METEOROLOGICAL EFFECT ON PHYSIOLOGICAL AND HEMATOLOGICAL VALUES IN CROSSBRED CATTLE

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ABSTRACT

The aim of present study is to determine the influence of season on the physiological and hematological parameters in Jersey Sahiwal crossbred cattle. Investigation was carried out on 10 crossbred cattle at Department of Livestock Production Management (LPM), College of Veterinary Science, Proddatur during winter, summer and monsoon seasons. The physiological parameters viz., rectal temperature, pulse rate and respiration were measured at monthly intervals. The haematological parameters viz., total erythrocyte (RBC) count, total leukocyte (WBC) count, haemoglobin, packed cell volume (PCV), Erythrocyte indices - mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were measured at monthly intervals, while the meteorological variables like temperature, relative humidity and rainfall were recorded daily. There is a significant increase ($P<0.05$) in rectal temperature, pulse rate, respiration rate during summer than during winter and monsoon seasons. The mean RBC and WBC counts, haemoglobin, PCV differ significantly ($P<0.05$) and were higher during summer than during winter and monsoon seasons.

Key Words: Jersey Sahiwal crossbred cattle, Hematological parameters, Physiological parameters, winter, summer and monsoon.

INTRODUCTION

Production and health of the animals depend mostly on environment in which they live. An important factor that affects the productive and reproductive performances of crossbred cows is climate, which influences the adaptability of crossbred cows to a particular environment, mostly tropical environmental condition. Exposure to a tropical environment affects both physiology and behaviour of the animal. It is well known that the blood is one of the best indicators of health and adaptation. Several haematological and physiological norms are reported to be influenced by the variation in climatic variables like increased heat load, atmospheric temperature, relative humidity, wind velocity, solar radiation, increase the body temperature and respiration rate, and can reduce feed intake and milk production (Ominski et al., 2002 and Sreedhar et al., 2013).

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Physiological responses like rectal temperature, pulse rate and respiration rate reflect the degree of stress imposed on animals by climatic parameters. The ability of an animal to withstand the climatic stress under warm conditions has been assessed physiologically by means of changes in body temperature, heart rate and respiration (Ganaie et al., 2013). Haematology refers to the study of the number and morphology of the cellular elements of the blood – the erythrocytes (RBC), leucocytes (WBC) and the use of these results in the diagnosis and monitoring of disease like hemoprotozoans (Sivajyothi et al., 2014), other systemic disorders (Reddy and Kumari, 2010), and other penetrating foreign body diseases conditions (Reddy et al., 2014) in cattle.

Haematological studies are of ecological and physiological interest in helping to understand the relationship of haematological values to the environment (Ovuru and Ekweozor, 2004) and so could be useful in the selection of the animals that are genetically resistant to certain diseases and environmental conditions (Isaac et al., 2013). Haematological parameters are good indicators of the physiological status of the animal (Khan and Zafar, 2005), changes in haematological parameters are often used to determine various status of the body and to determine stress due to environmental, nutritional and pathological factors (Aderemi, 2004).

The extent to which these haematological and physiological norms are influenced by the climatic factors is of great relevance to crossbred cattle production in this particular region. The present study was undertaken to investigate the influence of season on physiological and hematological values in Jersey Sahiwal crossbred cattle.

MATERIALS AND METHODS

The study was carried out on ten (10) Jersey Sahiwal crossbred cattle at Department of Livestock Production Management, College of Veterinary Science in Proddatur, Andhra Pradesh, India during the period between September 2013 to August 2014. The study area is located in the southern peninsular India, 130 621 N latitude and 790 421 E longitude at an altitude of 149 m above mean sea level. The experimental animals were housed in identical conventional shed. They were allowed for grazing in fodder plots for 2-3 hours. They were offered ad libitum paddy straw and supplemented with concentrates when they return to their respective sheds after grazing. Ad libitum drinking water was provided in the sheds.

Meteorological variables

1. Temperature range: By using a maximum and minimum thermometer, the maximum and minimum temperatures (^{0}C) inside the animal sheds were recorded daily. The average of the maximum and minimum temperature is taken as ambient temperature for plotting a graph.

2. Relative Humidity: Relative humidity (%) was recorded by using a Hygrometer.

3. Rain fall: Rain fall (mm) was recorded by using Rain gauge

Hematological parameters

Whole blood was collected in EDTA containing vial through jugular vein puncture at weekly intervals for estimation of Total RBC count, Total WBC count, Hb, PCV. Erythrocyte indices- mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were estimated by standard methods as described by Weiss and Wardrop (2010). The blood was analyzed for hematology parameters like red blood corpuscles (RBC) by using Hayme's fluid, white blood corpuscles (WBC) by using Thomas fluid, hemoglobin (Hb) by Sahlis method, packed cell volume (PCV) by microhematocrit method

by following procedure given in Veterinary Hematology by Jain NC (1986).

Physiological parameters

The physiological responses were also recorded at weekly intervals throughout the experimental period. The respiratory rate was measured by counting the number of hot gushes per minute exhaled from the nostrils by the animal, by placing the palm of hand in front of nostrils and counting the number of blows. The body temperature was recorded by clinical thermometer inserting into rectum for one minute. The pulse rate was recorded by coccegyeal artery pulse.

Statistical analysis of the data was analyzed by one way ANOVA as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

During the study period the average minimum temperature was 25.84±0.03^{0}C during winter, 30.64±0.16^{0}C during summer and 26.95±0.27^{0}C during monsoon, and the maximum temperature recorded 32.88±0.18^{0}C, 38.90±0.20^{0}C and 35.29±0.22^{0}C during winter, summer and monsoon, respectively. The ambient temperature was 29.38±0.43^{0}C during winter, 34.77±0.74^{0}C during summer and 31.11±0.66^{0}C during monsoon, while the relative humidity recorded 68.34±0.38 per cent, 60.09±0.60 per cent and 68.39±0.77 per cent during winter, summer and monsoon, respectively. The observed rainfall was 0.87±4.36 mm, 2.79±3.11 mm and 13.41±2.93 mm during winter, summer and monsoon, respectively. (Table 3). The relative humidity varied from 57.41 per cent in June to 73.16 per cent in October and ambient temperature varied from 28.82^{0}C in December to 36^{0}C in April. The monthly changes in ambient temperature and relative humidity were graphically presented in Fig 1.

The mean rectal temperature in the present study was ranged between 97.45 ± 0.49 to 100.76 ± 0.37 (^{0}F) (Table 2). In the present study a significant increase in rectal temperature was observed in summer than in monsoon and winter. This finding was in agreement with the studies of Koubkova et al., (2002), Chakravarthi et al., (2004), Chandra Bhan et al., (2012) and Naik et al., (2013), who also reported higher rectal temperature in animals exposed to higher ambient temperature. In this study, the pulse rate observed was higher in summer and monsoon seasons when compared with winter (Table 2). Similar to these observations, Naik et al., (2013) also indicated higher pulse rate during summer due to thermal stress in cattle. In the present study a significant increase in respiratory rate in summer than in winter and monsoon was observed which was in agreement with the findings of Chandra Bhan et al., (2012) and Naik et al., (2013), who reported higher respiratory rate in animals exposed to high environment temperature.

Hemotology

In this study, mean RBC count was varied among different seasons (Table 1) which was higher in summer than in monsoon and winter. The significant increase in total erythrocyte count in summer is in agreement with the findings of Naik et al., (2013) in Punganur cattle, Shibu et al, (2008) in Karan Fries heifers and Koubkova et al., (2002) in dairy cows. The present result is in contrary to findings reported by Soley and Singh (2003) and Mirzadeh et al., (2010) who reported reduced RBC levels during summer months. Chandra Bhan et al., (2012) observed a decrease in total erythrocyte count in adult Sahiwal cattle during summer than in winter. However, El-Nouty et al., (1990) and Ozdemir et al., (2005) reported that summer season had no effect on total erythrocyte count in cattle. In this study, the increase in RBC concentration in summer might be due to hemo-concentration resulting from the loss of water through sweating in an effort to loss heat from the body during hot and humid climate and maybe due to adaptative

mechanism of a breed to improve blood capacity for carrying oxygen due to hot environment.

The mean total leucocytes count in the present study was ranged between 8.95 ± 0.17 to 10.86 ± 0.19 ($X10^3/\mu l$) (Table 1). In the present study, a significant increase in total leucocyte count was observed in summer than in monsoon and winter. This finding was in agreement with the findings of Naik et al., (2013), who also observed higher leucocyte count in summer than in monsoon and winter season in Punganur cattle. Nouty et al., (1986) also noticed higher leucocyte count in summer than in other seasons in Holstein breed. This result is in contrary to the findings reported by Chandra Bhan et al., (2012) who observed an increased total leucocyte count during winter and decreased during heat stress in adult Sahiwal cattle. However, El-Nouty et al., (1990) found no significant change in total leucocyte count in summer season in cattle.

The mean haemoglobin (Hb) content in the present study was in the range between 9.85 ± 0.19 to 11.85 ± 0.21 g/dl (Table 1). In the present study there was a significant increase in haemoglobin (Hb) content during summer when compared to winter and monsoon seasons. This finding is in agreement with Kumar and Pachauria (2000), Naik et al., (2013), who also observed higher haemoglobin concentration in cattle in summer season. These findings were in contradictory to the results reported by El-Nouty et al., (1990), Chandra Bhan et al., (2012), Soley and Singh (2003) and Nouty et al., (1986) who noticed lower haemoglobin concentration in summer than any other season in cattle. However, Prava and Dixit (2008) reported that season had no significant effect on haemoglobin concentration in cattle. The higher levels of Hb during summer in the present study could be due to hemo-concentration resulting from the loss of water through sweating in an effort to loose heat from the body during hot and humid climate.

The mean PCV in the present study was in the range between 34.75± 0.67 to 40.0± 0.8 % (Table 1). In this study a significant increase in PCV was observed during summer when compared to winter. This is in agreement with the findings of Koubkova et al., (2002), and Naik et al, (2013), who have reported higher PCV in cattle in summer season. These findings were in contradictory to the results reported by El-Nouty et al., (1990), Soley and Singh (2003) and Nouty et al., (1986) who noticed lower PCV during summer. In this study, the increased hematocrit values during summer could be attributed due to dehydration associated with water loss from the body (Reddy et al., 2014) because of hot environment and may also be due to higher erythrocyte count during summer season.

In the present study, MCV, MCH and MCHC values were varied among different seasons. These results were in agreement with the findings of El-Nouty et al., (1990) who reported that under high environmental temperature the MCV and MCH values were decreased. These findings were in contradictory to Kumar and Pachaura (2000) who reported that the MCV and MCH values were increased in summer season.

CONCLUSION

Physiological and hematological findings in Jersey Sahiwal crossbred cattle were determined at different seasons of the year for studying the effect of season on physiological and hematological parameters. It is concluded that there is a significant increase in rectal temperature, pulse rate, respiration rate, total erythrocyte count, total leukocytes count, hemoglobin concentration and PCV during summer when compared to winter and monsoon seasons conforming the adaptation of animals to the summer stress. Further by adopting mitigation strategies, the productivity of the crossbred Jersey Sahiwal cattle can be improved in tropical climatic conditions.

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Table 1

Effect of season on haematological findings of cattle

Parameter	Winter	Summer	Monsoon
Total RBCs ($X10^6$/µl)	7.31^{a}±0.15	9.53^{b}±0.11	8.58^{b}±0.18
Total WBCs ($X10^3$/µl)	8.95^{a}±0.17	10.86^{b}±0.19	9.38^{a} ±0.11
Hb (g/dl)	9.85^{a}±0.19	11.85^{c}±0.21	10.57^{b} ±0.23
PCV (%)	34.75^{a}±0.67	40^{b}±0.8	38.25^{b}±0.03
MCV (fl)	47.78^{a}±1.84	41.94^{a}±0.69	44.67^{b}±1.12
MCH (pg)	13.49^{a}±0.01	12.43^{a}±0.21	12.36^{a}±0.01
MCHC (g/dl)	28.45^{ab} ±0.99	29.67^{b}±0.55	27.65^{a}±0.48

Values in the same row bearing different superscripts differ significantly (P<0.05).

Table 2

Effect of season on physiological findings of cattle:

Parameter	Winter	Summer	Monsoon
Rectal Temperature (^{0}F)	97.45^{a}±0.49	100.76^{b}±0.37	99.52^{b}±0.03
Pulse rate (Per Minute)	57.5^{a}±1.22	69.25^{c}±0.59	62.5^{b}±1.14
Respiration (Per Minute)	23.62^{a}±0.49	28.5^{b}±0.65	25 ±0.62

Values in the same row bearing different superscripts differ significantly (P<0.05).

Table 3

Seasonal variability of meteorological parameters pertaining to the study area

Parameter	Winter	Summer	Monsoon
Mean Minimum Temperature (^{0}C)	25.84±0.03	30.64±0.16	26.95±0.27
Mean Maximum Temperature (^{0}C)	32.88±0.18	38.90±0.20	35.29±0.22
Mean Ambient Temperature (^{0}C)	29.38±0.43	34.77±0.74	31.11±0.66
Average Relative Humidity (%)	68.34±0.38	60.09±0.60	68.39±0.77
Average Rainfall (mm)	0.87±4.38	2.79±3.11	13.41±2.93

Fig.1

Graphical presentation of monthly changes (from September, 2013 to August, 2014) in ambient temperature and relative humidity