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**ORIGINAL ARTICLE**

# A Study on Serum Electrolyte Pattern During Ambient Stress in *Murrah* Buffalo of Arid Tracts in India

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A study was undertaken to assess the effect of ambient stress on serum electrolyte pattern of *Murrah* buffaloes of arid tracts in India. Healthy adult female *Murrah* buffaloes were grouped according to physiological states and screened during moderate, hot and cold ambiences. The mean values (m mol $L^{-1}$) of serum inorganic phosphorus, calcium and magnesium during moderate ambience were 1.80± 0.01, 2.80± 0.01 and 0.90± 0.002, respectively. During hot and cold ambiences significant ($p \leq 0.05$) decrease was observed in the mean value of each electrolyte. Decline was higher during hot ambience as compared to cold ambience. In each ambience it was noticed that serum electrolyte concentration of pregnant dry animals was lowest significantly ($p \leq 0.05$) as compared to non pregnant milch followed by pregnant milch. Multipara animals showed significantly ($p \leq 0.05$) lower value of each electrolyte as compared to primipara. It was concluded that ambient stress during hot and cold ambiences resulted in depletion of electrolyte levels of the buffaloes of all physiological states.

*Key words: Ambience, cold, electrolytes, hot, Murrah buffalo, serum*

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The unprecedented, rapid change in environmental conditions of animals is likely to override the adaptive potential of animals which is day by day becoming a serious health issue for milch animals. Ambient temperature variation poses a number of physiological and behavioural responses which may vary in intensity and duration in relation to the animal species and breed. To enhance animal performance, it is essential to reduce ambient stress. This involves strategies to monitor certain simple analytes so that health can be monitored periodically. Electrolytes are minerals which, when dissolved in water, carry an electrical charge. There are many different electrolytes which the animals need, including inorganic phosphorus, calcium and magnesium. Each of these electrolytes has many different crucial roles in the body, especially for cells such as neurons and muscle cells, which use electrolytes to generate electrical signals. Hot ambience associated changes in electrolyte levels can be used as an index of heat stress (Ilambarithi *et al*., 2009).

Ambient stress related variations in the electrolyte level are well documented in various species of animals (Baruah and Baruah, 1998 and Dias *et al*., 2008). However, comprehensive studies on this aspect in buffaloes are lacking especially during various physiological states.Physiological concentrations of electrolytes should always be maintained for proper maintenance of the cellular functions of the animal. The normal concentrations of these electrolytes in different tissues mainly depend on the dietary concentration, absorption and also on concentration of other tissue elements, homeostatic control mechanism of the body and the species of animal involved. Regular reproductive patterns and optimum milk production of buffaloes depend upon proper mineral supplementation.There is a general consensus that low production and sub-optimal reproductive efficiency of buffaloes are due to inadequate nutrition, particularly deficiency of minerals. The ovarian activity of buffalo is influenced by mineral deficiency (Husnain *et al.,* 1981 ).

The *Murrah* is the premier milking buffalo of India. These animals contribute greatly in enhancing economical status of farmers. Although exposure of these animals to extreme temperatures of arid and semiarid tracts is unavoidable but certain health and management measures can protect them from health problems. Extreme ambient heat and cold bring about changes in electrolytes necessary for homeostasis resulting in reduced fertility, milk production and health disorders. Determination of extent of variation in the levels of electrolyte during extreme ambiences can contribute greatly in formulating type of mineral supplementation in these animals. So far very few reports are available on the effect of ambient stress on electrolyte levels in buffaloes. Therefore the present investigation was planned to determine serum electrolytes levels during extreme ambiences in *Murrah* buffaloes of arid tracts.

## MATERIALS AND METHODS

To carry out the study, four hundred and fifty blood samples of apparently healthy adult female *Murrah* buffaloes between 4 and 12 years of age were collected to harvest the serum during moderate (mean maximum ambient temperature 30.33 ± 0.20), hot (mean maximum ambient temperature 45.5 ± 0.08) and cold (mean minimum ambient temperature 4.88 ± 0.20) ambiences. All the animals belonged to private dairy farms in Rajasthan state, India and were managed in similar conditions of feeding and watering. In each ambience 150 blood samples were collected during morning hours. On the basis of physiological states, animals were broadly divided into group A (non-pregnant milch, pregnant milch and pregnant dry) and group B (primipara and multipara). Each category consisted of 30 animals in each ambience.

Serum inorganic phosphorus was determined by the method of Fiske and Subarrow (Oser,1976), serum calcium by the method of Clark and Collip, modified by Kramer and Tisdall (Oser,1976) and serum magnesium by titan yellow method (Varley, 1988). The changes in the means were measured by using multiple mean comparison procedures (Duncan, 1955 and Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

The mean ± SEM values of serum electrolytes In *Murrah* buffaloes during moderate, hot and cold ambiences are presented in table1. The mean values of serum inorganic phosphorus, calcium and magnesium were significantly ($p \leq 0.05$) lower during hot and cold ambiences in comparison to respective moderate mean values. In group A, serum inorganic phosphorus, calcium and magnesium mean values of non pregnant milch, pregnant milch and pregnant dry animals differed significantly ($p \leq 0.05$) from each other, respectively in all the ambiences. In each ambience the mean value of each electrolyte of non pregnant milch animals was highest whereas it was lowest in pregnant dry animals. In group B, the mean values of each electrolyte was significantly ($p \leq 0.05$) higher in primipara animals than multipara in each ambience.

Earlier researchers have documented the effect of ambient stress on electrolytes in various species (Kataria *et al*., 1993, Shrikhande *et al*., 1997, Antunovic *et al.,* 2002, Kataria *et al*., 2002 and Khan *et al.,* 2007). Extreme ambience associated stress could result in higher cortisol which is known to decrease serum phosphorus (Koch *et al.,* 1961) resulting in oxidative stress due to formation of free radicals producing disruption of ionic environment of the cell (Walwadkar *et al*., 2006). Extreme ambience associated decrease in serum calcium indicates towards oxidative stress with the fact that latter disrupts normal physiological pathways and cause cell death due to calcium influx from the extracellular environment and then influx into mitochondria modulating normal metabolism (Ermak and Davies, 2002). This intracellular excess of calcium helps in developing oxidative stress (Brookes *et al.,* 2000). Extreme ambience related decrease in serum magnesium concentration has been correlated to oxidative stress by researchers on the basis of an interrelationship between magnesium changes and blood oxidants or antioxidants (Cernak *et al*., 2000). The increasing significance to understand the role of serum magnesium as an indirect parameter to assess oxidative stress will help in health management of the animals. This is based on the fact that magnesium status directly influence the cellular redox state and its deficiency is associated with the increased production of free radicals along with induction of immune and inflammatory reactions (Schiffrin, 2005).

Effect of physiological states on serum inorganic phosphorus in buffaloes (Husnain *et al.*, 1981) could be due to oestrogen and progesterone influence (Dullo and Vedi, 2008). Variation in levels of inorganic phosphorus levels according to pariety indicated age effect (Sharifi *et al*., 2005). Higher serum inorganic phosphorus in young animals showed increased turnover under the influence of growth hormone (Durand *et al*., 1976). Correlation of variation in calcium levels due to physiological states of buffaloes has been reported (Hagawane *et al*., 2009). Calcium deficiency can lead to reproductive problems. Higher serum calcium in primipara probably indicates calcium retention in blood (Braithwaite, 1975). Higher value of serum magnesium in primipara indicated age effect which could be related to the effect of growth hormone on serum magnesium level (Hanna, 1961).

The results of variation in electrolyte pattern due to physiological states could be under the influence of various hormones. However, further lowering of serum electrolyte levels during extreme ambiences pointed out stress mediated modulations in the electrolytes. It was concluded that variations in the ambient temperatures during extreme hot and extreme cold ambiences produced stress to the animals and brought significant changes in the levels of serum electrolytes. Animals of all the physiological states showed depletion of electrolyte concentrations in the serum. This study substantiates the fact that buffaloes during extreme ambiences should be well supplemented with the electrolytes to avoid development of oxidative stress. The data generated from large number of animals will help in providing reference values for clinical diagnosis.

**Table 1.** Mean ± SEM values of serum inorganic phosphorus, calcium and magnesium in *Murrah* buffalo

| **Ambiences** | **Serum electrolytes( m mol $L^{-1}$ )** | | |
|---|---|---|---|
| | **Inorganic Phosphorus** | **Calcium** | **Magnesium** |
| **Moderate (150)** | 1.80±0.01[b] | 2.80±0.01 [b] | 0.90±0.002 [b] |
| **Group A** | | | |
| Non-pregnant milch(30) | 2.00±0.01 [d] | 2.9±0.01 [d] | 1.00±0.003 [d] |
| Pregnant milch (30) | 1.80±0.02[d] | 2.8±0.02[d] | 0.91±0.003[d] |
| Pregnant dry(30) | 1.60±0.01[d] | 2.7±0.01[d] | 0.79±0.002 [d] |
| **Group B** | | | |
| Primipara (30) | 1.93±0.02 [f] | 3.0±0.01 [f] | 1.00±0.002 [f] |
| Multipara (30) | 1.67±0.01[f] | 2.6±0.01[f] | 0.80±0.003 [f] |
| **Hot (150)** | 1.20±0.01[b] | 2.00±0.012[b] | 0.70±0.001[b] |
| **Group A** | | | |
| Non-pregnant milch(30) | 1.30±0.01 [d] | 2.20±0.01 [d] | 0.80±0.001 [d] |
| Pregnant milch (30) | 1.20±0.02[d] | 2.00±0.02 [d] | 0.71±0.002[d] |
| Pregnant dry(30) | 1.10±0.01 [f] | 1.80±0.01 [f] | 0.59±0.001 [f] |
| **Group B** | | | |
| Primipara (30) | 1.32±0.01 [f] | 2.00±0.02[f] | 0.75±0.002 [f] |
| Multipara (30) | 1.08±0.02 [f] | 1.60±0.01[f] | 0.65±0.001[f] |
| **Cold (150)** | 1.71±0.010[b] | 2.47±0.02 | 0.84±0.002[b] |
| **Group A** | | | |
| Non-pregnant milch(30) | 1.82±0.012 [d] | 2.68±0.02 [d] | 0.96±0.003 [d] |
| Pregnant milch (30) | 1.70±0.012 [d] | 2.46 ±0.02[d] | 0.85±0.003[d] |
| Pregnant dry(30) | 1.61±0.020 [f] | 2.27 ±0.01[f] | 0.71±0.001[f] |
| **Group B** | | | |
| Primipara (30) | 1.80±0.011 [f] | 2.79±0.03 [f] | 0.96±0.002 [f] |
| Multipara (30) | 1.62±0.021 [f] | 2.15±0.02[f] | 0.72±0.003[f] |

i.Figures in the parenthesis indicate number of buffaloes.
ii.'b' marks significant (p≤0.05) differences among ambience mean values of an electrolyte.
iii.'d' marks significant (p≤0.05) differences among non-pregnant milch, pregnant milch and pregnant dry mean values of an electrolyte within an ambience.
iv.'f' marks significant (p≤0.05) differences between mean values of primipara and multipara of an electrolyte within an ambience

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