

HAEMATO-BIOCHEMICAL STUDIES ON SUMMER HYPERTHERMIA IN CATTLE

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ABSTRACT

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To observe, the effect of temperature variability on haemato-biochemical profile the present study was conducted on 20 clinical cases of cattle suffering from summer hyperthermia brought to Medicine Clinic of Veterinary Clinical Complex, CVAS, Bikaner during the period of June 2016 to July 2016. Among haematological parameters haemoglobin concentration and mean corpuscular haemoglobin concentration increased significantly ($P < 0.01$). Total erythrocyte count and packed cell volume were non-significantly increased. MCH, MCV and total leucocyte count were non-significantly decreased while total platelet count decreased significantly ($P < 0.01$). Among biochemical parameters serum aspartate aminotransferase (AST), serum alanine aminotransferase (AL), serum alkaline phosphatase (ALKP), blood urea nitrogen, creatinine, creatinine kinase, lactate and lactate dehydrogenase increased significantly ($P < 0.01$) while blood glucose, decreased significantly ($P < 0.01$) in summer hyperthermia suffered cattle as compared to healthy cattle.

Key words: Haemato-biochemical profile, cattle, summer hyperthermia

Introduction

The performance of animals is a product of interaction between the environment and genotype (Silanikove, 2000). Cattle are homeothermic animals and they require to keep their core body temperature in a relatively steady state, when the external temperature changes, dairy cattle try to maintain this equilibrium by balancing the heat produced from their metabolism in exchange with the environment (Al-Kanaan, 2016). Heat is lost from the body by radiation, conduction, convection, evaporation of water from skin and respiratory passages and excretion of faeces and urine.

Bikaner has a subtropical desert/low-latitude arid hot climate (Koppen-Geiger classification: BWh). The climate in Bikaner is characterised by significant variations in temperature. In the summer season it is very hot when the temperatures lie in the range of 28-48.5°C. Cattle with heat intolerance lost body condition; milk production and fertility are reduced. Excessive heat stress may cause hyperthermia and potentially have several physiological side effects and economic impacts on the livestock industry. There are several potential metabolic health problems and related interaction of heat stress that might arise from physiological response to heat stress.

Materials and Methods

Animals

The present study was conducted on 20 clinical cases of cattle suffering from summer hyperthermia brought to Medicine Clinic of Teaching Veterinary Clinical Complex, CVAS, Bikaner, during the period of June 2016 to July 2016. The presented cattle were investigated for absence of protozoan parasite, clinical signs and changes in the haemato-biochemical parameters.

Collection of blood samples

After clinical examination of the cattle, blood samples were collected from ear vein of all diseased cattle for preparation of blood smears for detection of protozoan parasites. For

haemato-biochemical studies blood samples were collected from jugular vein with all aseptic precautions in sterilized test tubes from 20 cattle suffering with summer hyperthermia and ten healthy cattle. Blood was collected in sterile tubes having disodium salt of ethylene diamine tetra acetic acid (EDTA) as recommended by Jain (1986). For biochemical studies, after collection of blood the serum was separated by standard procedure and serum was pipette out in small Pyrex tubes and was kept immediately in the deep freeze at -20°C till analysis.

Haemato-biochemical examination

Haemoglobin, packed cell volume, total erythrocyte count, total leucocyte count, total platelet count, differential leucocyte count, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were analyzed as per the methods described by Jain (1986). Blood urea nitrogen, creatinine, creatinine kinase, lactate, lactate dehydrogenase, serum aspartate aminotransferase (AST), serum alanine aminotransferase (ALT), alkaline phosphatase (ALKP) and blood glucose were determined by the Vet Test Chemistry Analyser using kit supplied by Idexx laboratories, as per the manufacturer's subscribed procedure.

Results and Discussion

Haemoglobin

There was highly significant increase in mean value ($p < 0.01$) of haemoglobin (Table 1) in summer hyperthermia suffered cattle (11.72 ± 0.33 g/dl) as compared to healthy cattle (10.58 ± 0.35 g/dl). The findings of this research work supported by the findings of several workers including, Abd-Alkareem *et al.* (2015), Chaudhary *et al.* (2015) and Kiran (2016).

Packed cell volume

There was no significant increase in mean value of PCV (Table 1) in summer hyperthermia suffered cattle (34.77 ± 1.22

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per cent) as compared to healthy cattle (33.07 ± 1.23 per cent). The findings of this study were similar to the findings of several workers including Haque *et al.* (2013), Rana *et al.* (2014) and Abd-Alkareem *et al.* (2015).

Total erythrocyte count

There was no significant increase in mean value of total erythrocyte count (Table 1) in summer hyperthermia suffered cattle ($7.64 \pm 0.17 \times 10^{12}/l$) as compared to healthy cattle ($6.65 \pm 0.35 \times 10^{12}/l$). Similar findings were also recorded by several workers including Rana *et al.* (2014), Abd-Alkareem *et al.* (2015) and Chaudhary *et al.* (2015).

MCH, MCV and MCHC

There was no significant difference in mean value of MCH (15.48 ± 0.56 pg) and MCV (45.90 ± 1.81 fl) (Table 1) in summer hyperthermia suffered cattle as compared to healthy cattle MCH (16.09 ± 0.51 pg) and MCV (50.11 ± 1.17 fl). The present findings are in accordance with finding of Haque *et al.* (2013).

The increase in haemoglobin, PCV, total erythrocyte and MCHC values may be attributed to moderate to severe dehydration. Increase in haemoglobin also may be due to haemoconcentration. The increase may also be attributed to the fact that an animal requires more oxygen in any stressful condition and as a consequent, haemoglobin concentration may rise (Haque *et al.*, 2013). The higher PCV values had been reported to be an adapted mechanism to provide water necessary for evaporative cooling process (Al-Haidary, 2004).

Total leucocyte count

There was no significant difference in mean value of total leucocyte count (Table 1) in summer hyperthermia suffered cattle ($7.99 \pm 0.34 \times 10^9/l$) as compared to healthy cattle ($7.89 \pm 0.39 \times 10^9/l$). The findings of this research work supported by the findings of Rana *et al.* (2014). In present study, total leucocyte counts were non-significantly changed in summer hyperthermia suffered cattle as compared with healthy cattle which may be due to seasonal changes in thermal environment was not affect the total leucocyte counts (Abdelatif *et al.*, 2009).

Total platelet count

There was highly significant decrease in ($p < 0.01$) mean value of total platelet count (Table 1) in summer hyperthermia suffered cattle ($332.30 \pm 15.24 \times 10^9/l$) as compared to healthy cattle ($431.20 \pm 8.61 \times 10^9/l$). Similar findings were recorded by Hashim (2010). In the present study decrease in total platelets count thrombocytopenia were observed which may be explained as hyperthermia enhances vascular permeability, and increases the ability of cells to adhere to the vascular walls causing alterations in blood flow. The activation of the coagulation cascade is exaggerated and platelets are consumed in large quantities, leading to thrombocytopenia (Bouchama and Knochel, 2002).

Biochemical parameters

Serum alanine aminotransferase (ALT)

There was highly significant increase ($p < 0.01$) in mean value of serum alanine aminotransferase (Table 2) in summer hyperthermia suffered cattle (98.40 ± 7.07 U/l) as compared to that of healthy cattle (18.90 ± 3.42 U/l). The observations

recorded in the present study are in agreement with findings of Choudhary *et al.* (2015) and Kiran (2016).

Serum aspartate aminotransferase (AST)

There was highly significant increase ($p < 0.01$) in mean value of serum aspartate aminotransferase (Table 2) in summer hyperthermia suffered cattle (373.50 ± 14.13 U/l) as compared to healthy cattle (81.90 ± 5.96 U/l). The findings of this research work supported by the findings of Bhan *et al.* (2013) and Kiran (2016).

Serum alkaline phosphatase (ALKP)

There was highly significant increase ($p < 0.01$) in mean value of serum alkaline phosphatase (Table 2) in summer hyperthermia suffered cattle (112.00 ± 4.66 U/l) as compared to that in healthy cattle (77.30 ± 8.55 U/l). The observations recorded in the present study are supported by the findings of Hashim (2010) and Bhan *et al.* (2013).

Serum lactate dehydrogenase (LDH)

There was highly significant increase ($p < 0.01$) in mean value of serum lactate dehydrogenase (Table-2) in summer hyperthermia suffered cattle (1371.20 ± 20.06 U/l) as compared to healthy cattle (959.80 ± 57.45 U/l). The observations recorded in the present study are in agreement with findings of Bhan *et al.* (2013) and Kiran (2016).

Serum creatinine kinase (CK)

There was highly significant increase ($p < 0.01$) in mean value of serum creatinine kinase (Table 2) in summer hyperthermia suffered cattle (358.25 ± 5.42 U/l) as compared to that in healthy cattle (111.30 ± 10.43 U/l). The observations recorded in the present study are in agreement with findings of Varghese *et al.* (2005) and Kiran (2016).

These increases in AST, AL, ALKP, LDH and CK values may be associated with liver damage due to direct thermal injury and hypoxia secondary to splenic re-distribution (Bhan *et al.*, 2013).

Serum blood urea nitrogen (BUN)

There was highly significant increase ($p < 0.01$) in mean value of serum blood urea nitrogen (Table-2) in summer hyperthermia suffered cattle (42.05 ± 2.28 mg/dl) as compared to that in healthy cattle (15.70 ± 1.48 mg/dl). The observations recorded in the present study are in accordance with findings of Choudhary *et al.* (2015) and Kiran (2016).

Serum creatinine

There was highly significant increase ($p < 0.01$) in mean value of serum creatinine (Table 2) in summer hyperthermia suffered cattle (3.43 ± 0.22 mg/dl) as compared to that in healthy cattle (0.88 ± 0.08 mg/dl). The findings of this research work supported by the findings of Choudhary *et al.* (2015) and Yadav *et al.* (2016).

Increased serum creatinine may be due to reduced renal blood flow and glomerular filtration rate as well as to the release of creatine from muscle. Elevated urea may be due to prerenal causes such as hypovolaemia, cardiac failure and/or to intravascular haemolysis (Hashim, 2010).

Serum lactate

There was highly significant increase ($p < 0.01$) in

Table 1: Mean±SE values of haematological parameters in healthy and summer hyperthermia suffered cattle

Parameters	Healthy cattle (n=10)	Summer hyperthermia suffered cattle (n=20)
Hb (g/dl)**	10.58±0.35 ^a	11.72±0.33 ^b
PCV (%)	33.07±1.23	34.77±1.22
TEC (10 ¹² /l)	6.65±0.35	7.64±0.17
TLC (10 ⁹ /l)	7.89±0.39	7.99±0.34
TPC (10 ⁹ /l)**	431.20±8.61 ^b	332.30±15.24 ^a
MCH (pg)	16.09±0.51	15.48±0.56
MCV (fl)	50.11±1.17	45.90±1.81
MCHC (%) **	32.06±0.43 ^b	33.90±0.44 ^c

Table 2: Mean±SE values of biochemical parameters in healthy and summer hyperthermia suffered cattle

Parameters	Healthy cattle (n=10)	Summer hyperthermia suffered cattle (n=20)
ALT (U/L)**	18.90±3.42 ^a	98.40±7.07 ^c
AST (U/L)**	81.90±5.96 ^a	373.50±14.13 ^b
ALKP (U/L)**	77.30±8.55 ^a	112.00±4.66 ^b
LDH (U/L)**	959.80±57.45 ^a	1371.20±20.06 ^c
CK (U/L)**	111.30±10.43 ^a	358.25±5.42 ^c
BUN (mg/dl)**	15.70±1.48 ^a	42.05±2.28 ^c
Creatinine (mg/dl)**	0.88±0.08 ^a	3.43±0.22 ^b
Lactate (mmol/l)**	1.36±0.24 ^a	8.22±0.65 ^c
Glucose (mg/dl)**	67.30±4.32 ^b	53.10±1.93 ^a

meanvalue of serum lactate (Table 2) in summer hyperthermia suffered cattle (8.22±0.65 mmol/l) as compared to that in healthy cattle (1.36±0.24 mmol/l). The observations recorded in the present study are in agreement with findings of Temizel *et al.* (2009) and Kiran (2016).

Serum lactate level was increased significantly in summer hyperthermia suffered cattle which may be attributed to formation of L-lactate from anaerobic glycolysis following tissue hypo perfusion (Knochel, 1996).

Serum glucose

There was highly significant decrease (p<0.01) in mean value of serum glucose (Table 2) in summer hyperthermia suffered cattle (53.10±1.93 mg/dl) as compared to that in healthy cattle (67.30±4.32 mg/dl). The observations recorded in the present study are in agreement with findings of Macias-Cruz *et al.* (2016) and Teama (2016).

Decrease in glucose may be due to the increased metabolic activity which consumes vast amounts of glucose while glycogen store rapidly depleted in injured liver due to thermal injury and hypo-perfusion to liver in summer hyperthermia (Drobatz, 2004).

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