008$	$0.478^{b} \pm 0.002$	$0.374^{b} \pm 0.001$
2.	Categorization according to physiological states (A & B groups)			
I.	**Group A cows (60), Physiological states: Pregnancy and milch status**			
a.	Non-pregnant milch (20)	$0.705^{bd} \pm 0.0007$	$0.469^{bd}\pm0.0005$	$0.365^{bd}\pm0.0006$
b.	Pregnant milch (20)	$0.713^{bd} \pm 0.0005$	$0.478^{bd} \pm 0.0006$	$0.375^{bd} \pm 0.0004$
c.	Pregnant dry (20)	$0.720^{bd} \pm 0.0005$	$0.488^{bd} \pm 0.0007$	$0.384^{bd} \pm 0.0006$
II.	**Group B cows (60), Physiological states: Parity**			
a.	Primipara (30)	$0.710^{be} \pm 0.002$	$0.476^{be} \pm 0..001$	$0.372^{be} \pm 0.002$
b.	Multipara (30)	$0.715^{be} \pm 0.002$	$0.481^{be} \pm 0.003$	$0.377^{be} \pm 0.001$

CONCLUSIONS

On the basis of exploration it could be concluded that environmental ambiences and physiological stages affect the oxidative stress and hydration state utterly and these could be measured in terms of variation in biological markers and physiological parameters. Humid hot caused more stress and physiologically pregnant, dry and multipara cows were more affected than other animals.

FUTURE SCOPE

The study of stress in animals is one of the most crucial issues in animal husbandry, which must be addressed efficiently in scientific manner. In future the research may be carried out on genetic level and the effect of exogenous antioxidant can be monitored on production and reproduction performance of animals.

Acknowledgement. All research work was conducted in Department of Veterinary Physiology, College of Veterinary and Animal Science, RAJUVAS, Bikaner, Rajasthan.
Conflict of Interest. None.

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How to cite this article: Abhishek Kain, Sunil Arora, Kartar Singh, Nazeer Mohammed and Aarif Khan (2023). Antioxidants Profile Versus Hydration Status in *Tharparkar* Cows during various Environmental Periods from Arid Tracts of Rajasthan. *Biological Forum – An International Journal, 15*(5a): 01-05.