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Effect of heat stress on hematological parameter of lactating Kankrej cow during summer season as compared to thermoneutral period

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Abstract
The experiment was carried out to study the effect of heat stress on the haematological parameters of lactating Kankrej cow compared to the thermoneutral period. For the experiment, a total of 12 clinically healthy Kankrej cows were randomly selected from Livestock Research Station (LRS), SDAU and categorized into two different groups according to seasons. The haematological profile viz Total erythrocyte count (TEC), Hemoglobin (Hb), Mean corpuscular haemoglobin (MCH), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin concentration (MCHC), Packed cell volume (PCV), Total leukocyte count (TLC), Differential leukocyte count (DLC) and Platelets (PLT) were recorded. Blood samples were collected thrice from each animal during the summer season and thermoneutral period at fortnight intervals. The blood samples were analyzed by using an Automated Haematology Analyzer (Cell Dyn-3700, Abbott Diagnostics, USA). Haematological analysis revealed that the erythrocytic indices viz. Hb, MCH and MCHC were significantly ($P<0.05$) higher during the summer season than the thermoneutral period. However, non-significant ($p>0.05$) variations was observed in the values of TEC, PCV and MCV during different seasons. The total leukocyte counts and lymphocyte counts were significantly ($P<0.05$) lower during the summer season as compared thermoneutral period. However, non-significant ($p>0.05$) variations were observed in the neutrophil, monocyte, eosinophil and basophil values.
Haematological analysis revealed that the platelet count was significantly ($P<0.05$) higher during the summer season than during the thermoneutral period.

Keywords: Kankrej cow, heat stress, haematological profile, thermoneutral period, Immunity

Introduction
Heat stress has been a critical problem in limiting animal productivity in tropical, subtropical and arid regions. Physiological indices, haemato-biochemical profile, cortisol levels, and milk composition all respond to climatic stress promptly. Haematological parameters have been used to identify the effect of heat stress on productivity in dairy cattle (Grunwaldt et al., 2005). Stress-induced changes in immune function have been recorded in dairy cattle, with alterations to cell-mediated and humoral immunity having a significant impact on immune competence, which may render an animal more become more susceptible to infections (Carroll and Forsberg, 2007). High temperature and humidity also affect the immunity of dairy cows. It has been reported that heat stress influences various immune cells in heat-stressed dairy cows (Lacetera, 2005) [8]. In neonatal dairy cows, acute brief heat stress alters the total white blood cell and immune function in calves (Strong, 2015) [10].
Considering that summer stress are major physiological stressors that affect the animal's biological system, the objective of this study was to find out the effect of heat stress on the haematological parameter of lactating kankrej cow during the summer season as compared to the thermoneutral period

Materials and Methods
Selection of Animals
The experiment was carried out at Sardarkrushinagar Dantiwada Agricultural University's Livestock Research Station. A total of 12 clinically healthy animals were chosen, with parity ranging from second to fifth and an average bodyweight of roughly 430 kg. All the cows were clinically healthy, maintained under standard management conditions and allowed to take ad libitum food.

Prior approval of the Institutional Animal Ethics Committee (IAEC) was taken before experimenting.

Experimental Design

The experiment was carried out in two periods according to the temperature and relative humidity recorded: from May 2018 to June 2018 (Maximum Temperature- 42.1 and Maximum Relative Humidity- 77, Minimum Temperature- 23.9 and Minimum Relative Humidity- 50) for the summer season and from February 2019 to March 2019 (Maximum Temperature- 36.5 and Maximum Relative Humidity- 68, Minimum Temperature- 11.8 and Minimum Relative Humidity- 38) for the thermo-neutral period. During each season, Six animals were selected (n=6).

Collection of Samples

The whole blood samples were collected in vials containing K_3 EDTA (Tripotassium ethylene diamine tetraacetic acid) for Haematological analysis.

Analysis of haematological profile

The haematological profile viz TEC, Hb, MCH, MCV, MCHC, PCV, TLC, DLC and PLT were analyzed by employing an Automated Haematology Analyzer (Cell Dyn-3700, Abbott Diagnostics, USA).

Statistical Analysis

The data was analyzed by applying one way ANOVA test using the Sigma stat 32 software package. $P<0.05$ was considered to be statistically significant.

Results and Discussion

Hematological profile

The mean±S.E. values of TEC, Hb, PCV, MCV, MCH and MCHC during different seasons in lactating Kankrej cow shown in Table 1.

The recorded mean±S.E. (millions/µl) values of total erythrocyte count (TEC) during different seasons in lactating Kankrej cow was 5.84±0.24 in the summer season and 6.02±0.24 in the thermoneutral period. Total erythrocyte count during the summer season and thermoneutral period did not vary significantly, but there was a slight decrease in total erythrocyte count during the summer season compared to the thermoneutral period. When the haemoglobin concentration of Lactating kankrej cow was observed during different seasons, the values obtained were 10.05±0.38 in the summer season and 9±0.29 in the thermoneutral period. The Hb concentration in the summer season and thermoneutral period did not vary significantly, but there was a slight increase in haemoglobin concentration during the summer season compared to the thermoneutral period. It was observed that PCV in the summer season and thermoneutral period were 28.16±1.29 and 26.93±1.07 respectively. The PCV in the summer season and thermoneutral period did not vary significantly, but there was a slight increase in PCV during the summer season compared to the thermoneutral period. The values of MCV during different seasons in lactating kankrej cow was found to be 35.24±0.99 (Summer season) and 33.90 ±0.18 (Thermoneutral season). The values of MCH in the summer season and thermoneutral period were 17.18±0.30 and 15.02±0.5, respectively. The MCH during the summer season was significantly ($P<0.05$) higher than the thermoneutral period. The MCHC values (g/dl) during different seasons in lactating in Kankrej cow were found to be 48.34±1.29 (summer season) and 44.32±1.39 (Thermoneutral period). Statistical analysis indicated no significant difference in MCHC values during different seasons, but it was non-significantly higher during the summer than during the thermoneutral period.

In the present study, there was a significant increase in haemoglobin concentration along with erythrocytic indices viz. MCH, MCHC and a non-significant increase in PCV and MCV was found during the summer season. On the other hand, there was a non-significant decrease in TEC found during the summer season. These findings corroborate the reports of Gutierrez –De La R. et al. (1971), El-Nouty et al. (1990) [3] and Kumar and Pachaura (2000) [7].

The present study showed a significant ($P<0.05$) increase in haemoglobin concentration and erythrocytic indices viz. MCH, MCHC, and non-significant increase in PCV and MCV in the summer season were probably due to haemoconcentration as excessive water was lost in evaporative cooling to maintain body temperature alternatively, to compensate for the demand for oxygen, which was fulfilled by a slightly higher amount of erythrocyte during the thermoneutral period than the summer season, erythrocyte count was slightly decreased during the summer season.

Leukocytic indices

The mean and standard error (mean± S.E.) of leukocytic indices during different seasons in lactating kankrej cows are presented in Table 2.

The TLC levels in the summer season and thermoneutral season were 7.59±0.38, 7 and 8.22±0.32, respectively. The results revealed a non-significant decrease in TLC levels during the summer seasons. It was observed that lymphocyte count (thousands/µl) were 3.18±0.26 in the summer season and 4.06±0.28 in the thermoneutral period. The lymphocyte count during the summer season was significantly ($p < 0.05$) lower than the thermoneutral period. The neutrophil counts (thousands/µl) in the summer and thermoneutral seasons were 3.12±0.29 and 3.49±0.24, respectively. Statistical analysis indicated there was no significant difference in the neutrophil count during different seasons. The recorded values of monocyte count (thousands/µl) during the summer season and thermoneutral period were 0.61±0.06 and 0.03±0.01respectively. Statistical analysis indicated no significant difference in Monocyte count during different seasons but slightly increased monocyte count during the summer season compared to the thermoneutral period. The eosinophil count (thousands/µl) was found to be 0.58±0.12 (Summer season) and 0.54±0.10 (Thermoneutral season). Statistical analysis indicated there was no significant difference in eosinophil count during different seasons. It was observed that the values of the basophil count (thousands/µl) during the summer season and thermoneutral period were 0.42±0.06 and 0.08±0.04, respectively. Statistical analysis indicated there was no significant difference in Basophil count during different seasons.

The circulating total leukocyte count (TLC) generally represents the outcome of the dynamic production by the bone marrow, the release of the cells to the peripheral circulation and the storage in different organs or pools.

In the present study, there was a significant ($P<0.05$) decrease in TLC and lymphocyte count found during the summer season. These findings corroborate Mirzadeh et al. (2010) [9] reports, while non-significant variations were found in

neutrophil count, monocyte count, basophil count, and eosinophil count.

The significant decrease in TLC and lymphocyte count found in the present study was probably due to increased cortisol levels during the summer season, which has an immunosuppressive action.

In contrast, to present findings, Bhan et al. (2013) [2] observed an increase in the mean TLC values with an increase in temperature in buffalo heifers. Similar results were found by Wegner et al. 1976 [11], Abdelatif and Alameen, (2012) [1].

Platelet count (thousands/µl)

When the lactating kankrej cow is observed during different seasons for the platelet count (PLT), The mean±S.E. values (thousands/µl) during different seasons in lactating kankrej cow are presented in Table 3.

The platelet count was recorded during the summer season and the thermoneutral period was 330.20±24.05and 252.50±24.05, respectively. The result showed that the platelet count during the summer season was significantly ($P<0.05$) higher than the thermoneutral period.

The Platelet count determined in the present study corroborates with Keatinge et al. (1986) [6], who reported increased platelet counts and blood viscosity related to heat exposure.

In the present study, there was a significant ($P<0.05$) increase in platelet count during the summer season, probably due to haemoconcentration as excessive water was lost in evaporative cooling to maintain body temperature, which leads to a nonsignificant increase in cholesterol level, increase in blood viscosity as well as platelet counts (Keatinge et al., 1986) [6].

Table 1: Erythrocytic indices during different seasons in lactating Kankrej

Seasons Parameters	Season-I Summer season (May-June)	Season –II Thermoneutral period (February-March)
TEC (millions/µl)	5.85±0.16^a	6.02±0.14^a
Hb (g/dl)	10.06±0.31^b	9.00±0.16^a
PCV (%)	28.16±0.73^a	26.93±0.66^a
MCV (fl)	48.34±0.88^a	44.32±0.81^a
MCH (pg/cell)	17.18±0.27^b	15.02±0.28^a
MCHC (g/dl)	35.25±1.04^b	33.91±0.11^b

Means with different superscript (a, b) within a row do not differ significantly from each other.

Table 2: Leukocytic indices during different seasons in lactating Kankrej cow

Seasons Parameters	Season-I Summer season (May-June)	Season –II Thermoneutral period (February-March)
TLC (thousands/µl)	7.59±0.23^a	8.22±0.19^b
Lymphocyte (thousands/µl)	3.19±0.17^a	4.06±0.16^b
Neutrophil (thousands/µl)	3.12±0.21^a	3.49±0.14^a
Monocyte (thousands/µl)	0.04±0.01^a	0.03±0.01^a
Eosinophil (thousands/µl)	0.58±0.11^a	0.54±0.06^a
Basophil (thousands/µl)	0.14±0.04^a	0.08±0.02^a

Means with different superscript (a, b) within a row differ significantly from each other.

Table 3: Platelet count (PLT) during different seasons in lactating Kankrej cow

Seasons Parameters	Season-I Summer season (May-june)	Season-II Thermoneutral period (February March)
PLT (thousands/µl)	330.20±24.05^b	252.50±24.05^a

Means with different superscript (a, b) within a row significantly from each other.

Conclusion

Heat stress-related haematological changes were found during this study. Heat stress significantly affects some haematological values and some non-significantly, which can be further used to assess heat stress and its negative impact on animals' physiological responses.

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