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EFFECT OF SEASONS ON PHYSIOLOGICAL AND HEMATOLOGICAL VALUES IN PUNGANUR CATTLE

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ABSTRACT

The present study was conducted to establish base line physiological and hematology values in Punganur cattle in different age groups (bulls, cows, young bulls, heifers, and male and female calves) and during different seasons (monsoon, winter and summer). The mean rectal temperature (^{o}F), respiration, pulse and heart rate (per min.) were significantly higher (P<0.01) in young animals than in adult cows and bulls and also during summer than during monsoon and winter seasons. The mean RBC and WBC counts differed significantly (P<0.01) among the age groups and were higher during summer than either during monsoon or winter seasons. The Hemoglobin content was not significantly different among the age groups but was significantly higher (P<0.01) during summer than during either monsoon or winter seasons. The mean PCV (%) in different age groups and also during monsoon, winter, and summer seasons were not significantly different. The mean ESR (mm/hr) in different age groups was not significantly different but was significantly (P<0.01) higher during summer than during winter. The DLC count (%) among different age groups of Punganur cattle was significantly different (P<0.01) for Neutrophils, Eosinophis, Basophils, Lymphocyte except for monocytes. Neutrophils and lymphocytes were significantly higher (P<0.01) during summer, Eosinophils and Basophils during monsoon while Monocytes count was significantly higher (P<0.01) during winter than during other seasons.

KEY WORDS: Punganur cattle, Seasons, Hematology

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INTRODUCTION

Indian subcontinent has a variety of indigenous breeds of cattle (*Bos indicus*) with wide genetic diversity. Most of these breeds are undergoing genetic degradation due to indiscriminate cross breeding and irregular mating among the breeds situated in each other's vicinity. As a result several indigenous breeds with many desirable traits are threatened with extinction while others are in the process of getting replaced completely by certain high producing crossbred animals. Punganur is one such breed of Indigenous cattle at the brink of extinction. (Ramesha, 2001). Physiological norms for many Indian breeds of cattle like Kankrej, Hariana, Gir, Deoni, Ongole, Redkhandari, Malvi, and Rathi (Mithuji et al., 1966 and Deshpande et al., 1987) are available. However, Punganur cattle are poorly characterized both in terms of physiology and genetics. Therefore there is a need to characterize these animals for conservation and propagation. Punganur, is the Worlds shortest, humped cattle with long tail with switch touching the ground, white and light grey in color with a broad forehead and short horns (Reddy *et al*., 2004). The average height is 60-100 centimeters and weight 115-200 kgs. Physiological characterization of any breed of animals involves establishing reference values for hematology, cardiovascular and blood chemistry parameters by studying the same in both the sexes at different ages during different seasons. Accordingly the present study was undertaken to establish the base line values for selected physiological and hematology values in various age groups of both sexes, the influence of various seasons and also the interaction of age, sex and season on the above parameters in Punganur cattle.

MATERIALS AND METHODS

The present study was conducted at Livestock Research Station (LRS), Palamaner, Chittoor district, Andhra Pradesh, India from March 2010 to August 2011. The institute is located at an altitude of 2550 feet above mean sea level, at the longitude of 78° and Latitude 13.15° and mean environmental temperature, relative humidity and vapor pressure ranged between 12-40° C, 59-85 per cent and 7-17 mm Hg, respectively. Chemicals used were of ANALAR grade procured from Sigma, SRL, BDH, Merck, and Qualigens. A total of thirty six (36) Punganur breed animals in different age groups were selected from the animals available at the Livestock Research Station and divided into six groups of six animals in each group. Group I Bulls (4 years and above) Group II **:** Cows (after first calving) Group III **:**Young bull (1 to 4 years) Group IV **:** Heifers (1 to 3years) Group V **:** Male calves (Below 1 year) Group VI : Female calves (Below 1 year). The experiment was conducted during three seasons of the year monsoon (June to August) winter (November to January) and summer (March to May). All animals were maintained under uniform managemental and husbandry conditions. They were housed in well-ventilated asbestos roofed shed with cemented anti-slippery floor. The animals fed with concentrate mixture consisted of maize 40%, wheat bran 37%, ground nut cake 20%, mineral mixture 2% and common salt 1% on dry matter basis and fresh greens and wheat straw were *ad libitum*. The animals were provided with clean drinking water *ad libitum* twice a day at about 9.30 AM and 3.30 PM. Same feeding and water regimen was given to all the cattle during the entire experiment period also. Blood samples were collected from jugular vein by adding EDTA at weekly intervals from all the animals to conduct hemogram. The physiological responses were also recorded at weekly intervals throughout the experimental period. Rectal temperature was recorded by clinical thermometer by inserting into rectum for one minute. Respiration rate was recorded by noticing the flank movements from a distance prior to examining the rectal temperature in order to avoid any disturbance to the animals. Pulse rate was recorded by counting middle coccegyeal artery pulse and heart rate with the help of a stethoscope. The blood was analyzed for hematology parameters like Red blood corpuscles (RBC) by Haymes fluid, White blood

corpuscles (WBC) using Thomas fluid, Differential leukocyte count by Battlement method ,Hemoglobin(Hb) by Sahlis method (Coles, 1986)., Packed cell volume(PCV) by microhematocrit method and erythrocyte sedimentation rate (ESR) by Wintrobe method by following procedure given in Veterinary Hematology by Jain NC (1986) The data was analyzed by ANOVA one way and two way as per Snedecor and Cochran (1994) using SPSS (V.15) software. A value of P<0.01 is considered as significant.

RESULTS AND DISCUSSION

The mean pulse rate in Punganur cattle of different age groups ranged between 59.79 and 63.56/min (Table 1) and these values are comparable to average pulse rate of 63.09 reported in Haryana cattle (Yadav et al., 2001), higher than the values reported for Ongole cattle 44 to 52/min (Chakravarthi *et al*., 2004) and lower than the values reported (Mahendra Singh et al., 2008) for crossbred cattle (70 to 77/min). The young animals i.e., young bulls, heifers and calves (Table 1) had a significantly (P<0.01) higher pulse rate than older cows and bulls. The mean pulse rate of Punganur cattle was significantly higher (P<0.01) during summer (64.03) than during monsoon or winter seasons (Table2). Similar to these observations several earlier reports (Singh and Bhattacharya, 1986; Yadav et al., 2001; Singh and Singh, 2005; Singh and Mishra, 1980) indicated higher pulse rate during summer due to thermal stress in cattle. The mean heart rate (per min) of young animals i.e., young bulls, heifers, male and female calves (Table 1) were significantly higher (P<0.01) than in adult cows and bulls and were higher than the values of 61 to 62 reported in Karanfries and Sahiwal cows (Singh and Singh, 2005) and comparable to the value of 67.40 reported (Chhikara and Singh, 2000) for crossbred cattle. The heart rate observed either during summer or monsoon was higher than that observed during winter (Table 2) and it might be due to thermal stress during summer or higher humidity during monsoon season. The mean rectal temperature in female calves was significantly higher (P<0.01) than in other age groups,(Table 1) although it is within normal range in all the age groups and is in agreement with the temperature reported in Holstein breed, Jersey crossbred and Haryana cattle (Singh and Mishra, 1980) in different seasons. However, Patel et al., (1985) reported higher rectal temperature in crossbred male than in female calves. The mean rectal temperature of Punganur cattle in the present study was significantly higher in summer season than in monsoon and winter seasons,(Table 2). This might be due to increase in ambient temperature during summer. Several other reports (Gaalaas, 1945, Chakravarthi *et al*., 2004; Singh and Singh, 2005; Koubkova et al., 2002, Singh and Upadhyay, 2009) also indicated similar observations of higher rectal temperature in animals exposed to higher ambient temperature. Punganur cattle rectal temperature was in agreement with that of Holstein breed, Jersey, crossbred and Haryana cattle reported by Singh and Mishra (1980) in different seasons. The respiratory rate in young animals i.e., male and female calves, heifers and young bulls was lower than in adult cows and bulls (Table 1) with the values ranging from 21.16 to 27.98 and these values are comparable well with the reported values of 25.60/min in Haryana cattle (Yadav et al., 2001), 22.52/min in Ongole bulls (Chakravarthi et al., 2004), 26.19 in Sahiwal heifers (Singh and Singh, 2005), 21.52/min in Karan Swiss bulls (Panjeta and Verma, 1995). However, Patel et al. (1985) reported higher respiratory rates of 25.66/min in Jersey cows and 28.33/min in Holstein crosses, whereas a lower respiratory rate of 17.77/min in crossbred calves under loose housing system was reported (Yazdani and Gupta, 2000). These variations in respiratory rate might be due to the varying environmental conditions, particularly ambient temperature which has a marked effect on respiratory rate.

Hemotology

The mean Total erythrocyte count (TEC) recorded in the present study was in the range of 7.50±0.15 to 8.68±0.54 millions/cumm (Table3). These counts were higher than the Harayana cattle (Ramakrishna *et al*., 1979) Kankrej cattle

(Mithuji et al., 1966) and Deoni cattle (Deshpande and Sawant, 1995) but these values were within the physiological limit for a cattle. The mean TEC of Punganur cattle was significantly higher in bulls than in other age groups. This result is in contrary to Prava and Dixit (2008) in Frieswal cattle and Oshare (2010) in HFX Sahiwal crosses who reported declining TEC with advancing of age from calves through heifers that became stable in adults. However, Deshpande et al. (1987) recorded higher TEC in heifers than in calves and cows of Red Kandhari cattle. The mean RBC count between sexes also differed significantly which was higher in males than in females. This is in agreement with the findings of Deshpande et al. (1987) in Red Kandhari cattle and Stark et al. (1978) in dairy cows. This might be due to testosterone hormone in males that increases basal metabolic rate and creates hypoxic condition and resultant erythropoietin and consequently more RBC count in males. Mean RBC count was varied among different seasons (Table 4) and which was higher in summer than in monsoon and winter. This result is in contrary to findings reported by Soley and Singh (2003) in dairy cattle and Mirzadeh et al. (2010) in Iranian cattle who reported reduced RBC levels during summer months. Whereas, Ozdemir et al. (2005b) in their study found that season had no effect on TEC in Holstein Swiss brown and their cross breeds. But, Prava and Dixit (2008) noticed higher TEC in calves and lactating cows of 5 years and above age during summer months. This increase in RBC concentration in summer might be due to adaptative mechanism of a breed to improve blood capacity for carrying oxygen due to hot environment (Nouty et al. 1986).

The mean PCV in the present study was in the range between 35.50±1.44 to 37.45±0.41%(Table 3) in different age groups. It is in the same range reported by Deshpande and Sawant (1995) in Deoni cattle and Pushpendra Kumar et al. (1999) in Siri cattle. Whereas, Rao et al. (1981) in Ongole cattle and Ramakrishna et al. (1979) in Hariana cattle reported less PCV values. The PVC value did not differ statistically among different age groups and also during different seasons, (Table 4), but it was significantly higher in heifers and also in summer season. This is in agreement with findings of Deshpande et al. (1987) who reported higher PCV in heifers. This might be due to intense care taken to attain early maturity for heifers. Soley and Singh (2003) in dairy cattle and Nouty et al. (1986) in Holstein cows noted lower PCV during summer than in spring season. The increased PCV during summer in the present study could be due to increased water loss from the body because hot environment stimulates sweating and consequently water loss and may also be due to higher RBC count during summer (Oshare 2010). The mean hemoglobin (Hb) content in the present study was in the range between 10.51±0.15 and 12.18±1.17 g/dl (Table3) among different age groups, which was lowest in young bulls and highest in male calves. Same range of Hb content was reported by Deshpande et al. (1986) in Red Kandhari cattle and Pushpendra Kumar et al. (1999) in Siri cattle. Raghunadan et al. (1977) reported higher Hb levels in calves than in heifers and cows this is in agreement with our results. Mirzadeh et al. (2010) noticed no sex difference in hemoglobin concentration in Iranian cattle, where as Korsbang (1959) and Deshpande et al. (1987) noticed sex difference in Hb levels which were higher in males than in females. It coincides with present results in which male Punganur cattle showed non-significantly higher Hb levels than females. The Hb levels were higher in summer than either in winter or monsoon (Table 4). These results were in contradiction of results reported by Soley and Singh (2003) in dairy cattle and Nouty et al. (1986) in Holstein cows who noticed lower values in summer than any other season of a year. Whereas, Prava and Dixit (2008) reported that season had no effect on Hb concentration in Frieswal cattle. The higher levels of Hb during summer may be because of higher total binding capacity of Fe+ during summer season (Srikhande et al. 2008) or could be due to hemo-concentration resulting from the loss of water through excessive sweating in an effort to lose heat from the body during stressful climate (Gadriya et al. 2008).

The mean total leucocytes count (TLC) in the present study was ranged between 8.69±0.24 and 11.27±0.95/cumm (Table3). Similar range for TLC was reported for Haryana

cattle by Ramakrishna et al., (1979) where as Deshpande and Sawant (1995) noticed less TLC in Deoni cattle. Among the different age groups, both adult groups i.e., bulls and cows showed higher TLC than young animals. This is in agreement with the findings of Mithuji et al. (1966). Whereas, Ozdemir et al. (2005) observed absence of variation in TLC among different age groups in Holstein and Brown Swiss cattle. Nouty et al. (1986) noticed higher TLC in Holstein breed in summer months than other seasons. In the present study also mean TLC was higher in summer than either in monsoon or winter, (Table 4). This could be due to release of corticosteroids or epinephrine hormones due to summer stress which in turn increased leukocyte count (Jain, 1986). The mean neutrophil (%) count recorded in the present study was ranged between 25.57±0.30 and 28.24±0.34 per cent (Table3) among different age groups, which was the lowest in cows and the highest in young bulls. The average neutrophil count reported in Haryana breed was 48.1±3.10 per cent which was higher than our results. Whereas, Deshpande and Sawant (1995) reported average value of 24.13±0.98, which is similar to our findings. Mean neutrophil count was significantly higher in summer than in winter and monsoon seasons,(Table 4). This is in contrary to results reported by Udaynarayan et al. (2007) who observed a decrease in summer. This increase might be due to accelerated mobilization of mature neutrophlis from marrow storage pool which occurred when the animal were exposed to any stress due to release of glucocorticoids (Jain, 1986). The range of eosinophil counts (%) recorded in the present study ranged between 4.28±0.24 and 6.03±0.37 percent (Table 3) with the lowest in young bulls and the highest in cows. These values are in agreement with the values reported by Mithuji et al. (1966) in Kankrej breeds. Whereas, Pushpendra Kumar et al. (1999) reported less values in Siri breed as 1.5±0.3 % only. The mean eosinophil count in the present study was higher in monsoon and lowest in summer seasons (Table 4). Whereas, no variations in eosinophil counts was found during different season (Udaynarayan et al., 2006). In the present study the mean basophil ranged between 0.18±0.03 and 0.58±0.08 percent (Table3) in different groups with the lowest in cows and the highest in young bulls. These values are in the same range reported for Hariana and Sahiwal breeds (Pyne and Maitra 1981). The mean basophil percentage reported in Deoni cattle was zero (0) (Deshpande and Sawant, 1995). The mean basophil count was statistically lower in summer as compared to either monsoon or winter, (Table 4). But this was also within the physiological range. In the present study the mean monocyte ranged between 6.45±0.22 and 6.98±0.21 % (Table 3) with lowest per cent in male calves and highest percent in cows which were statistically not differed. The mean monocyte value reported in Hariana cattle by Ramakrishna et al. (1979) was 3.45±0.4 which was slightly lower than our results. Similarly, Deshpande and Sawant (1995) also reported lower values (1.63±0.26) in Deoni cattle. The mean monocyte per cent recorded in the present study was higher in winter than in summer or monsoon, (Table 4). These findings are in contradiction to Udaynarayan et al. (2006) who reported no variation among different seasons.

The mean lymphocyte reported in the present study ranged between 59.49±0.52 and 62.00±0.24 percent (Table 3) with the lowest in male calves and the highest in bulls. The normal values for lymphocyte reported in Hariana cattle, Deoni cattle, Kankrej and Siri cattles were 60.68±2.35, 64.13±1.55, 67.01±1.68 and 42.33±9.80 percent, respectively. In the present study, the lymphocyte percent was increased in summer months as compared to either monsoon or winter seasons (Table 4). Similar findings were also noticed by Udaynarayan et al. (2006) in HF X Sahiwal cross breeds and they also reported that increase in blood leukocyte in cattle during summer was particularly due to the increase in lymphocyte count. The mean ESR recorded in the present study was in the range of 3.13±0.18 to 3.46±0.07 mm/hr(Table 3) among different age groups with the lowest in female calves and the highest in bulls. Similar values were reported in Hariana cattle by Ramakrishna et al. (1979). Whereas, Ahmed et al. (2003) recorded higher values of ESR in Sahiwal cattle. In the present study, higher ESR values were recorded in summer than either in winter or

monsoon (Table 4). The value was within the physiological range only. These findings are in contrary to Sattar and Mirza (2009) who reported no variation in ESR during different seasons. It is concluded that the values for the physiological responses such as temperature, respiration, pulse and heart rate were within the limits as prescribed for cattle, however during summer these values were higher as compared to winter and monsoon seasons confirming the effect of thermal stress on physical response of cattle. And the total RBC and WBC count, Hb content, PCV and ESR of Punganur cattle of different age groups were within the limit prescribed to the cattle and these values were higher during summer than monsoon and winter seasons confirming the adaptation of animals to the summer stress.

Table.1

Physiological parameters in different groups of Punganur cattle

Groups	Pulse rate per minute	Heart rate per minute	Rectal Temperature(^{o}F)	Respiration (per min)
Bull	61.19±0.94^{b}	62.94±1.74^{b}	100.24±0.42^{bc}	21.16±0.50^{e}
Cow	59.79±0.79^{c}	63.28±0.96^{b}	99.93±0.18^{c}	22.33±0.36^{d}
Young Bull	63.56±0.90^{a}	67.14±0.98^{a}	100.05±0.23^{c}	24.58±0.31^{c}
Heifer	63.10±0.65^{a}	66.92±0.77^{a}	100.49±0.15^{b}	27.24±0.47^{b}
Male calf	63.39±0.55^{a}	67.95±0.38^{a}	100.48±0.20^{b}	27.98±0.38^{a}
Female Calf	62.81±0.53^{a}	67.05±0.44^{a}	100.92±0.26^{a}	27.36±0.56^{ab}

Values with different lower superscripts in a column are significantly (P<0.01) different

Table.2

Effect of seasons on Physiological parameters of Punganur cattle

Seasons	Pulse rate per minute	Heart rate per minute	Rectal Temperature	Respiration (per min)
Monsoon	62.84±0.32^{b}	67.99±0.23^{a}	100.20±0.10^{b}	24.77±0.49^{b}
Winter	60.05±0.54^{c}	62.11±0.82^{b}	99.49±0.15^{c}	23.59±0.48^{c}
Summer	64.03±0.58^{a}	67.54±0.64^{a}	101.36±0.14^{a}	26.96±0.49^{a}

Values with different lower superscripts in a column are significantly (P<0.01) different

Table.3
Hematology in different groups of Punganur cattle

Groups	RBC count (millions/cumm)	PCV (%)	Hb (g /dl)	TLC ($X10^3$ cells/cumm)	Neutrophils (%)	Esinophils (%)	Basophils (%)	Monocytes (%)	Lymphocytes (%)	ESR
Bull	8.68±0.54^{a}	36.37±0.74	11.11±0.53	11.27±0.77^{a}	25.65±0.39^{cd}	5.74±0.37^{a}	0.43±0.12^{ab}	6.48±0.21^{a}	62.00±0.24^{a}	3.46±0.07
Cow	7.77 ±0.22^{bcd}	35.09±0.62	10.88±0.16	10.99±0.98^{ab}	25.57±0.30^{d}	6.03±0.37^{a}	0.18±0.03^{c}	6.84±0.32^{a}	61.32±0.53^{a}	3.23±0.06
Young Bull	7.86 ±0.23^{bc}	35.16±0.51	10.51±0.15	8.69±0.24^{b}	28.24±0.34^{a}	4.28±0.24^{b}	0.58±0.08^{a}	6.63±0.31^{a}	60.29±0.55^{bc}	3.40±0.08
Heifer	7.50 ±0.15^{d}	39.87±2.66	10.84±0.15	10.36±0.69^{abc}	26.40±0.37^{c}	4.59±0.24^{b}	0.46±0.11^{ab}	6.59±0.36^{a}	61.87±0.47^{a}	3.20±0.07
Male calf	8.04±0.23^{b}	36.35±0.53	12.18±1.17	9.76±0.20^{bcd}	27.37±0.35^{b}	5.86±0.37^{a}	0.40±0.08^{b}	6.45±0.22^{a}	59.49±0.52^{c}	3.14±0.07
Female Calf	7.53±.19^{cd}	36.11±0.53	11.13±0.13	9.12±0.13^{cd}	25.79±0.28^{cd}	5.83±0.37^{a}	0.33±0.05^{bc}	6.98±0.21^{a}	61.15±0.36^{ab}	3.13±0.18

Values with different lower superscripts in a column are significantly (P<0.01) different

Table.4
Effect of seasons on Hematology of Punganur cattle

Seasons	RBC count (millions/cumm)	PCV (%)	Hb (g /dl)	TLC ($X10^3$ cells/cumm)	Neutrophils (%)	Esinophils (%)	Basophils (%)	Monocytes (%)	Lymphocytes (%)	ESR
Monsoon	7.56±0.05^{b}	36.53±0.23	11.02±0.08^{b}	9.91±0.34^{b}	26.38±0.29^{b}	6.34±0.24^{a}	0.49±0.07^{a}	6.00±0.10^{b}	60.51±0.36^{b}	3.25±0.05^{Ab}
Winter	6.94±0.06^{c}	35.50±1.44	10.33±0.07^{b}	8.83±0.34^{b}	25.72±0.28^{c}	5.94±0.17^{b}	0.48±0.07^{a}	7.99±0.15^{a}	60.01±0.31^{b}	3.11±0.09^{b}
Summer	9.19±0.23^{a}	37.45±0.43	12.11±0.58^{a}	11.36±0.52^{a}	27.41±0.22^{a}	3.88±0.13^{c}	0.22±0.03^{b}	6.00±0.11^{b}	62.54±0.21^{a}	3.42±0.05^{a}

Values with different lower superscripts in a column are significantly (P<0.01) different

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