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Effect of extreme heat conditions on hematological parameters in cross-bred cows during different seasons in central plane zone of Uttar Pradesh

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Abstract
The study demonstrates the effect of extreme heat conditions on hematological parameters in cross-bred cows during different seasons. Total eighteen cross bred cows of 2-4 years age group were selected from three districts namely Lucknow, Sitapur and Unnao of central plane zone of Uttar Pradesh. Blood sample was collected from experimental animal at weekly intervals in spring and summer season from the same animals. The haematological parameters like Haemoglobin, Total erythrocyte count (TEC), Total leucocyte count (TLC) and Packed cell volume (PCV) were recorded. Maximum and minimum ambient temperature and relative humidity of all three districts were also recorded during the experimental periods. There was found a significant (p<0.01) deference in the mean values of maximum and minimum ambient temperature in spring and summer seasons in all three districts. There was also found a significant (p<0.01) deference in the mean values of relative humidity in spring and summer seasons in all three districts. There was decrease in haemoglobin concentration and packed cell volume in summer season as compared to spring season in all three districts and was found significant (p<0.01) deference between two seasons. There was significant (p<0.01) decrease in Total Erythrocyte Count (TEC) and increase in Total Leucocyte Count (TLC) in summer session as compared to spring session in all three districts. In conclusion there was found a significant positive correlation among Haemoglobin concentration with PCV and Total Erythrocyte Count and negative correlation with Total Leucocyte Count.

Keywords: Temperature humidity index, haemoglobin, total erythrocyte count, total leucocyte count

Introduction
Extreme hot condition causes a huge economic loss by decreasing productivity and growth performance in the dairy animals. As the fact about the changing weather conditions which are deteriorating the environment with global climatic changes, one of the greatest challenges to production facing dairy farmers in India is the heat stress and the strain that it causes to the lactating dairy cows. Milking cow produces large amount of metabolic heat and accumulates extra heat from the energy transferred by radiation. When the animal is unable to lose excess metabolic heat by the different heat loss mechanisms it develop heat stress syndrome (Collier *et al.*, 2019) [5]. Heat stress is one amongst the most stressful condition and has the crucial impacts on growth and development (Singh *et al.*, 2016) [18]. So developing optimal environmental factors can be used to prevent heat stress and reduce economic losses.
Hematology is required to assess general health of the animals (Jain 1993) [9]. Complete blood count is an important diagnostic tool and a component for indicating stress and welfare (Aengwanich *et al.*, 2009; Anderson *et al.*, 1999) [1, 2]. Haematological measurements have been used to identify constraints on productivity in beef cattle (Grünwaldt *et al.*, 2005) [7]. Blood parameter profile as animal response indicators can serve as the basis for diagnosis, treatment, and prognosis of diseases (Otto *et al.*, 2000; Ndlovu *et al.*, 2007) [13.12]. Stress-induced changes in immune function have been documented in cattle, with alterations to cell-mediated and humoral immunity having a significant impact on immunocompetence which may render an animal more susceptible to infection (Carroll and Forsberg, 2007) [3]. There are numerous physiological and biochemical changes which occur in the cattle during the heat stress which includes alterations in their digestive systems, acid-base chemistry as well as haematological parameters.

The present study therefore gives an account on the effect of extreme heat conditions on hematological parameters in cross-bred cows reared under hot and arid conditions with an aim to assess changes during different seasons.

Materials and Methods

Design of experiment has been approved by the Institutional animal ethics committee. The study was conducted in spring (March, 2021) and summer (June, 2021) season in the Department of Veterinary Physiology and Biochemistry, College of Veterinary Science and Animal Husbandry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh. Total 18 cross bred cows of age group 2-4 years were randomly selected from the different dairy farms of Lucknow, Sitapur and Unnao district of Central plane zone of Uttar Pradesh. The experimental animals were selected on the basis of their similar body weight, body condition score and parity and maintained under standard management conditions at farm. Maximum and minimum ambient temperature and relative humidity of all three districts were also recorded during the experimental periods.

Blood samples (10 ml/cow) were collected in sterile tubes with EDTA from jugular vein puncture, posing minimum disturbance to animal. Samples were collected from experimental animal at weekly intervals in spring and summer season from the same animals. The collected blood samples were taken to laboratory in ice box. The haematological parameters like Haemoglobin, Total erythrocyte count (TEC), Total leucocyte count (TLC) and Packed cell volume (PCV) were recorded. Haemoglobin (Hb) was estimated in gm % by using method as described by Schalm et al. (1975) [15]. Packed Cell Volume was determined by using Wintrobe haematocrit tube as per the standard method described by Jain (1986) [10] and expressed in terms of percentage (%). Total Erythrocyte Count (TEC) and Total Leucocyte Count (TLC) were enumerated by haemocytometer method as described by Jain (1986) [10]. TEC was expressed in millions per cubic millimeter (10^6/cmm) and TLC expressed in thousand per cubic millimeter (10^3/cmm).

Statistical analysis of data was carried out to find the Mean ± SE. Paired "t-test" were done to find significant difference between groups of experiment and their interaction by using Data were subjected to analysis by Computer software package.

Results and Discussion

Ambient temperature and Relative humidity

Mean values of environmental conditions (ambient temperature and relative humidity) of Lucknow, Sitapur and Unnao districts during spring and summer season of the experimental period are presented in the Table 1. Maximum and minimum ambient temperature was 35 °C & 17 °C, 34 °C & 16 °C and 34 °C & 17 °C in Lucknow, Sitapur and Unnao districts respectively in spring season (March) where as Maximum and minimum ambient temperature was 43 °C & 26 °C, 41 °C & 25 °C and 42 °C & 26 °C in Lucknow, Sitapur and Unnao districts respectively in summer season (June).

Maximum and minimum values of relative humidity was 59% & 23%, 52% & 20% and 70% & 23% in Lucknow, Sitapur and Unnao districts respectively in spring season (March) where as Maximum and minimum values of relative humidity was 91% & 40%, 94% & 37% and 90% & 40% in Lucknow, Sitapur and Unnao districts respectively in summer season (June).

In the present study high ambient temperature and relative humidity causes moderate to severe stress in summer season where as no or mild stress in spring season in all three districts which affected physiological responses, hematological and biochemical changes in animals including productive and reproductive performance in dairy cattle (Hsu and Liu, 1996) [8]. Casella et al. (2013) [4] reported that the environmental condition at the different times of the year highly influences the haematological profile of the dairy cow.

Table 1: Variations in maximum (max) and minimum (min) values of environmental conditions (ambient temperature and relative humidity) of Lucknow, Sitapur and Unnao districts during spring and summer season of the experimental period

Season/ Month	District	Ambient Temperatures (°C)		Relative Humidity (%)	
		Max	Min	Max	Min
Spring (March)	Lucknow	35	17	59	23
	Sitapur	34	16	52	20
	Unnao	34	17	70	23
Summer (June)	Lucknow	43	26	91	40
	Sitapur	41	25	94	37
	Unnao	42	26	90	40

Haemoglobin Concentration

Changes in Mean±SE of Haemoglobin Concentration during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts is represented in Table 2, 3 and 4 respectively. Mean±SE of haemoglobin concentration was 11.58±0.04, 11.59±0.05 and 11.51±0.07 g/dl in Lucknow, Sitapur and Unnao districts respectively in spring season. ME±SE of haemoglobin concentration was 10.31±0.05, 10.22±0.06 and 10.17±0.06 g/dl in Lucknow, Sitapur and Unnao districts respectively in summer season.

There was decrease in haemoglobin concentration in summer season as compared to spring season in all three districts and there was significantly (p<0.01) deference between two seasons. Similar findings were also reported by Lemerle and Goddard (1986) [11]. They also reported that hemoglobin concentration was regulated by changing environmental condition and haemoglobin concentration and showed negative correlation with environmental temperature. Probable reason of this significant decrease may be due to increased water intake during the summer months (Shehab-el-deen *et al.*, 2010) [16] and was associated to haemodilution effect where more water is transported in the circulatory system for evaporative cooling during extreme hot conditions (El-Nouty *et al.*, 1990) [6].

Packed Cell Volume (PCV)

Changes in Mean±SE of Packed Cell Volume (PCV) during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts is represented in Table 2, 3 and 4 respectively. Mean±SE of Packed Cell Volume (PCV) was 31.34±0.04, 31.32±0.04 and 31.34±0.04% in Lucknow, Sitapur and Unnao districts respectively in spring season. Mean±SE of Packed Cell Volume (PCV) was 28.37±0.04, 28.39±0.05 and 28.31±0.07% in Lucknow, Sitapur and Unnao districts respectively in summer season.

There was decrease in packed cell volume in summer season as compared to spring season in all three districts and there was significantly (p<0.01) difference between two seasons and the similar findings were also reported by Razdan *et al.*

*(*1969) [14]. They reported that packed cell volume, hemoglobin and red blood cells (RBC) count decreased with the increase in environmental temperature. Silanikove (2000) [17] also reported that decrease in PCV is due to the elevated ambient temperature and is the main stressor that imposes strain to the animals.

Total Erythrocyte Count (TEC)

Changes in Mean±SE of Total Erythrocyte Count (TEC) during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts is represented in Table 2, 3 and 4 respectively. Mean±SE of Total Erythrocyte Count (TEC) was 6.70±0.02, 6.68±0.03 and 6.71±0.03 million/µl in Lucknow, Sitapur and Unnao districts respectively in spring season. Mean±SE of Total Erythrocyte Count (TEC) was 5.76±0.04, 5.74±0.04 and 5.77±0.03 million/µl in Lucknow, Sitapur and Unnao districts respectively in summer season.

There was decrease in Total Erythrocyte Count (TEC) in summer session as compared to spring session in all three districts and the similar findings were reported by Razdan *et al.* (1969) [14]. They reported that packed cell volume, hemoglobin and red blood cells (RBC) count decreased with the increase in environmental temperature. Concentration of blood constituents tends to decrease, with rising ambient temperatures, due to haemodilution, provided that cool water is available (Wood and Quiroz-Rocha, 2010) [20].

Total Leucocyte Count (TLC)

Changes in Mean±SE of Total Leucocyte Count (TLC) during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts is represented in Table 2, 3 and 4 respectively. Mean±SE of Total Leucocyte Count (TLC) was 8.78±0.02, 8.79±0.03 and 8.80±0.02 thousand/µl in Lucknow, Sitapur and Unnao districts respectively in spring season. Mean±SE of Total Leucocyte Count (TLC) was 9.22±0.03, 9.25±0.04 and 9.22±0.03 thousand/µl in Lucknow, Sitapur and Unnao districts respectively in summer season.

The overall Mean±SEM of total leucocyte count was found significantly (p<0.01) higher in summer session as compared to spring season. The probable reason of the increase in TLC in summer attributed due to stressed condition under the influence of cortisol. Adrenal medulla secrete catecholamine, mobilizes white blood cells from the marginal pool into blood circulation is responsible for increase in the total leucocyte count (William 2005) [19]. Haematological parameters are used as indicator of stress and welfare (Anderson *et al.*, 1999) [2] and some of the haematological values represented adaptability to adverse environmental conditions (Wood and Quiroz-Rocha, 2010) [20].

Table 2: Mean ± SEM of Haemoglobin (g/dl), Packed Cell volume (%), Total Erythrocyte Count (million/µl) and Total Leucocyte Count (thousand/µl) during spring and summer season in Cattle in Lucknow district of Uttar Pradesh

Week	Haemoglobin (g/dl)		Packed Cell volume (%)		Total Erythrocyte Count (million/µl)		Total Leucocyte Count (thousand/µl)	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
First	11.80±0.05	10.78±0.05	31.88±0.03	28.80±0.03	6.88±0.02	6.18±0.03	8.49±0.05	8.93±0.01
Second	11.71±0.05	10.61±0.06	31.65±0.04	28.59±0.02	6.78±0.01	5.85±0.03	8.80±0.02	9.16±0.03
Third	11.61±0.04	10.12±0.03	31.51±0.03	28.35±0.06	6.66±0.02	5.68±0.03	8.89±0.01	9.29±0.05
Fourth	11.18±0.04	9.71±0.07	31.32±0.05	27.74±0.04	6.50±0.04	5.33±0.05	8.94±0.02	9.49±0.04
Mean±SEM	11.58^{a}±0.04	10.31^{b}±0.05	31.34^{a}±0.04	28.37^{b}±0.04	6.70^{a}±0.02	5.76^{b}±0.04	8.78^{a}±0.02	9.22^{b}±0.03

Notes: Means bearing different superscripts differ significantly (p<0.01)

Table 3: Mean ± SEM of Haemoglobin (g/dl), Packed Cell volume (%), Total Erythrocyte Count (million/µl) and Total Leucocyte Count (thousand/µl) during spring and summer season in Cattle in Sitapur district of Uttar Pradesh

Week	Haemoglobin (g/dl)		Packed Cell volume (%)		Total Erythrocyte Count (million/µl)		Total Leucocyte Count (thousand/µl)	
	Spring	Summer	Spring	Summer		Spring	Summer	Spring
First	11.85±0.04	10.72±0.08	31.88±0.03	28.82±0.02	6.87±0.03	6.17±0.03	8.53±0.07	8.99±0.01
Second	11.76±0.03	10.28±0.04	31.64±0.05	28.57±0.05	6.75±0.02	5.81±0.05	8.75±0.02	9.20±0.06
Third	11.52±0.05	10.14±0.04	31.47±0.04	28.43±0.07	6.63±0.03	5.66±0.03	8.91±0.02	9.28±0.05
Fourth	11.22±0.07	9.73±0.06	30.29±0.04	27.75±0.04	6.49±0.05	5.31±0.05	8.97±0.01	9.51±0.04
Mean±SEM	11.59^{a}±0.05	10.22^{b}±0.06	31.32^{a}±0.04	28.39^{b}±0.0.05	6.68^{a}±0.03	5.74^{b}±0.04	8.79^{a}±0.03	9.25^{b}±0.04

Notes: Means bearing different superscripts differ significantly (p<0.01)

Table 4: Mean ± SEM of Haemoglobin (g/dl), Packed Cell volume (%), Total Erythrocyte Count (million/µl) and Total Leucocyte Count (thousand/µl) during spring and summer season in Cattle in Unnao district of Uttar Pradesh

Week	Haemoglobin (g/dl)		Packed Cell volume (%)		Total Erythrocyte Count (million/µl)		Total Leucocyte Count (thousand/µl)	
	Spring	Summer	Spring	Summer		Spring	Summer	Spring
First	11.86±0.03	10.61±0.09	31.86±0.02	28.85±0.03	6.88±0.02	6.19±0.03	8.50±0.04	8.94±0.01
Second	11.77±0.03	10.26±0.03	31.65±0.04	28.46±0.07	6.79±0.01	5.86±0.03	8.83±0.02	9.15±0.04
Third	11.24±0.11	10.13±0.05	31.51±0.03	28.27±0.06	6.67±0.02	5.69±0.03	8.92±0.02	9.30±0.05
Fourth	11.18±0.09	9.70±0.06	30.32±0.05	27.64±0.14	6.51±0.05	5.34±0.05	8.94±0.02	9.47±0.04
Mean±SEM	11.51^{a}±0.07	10.17^{b}±0.06	31.34^{a}±0.04	28.31^{b}±0.07	6.71^{a}±0.03	5.77^{b}±0.03	8.80^{a}±0.02	9.22^{b}±0.03

Notes: Means bearing different superscripts differ significantly (p<0.01)

Conclusion

High ambient temperature and relative humidity causes changes in haematological parameters and also imposes heat stress in animals. There was significant decrease in haemoglobin concentration, packed cell volume and total erythrocyte count in summer season as compared to spring season and increase in total leucocyte count in summer session as compared to spring session. There was significant

positive correlation among Haemoglobin concentration with PCV and total erythrocyte count and negative correlation with total leucocyte count. Haematological parameters can be used as indicators with animal response and welfare to the environmental changes.

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References

1. Aengwanich W, Chantiratikul A, Pamok S. Effect of seasonal variations on hematological values and health monitor of crossbred beef cattle at slaughterhouse in northeastern part of Thailand. American-Eurasian J Agric Environ Sci. 2009;5:644-648.
2. Anderson BH, Watson DL, Colditz JG. The effect of dexamethasone on some immunological parameters in cattle. Vet Res Commun. 1999;23:399-413.
3. Carroll A, Forsberg NE. Influence of stress and nutrition on cattle immunity. Vet Clin North Am Food Anim Pract. 2007;23:105-149.
4. Casella S, Scianò S, Zumbo A, Monteverde V, Fazio F, Piccione G. Effect of seasonal variations in Mediterranean area on haematological profile in dairy cow, Comp. Clin. Pathol. 2013;22:691-695.
5. Collier RJ, Baumgard LH, Zimbelman RB, Xiao Y. Heat stress: physiology of acclimation and adaptation. Ani. Fron. 2019;9(1):12-19.
6. El-Nouty FD, Al-Haidary AA, Salah MS. Seasonal variation in haematological values of high- and average-yielding Holstein cattle in semi-arid environment. J King Saud Univ. 1990;2:173-182.
7. Grünwaldt EG, Guevara JC, Estévez OR, Vicente A, Rousselle H, Alcuten N *et al*. Biochemical and Haematological Measurements in Beef Cattle in Mendoza Plain Rangelands (Argentina). Trop Anim Health Prod. 2005;37:527-540.
8. Hsu SH, Liu BT. The influence of stock farm microclimate on the characteristics of dairy cattle production (3). Chinese J Agromet. 1996;3(2):105-109.
9. Jain NC. Essentials of veterinary hematology. Edn 1, Lea and Febiger, Philadelphia; c1993.
10. Jain NC. Schalm's Veterinary haematology. Edn 4, Leg and Febiger; c1986.
11. Lemerle C, Goddard ME. Assessment of heat stress in dairy cattle in Papua New Guinea. Tropical Animal Health Production. 1986;18:232-242.
12. Ndlovu T, Chimonyo M, Okoh AI, Muchenje V, Dzama K, Raats JG. Assessing the nutritional status of beef cattle: current practices and future prospects. African Journal of Biotechnology. 2007;6:2727-2734.
13. Otto F, Vilela F, Harun M, Taylor G, Baggasse P, Bogin E. Biochemical blood profile of Angoni cattle in Mozambique. Israel Journal of Veterinary Medicine. 2000;55(3):95-102.
14. Razdan MN, Bhosrekar MR, Ray SN. Physiological behaviour of tharparkar cattle under different environments. III Haematological picture. Indian J Dairy Sci. 1969;21:82-91.
15. Schalm OW, Jain NC, Carroll EJ. Veterinary Haematology. Edn 3, Leg and Febiger, Philadelphia, 1975.
16. Shehab-el-deen MAMM, Fadel MS, Saleh SY, Leroy JLMR. Circadian rhythm of metabolic changes associated with summer heat stress in high-producing dairy cattle. Trop Anim Health Prod. 2010;42:1119-1125.
17. Silanikove N. Effects of heat stress on the welfare of extensively managed domestic ruminants. Livest Prod Sci. 2000;67:1-18.
18. Singh KM, Singh S, Ganguly I, Ganguly A, Nachiappan RK, Chopra A, Narula HK. Evaluation of Indian sheep breeds of arid zone under heat stress condition. Small Ruminant Research. 2016;141:113-117.
19. William OR. Dukes Physiology of domestic animals, 12th Edn., Panima Publishing Corporation, New Delhi, 2005.
20. Wood D, Quiroz-Rocha GF. Normal hematology of cattle. In: Weiss DG, Wardrop KJ. (eds) Schalm's Veterinary Hematology. Edn 6, Wiley, Philadelphia; c2010. p. 829-835.