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Hematological Profile of Crossbred Cattle in Response to Seasonal Variations at Medziphema, Nagaland

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ABSTRACT: This study aims to investigate, for the first time in medziphema, the effects of seasonal temperatures and THI changes on the hematological profile in crossbred cattle as an indicator for their physiological status assessment. The study was conducted seasons wise THI calculated for calendar years and divided in three seasons such as spring (January to April), summer (May to August), and winter (September to December) 2022 and was performed on ten crossbred cattle. Blood samples were collected two times during this study period. The data regarding temperature changes in hematological parameters were significantly ($P \leq 0.05$) variations concerning red blood cell count (RBC), white blood cell count (WBC), hemoglobin concentration (Hb) and mean corpuscular volume (MCV). As well as variations were significant for packed cell volume (PCV), mean corpuscular hemoglobin content (MCH) and mean corpuscular hemoglobin concentration (MCHC). The concentration was significantly ($P \leq 0.05$) RBC, hemoglobin, PCV, MCV and MCH levels were higher in winter compared to the other seasons ($P \leq 0.05$), respectively. The lowest percentage was significantly ($P \leq 0.05$) WBC and MCHC was generally observed in winter as compared to other seasons, respectively. The hematological profile of dairy crossbred cattle has been altered in response to different seasons which ultimately affected on production system. This study might be useful for providing base line information on the hematological profile of dairy cattle for the assessment of physiological status.

Keywords: Cattle, Hematological, THI, Seasonal Variations, MCHC, MCV.

INTRODUCTION

Weather and climate impact both animal production and agronomic production. Seasonal change is one of the major risks for survival of various species, ecosystems and the sustainability of livestock production systems across the world, especially in tropical and temperate countries. The evaluation of the physiological status is essential as a reference for the development of different livestock maintenance systems. Animals face thermal challenge for most of the time during the year as India is a tropical country. Heat tolerance of crossbred cattle is poor compared to indigenous cattle mainly due to low sweat gland density and less surface area per unit body weight. Under excess thermal load crossbred animals employ moderate levels of sweating and resort to panting. The adaptive mechanisms under heat stress have been mostly explained by coetaneous characteristics, respiratory frequency, and rectal temperature, sweating and panting abilities of the species. Activation of such adjustments is highly dependent on the external temperature. The variable insulation, mainly due to circulatory adjustments in the thermo neutral zone of constant metabolism, is sufficient to maintain a thermal steady state. But above and below this thermo neutral zone, circulatory adjustments are no longer enough for maintenance of heat balance. In high and cold temperatures, an increase of evaporative heat loss through skin and respiratory vaporization and an increase in metabolism occur, respectively. Physiological equilibrium is maintained mainly by the blood in the body1 but many physiological conditions may alter this equilibrium. Rise in environment temperature decreases the milk production in high milk producing dairy crossbred cattle. With rise in population, increased livestock productivity is associated with increased production diseases that reflect changes in blood profile.

MATERIALS AND METHODS

The present study was conducted at Nagaland university dairy farm, school of agricultural science rural development SASRD Medziphema campus Nagaland, India. The metrological factors such as ambient temperature and relative humidity values were obtained from the metrological station of ICAR research complex for NEH region, Nagaland center, India located at the experimental stations for calculation of temperature humidity index (THI).The ambient thermal data were assessed to know the climatic condition of the research station where crossbreed cattle are kept for the research. Seasons wise THI calculated for calendar years and years divided in three seasons such as spring (January to April), summer (May to August), and winter (September to December).

The present research was carried out on ten crossbred cattle's with an average age of 1.5 to 3 years and average body weight of 100-300 kg were selected organized dairy farm at Nagaland university school of agricultural science and rural development, Medziphema campus, Nagaland, India and were maintained standard under the same feeding, housing, and natural photoperiod, environmental temperature condition. Blood sample were 5 ml collected from jugular vein two times between monthly interval in each seasons under different environmental condition from all animals for estimation of hematological, biochemical and hormonal parameters. The blood sample was collected in heparin tubes and immediately stored in ice box for transportation. The experimental data obtained were subjected to statistical analyzed of using randomized block design as per the standard procedure described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The mean values of hematological parameters are presented in Table 2. Effects of seasonal variation on hematological profile on crossbred cattle at Medziphema, Nagaland. The hematological standards obtained were comparable to the values measured normal for dairy crossbred cattle; the seasons impact the hematological profile of the dairy crossbred cattle.

A. Effects on RBC

The mean concentration of red blood corpuscles was significantly ($P<0.05$) lowest in summer season (4.79 ± 0.18 10^6 /µl) followed by spring season (4.90 ± 0.16 10^6 /µl) and highest in winter season (5.58 ± 0.15 10^6 /µl). However, there was no significant difference between summer, spring seasons respectively. In the summer season, the amount of evaporation rate by the crossbred increased due to the increased in ambient temperature this evaporation takes places through the skin pores. At the same time the respiration rate also increase due to more water required and regulation of more water in the body increased to cooling the haemo-dilution effect animal's body, due to which the amount of RBC decreased in summer season. RBC increased in winter season might be due to winter highest cold stress; be responsible for higher productions of erythropoietin hormone, which be responsible for highest RBC count during winter seasons. The finding of the present study was well corroborated with the observation of Jelkmann (2011) who observed the highest concentration of RBC during winter seasons followed by spring and summer seasons. Arup Giri Vijay Bharti (2017) reported that the red blood corpuscles significantly ($P<0.05$) highest in winter season followed by summer season on dairy cows in high altitude cold desert. These results were in contrast with finding of Abdelatif *et al*. (2009) reported that the highest significantly ($P<0.05$) value of erythrocyte count was calculated during wet summer. Quartermain and Broadbent (1997) reported that the highest erythrocytes count during wet summer followed by winter and dry summer seasons.

B. Effects on WBC

The mean concentration of white blood corpuscles was significantly ($P<0.05$) highest in summer season (32.16 ± 1.44 10^3 /µL) followed by spring season (27.97 ± 2.33 10^3/µL) and lowest in winter season (24.72 ± 1.34 10^3 /µl). However, there was no significant difference between spring, winter seasons as well as spring and summer seasons, respectively. WBC increased summer season might be due to summer highest heat stress and relative humidity; be responsible for improved production of epinephrine hormone, which be responsible for improved WBC count during summer seasons. Due to the higher temperatures during summer season there was released of corticosteroids or epinephrine hormone, due to which the amounts of leukocyte have increased. This can be due to keeping the crossbred cattle in the open house during summer season. In addition an increased in monocyte counts was observed in summer which might be due to an increased cortisol hormone. The finding of the present study was well corroborated with the observation of Abdelatif and Alameen (2012) who had also observed the highest concentration of WBC during summer season followed by spring and winter seasons, respectively. Lateef *et al.* (2014) found that highest WBC concentration during summer seasons followed by spring and winter in Kankrej (Bos indicus) cattle. These results were in contrast with finding of Mirzadeh *et al*. (2010) reported that lowest concentration of WBC different strain, age and sex of during summer in Iranian cattle. Shibu *et al.* (2008) reported that the WBC of growing and adult Sahiwal cattle during afternoon was significantly ($P<0.05$) lowest followed by morning values.

Table 1: Local climatic parameters during different seasons of experimental period (THI Values).

Seasons	Air Temperature (°C)			Relative humidity (%)			THI Value
	Max.	Min.	Mean	Max	Min.	Mean	Mean
Spring	27.25 (22.7-32.2)	13.77 (9.6-19.9)	20.51	92.75 (90 - 96)	53 (40 - 68)	72.87	67.72
Summer	32.2 (30.5-33.0)	23.62 (21.9-24.6)	27.51	93.25 (92 - 95)	70.5 (69 - 72)	81.87	78.08
Winter	29.4 (25.7-33.0)	17.9 (11.7-23.8)	23.65	94.25 (91 - 96)	62.25 (53 - 69)	78.25	72.66

Table 2: Effect of hematological parameters (Mean ± SE) during different seasons.

Parameters	Spring	Summer	Winter
Red blood cells (10^6 µ/l)	4.90 ± 0.16^a	4.79 ± 0.18^a	5.58 ± 0.15^b
White blood cells (10^3 µ/l)	$27.97 \pm 2.33^{a,b}$	32.16 ± 1.44^b	24.72 ± 1.34^a
Hemoglobin content (g/dl)	10.03 ± 0.21^b	09.24 ± 0.21^a	12.28 ± 0.23^c
Packed cell volume (%)	23.89 ± 0.62^a	23.51 ± 0.53^a	33.04 ± 0.94^b
MCV (µ/l)	49.85 ± 1.71^a	50.94 ± 3.83^a	60.30 ± 0.95^b
MCH (pg)	$20.99 \pm 0.63^{a,b}$	19.78 ± 0.83^a	22.43 ± 0.58^b
MCHC (g/dl)	42.49 ± 1.08^b	$40.32 \pm 1.46^{a,b}$	37.55 ± 1.10^a

$^{a, b, c}$ Mean bearing different superscripts in a column varied significantly (P<0.05)

C. Effects on Heamoglobin

The mean concentration of Heamoglobin was significantly (P<0.05) lowest in summer season (09.24 ± 0.21 g/dl) followed by spring season (10.03 ± 0.21 g/dl) and highest in winter season (12.28 ± 0.23 g/dl). However, there was significant difference between winter, spring and summer seasons. This Hb lowest in summer season might be due to summer highest heat decrease heamoglobin showed positive connection with highest ambient temperature. Hemoglobin concentration during the heat stress in the summer season the skin of animal heated due to which evaporation rate from the skin increased in animals. The potential blood pressure of water and oxygen increased during summer which called haemodilution effects as well as accredited to lowest RBC, decrease feed intake, due to which concentration decreased during hot summer. The finding of the present study was well corroborated with the observation of Abdelatif *et al*. (2009) reported that a heamoglobin concentration was significantly (P<0.05) highest during winter seasons followed by spring and summer and lowest Hb concentration during hot situation followed by cold seasons. Wilson *et al.* (1999) also reported a decrease in Hb during summer season in dairy cattle. These results were in contrast with Koubkova *et al.* (2002) reported a maximum heamoglobin concentration during summer seasons in high-yielding dairy cows. Farooq *et al.* (2017); Chandra Bhan *et al.* (2012) also reported that the Hb of growing and adult Sahiwal cattle during afternoon was significantly (P<0.05) lowest followed by morning values.

D. Effects on PCV

The mean concentration of packed cell volume was significantly (P<0.05) lowest in summer season (23.51 ± 0.51 %) followed by spring season (23.89 ± 0.62 %) and highest in winter season (33.04 ± 0.94 %). However, there was no significant difference between spring and summer seasons. This might due to decrease PCV show positive connection with highest ambient temperature. Packed cell volume lower level during the heat stress was accredited to lowest RBC, heat induced depression in cattle exposed to high temperature was almost certainly associated to haemo-dilution effect, because extra water was transported in body blood circulation system for evaporation. The finding of the present study was well corroborated with the observation of Abdelatif *et al*. (2009) observed the highest concentration of packed cell volume during winter seasons followed by spring and summer seasons. Wilson *et al.* (1999) also reported that a decline in PCV during summer season in dairy cattle. The results of present study were in contrast with Koubkova *et al.* (2002) reported a get higher in packed cell volume concentration during summer seasons in high-yielding dairy cows. Gaafar *et al.* (2021) recoded that the PCV percentage were raised significantly (P<0.05) in summer season followed winter season due to heat stress in Suckling Friesian Calves at Egypt.

E. Effects on MCV

The mean concentration of mean corpuscular volume was significantly (P<0.05) highest in winter season (60.30±1.85 fl) followed by summer season (50.94±3.83 fl) and lowest in spring season (49.85±1.71fl). However, there was no significant difference between summer and spring seasons. MCV increased in winter season might be due to the hypoxic condition increase of erythrocyte-stimulating factor release was increased because correlation oxygen demand of tissue and the mounts of oxygen carried by blood in crossbred cattle during winter. The finding of the present study was well corroborated with the observation of Mirzaded (2010); Casella *et al.* (2013) who observed the highest concentration of MCV were significantly (P<0.05) during winter seasons followed by summer and spring seasons. These results were in contrast with Gaafar *et al.* (2021) reported that MCV concentration significantly (P<0.05) highest in Friesian calves during the summer season compared winter.

F. Effects on MCH

The mean concentration of mean corpuscular heamoglobin was significantly (P<0.05) lowest in summer season (19.78± 0.83 pg) followed by spring season (20.99± 0.63 pg) and highest in winter season (22.43±0.58 pg). However, there was no significant difference between spring and summer season as well as spring, winter season, respectively. MCH increased in winter season might due to hypoxic condition raise of erythrocyte-stimulation factor released was raise because correlation oxygen require of tissue and the mounts of oxygen accepted by blood in crossbred cattle during winter seasons. The finding of the present study was well corroborated with the observation of Mirzaded (2010); Casella *et al.* (2013) observed that MCH concentration were significantly (P<0.05) highest during winter seasons followed by spring and summer seasons. Wilson *et al.* (1999) reported a reduction in MCH during summer season followed by other seasons. These results were in contrast with Farooq *et al.* (2017) reported that a MCH in Friesian calves significantly (P<0.05) highest during summer season followed by winter. Mekroud *et al.* (2021) reported that the concentration of MCH was significantly (P<0.05) highest in summer followed by the other seasons in Holstein dairy cows.

G. Effects on MCHC

The mean concentration of mean corpuscular hemoglobin concentration was significantly (P<0.05) highest in spring season (42.49± 1.08 g/dl) followed by summer season (40.32± 1.46 g/dl) and lowest in winter season (37.55± 1.10 g/dl). However, there was no significant difference between summer and winter seasons. Decreased in winter season might due to (MCHC) value during summer obtained could be correlated to the negative correlation between size and number of erythrocytes. The finding of the present study was well corroborated with the observation of Dzavo *et al.* (2020) observed that the highest concentration of MCHC during summer seasons followed by winter seasons. Arup *et al.* (2017) reported that the concentration of mean corpuscular heamoglobin concentration significantly (P<0.05) highest in summer season followed by winter season dairy cows in high altitude cold desert. These results were in contrast with Mirzaded (2010); Casella *et al.* (2013) reported that the MCHC significantly (P<0.05) highest during winter season followed by summer in Friesian calves.

CONCLUSIONS

On the basis of this study, it can be concluded indicated that highest RBC, Hb during winter and spring season due to comfort and cool climatic condition. WBC lowers during summer season due to higher stressful temperatures and stress period. This variation in hematological parameters related to changes in ambient temperature, relative humidity and THI, although within the hematological parameters for crossbred cattle. Therefore, we can claim that the seasonal changes can impact the metabolic profile.

FUTURE SCOPE

The hematological profile obtained for correct interpretation of normal physiology behavioural crossbred cattle in particular medziphema Nagaland region. Variation in these parameters due to seasonal changes may helpful improved better health management prectices crossbred cattle and designing strategies for combating stress maximum production in Nagaland.

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Conflict of Interest. None.

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