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RESEARCH ARTICLE

Minerals and electrolytes profile in different physiological stages of Gir cattle and Jaffarabadi buffaloes

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Abstract : The study was carried out in Gir cattle and Jaffarabadi buffaloes from different age groups that are from birth to mature animal of both sexes of various physiological stages were used for the study which were reared and maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, Gujarat and various parameters was estimated in Department of Physiology and Biochemistry.A total of 8 ml of blood was collected aseptically through the jugular vein from the animals and were centrifuged to separate clear plasma. Plasma aliquots were stored in different vials at -20 ºC for the estimation of various mineral and electrolyte parameters. The levels observed and the detailed comparison of trace minerals (Copper, Iron, Zinc, Manganese and Chromium) and electrolyte parameters (Bicarbonate, Chloride and Osmolality) of both the sexes between Gir cattle and Jaffarabadi buffaloes recorded in this study may serve as baseline data and reference point for further studies in these species and will help in planning for the improvement of reproductive and productive performance of these animals.

Key words : Plasma minerals, Electrolytes, Osmolality, Gir, Jaffrabadi

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INTRODUCTION

Our country has a rich genetic diversity of cattle with 30 well known breeds of cattle in various parts of the country (Anonymous, 2007). The bovine population in Gujarat in the year 2007 was 1.67 crores consisting of 79.75 lakh cattle and 87.73 lakh buffaloes. As per the census of 2007, Gir cattle constitute 13.99 lakh of the total 79.75 lakh cattle and 14.70 lakh of the total 87.73 lakh buffalo population of Gujarat (Gswan, 2011). Gir cattle originally belongs to Saurashtra region of Gujarat having advantages such as resistant to hot temperatures as well as tropical diseases and good animal produces around 12-25 litres (L) milk/day.The buffalo (*Bubalus bubalis*) occupies an important and strategic place in the overall agricultural economy of India. Though it is considered similar to cattle, there exist many physiological and biochemical differences between them which is reflected through their production and reproduction performances. Buffalo has been used in India from time immemorial in one form or another and has better survival ability under Indian conditions (Dhanda, 2004).

Assessment of physiological norms for particular breed in particular region has great importance for base of clinical interpretation of certain indices. These indices may vary depending upon the factors such as age, sex, weather, stress, season, physiological stage etcof the animal (Kaneko *et al*., 2008). Thus, the biological variations in the plasma indices serve valuable importance in judging the status of health, production and reproduction.Many of the parameters in these two breeds *viz.*, Hematology, Some of Serum Enzymes, Endocrine estimates, Major minerals such as Calcium, Phosphorus and Magnesium, etc. have been recently worked upon (Ninan, 2012). However, information on trace minerals which are related to the production and reproduction is very scanty. Therefore, the present study was conducted in different age groups and physiological stages in Gir cattle and Jaffarabadi buffaloes to estimate the levels of trace minerals *viz.*, Copper, Iron, Zinc, Manganese and Chromium in plasma of both the species and to determine the values of Chloride, Bicarbonate and Osmolality in plasma of both the species.

RESEARCH METHODOLOGY

The study was carried out in Gir cattle and Jaffarabadi buffaloes from different age groups that are from birth to mature animal of both sexes of various physiological stages were used for the study which were reared and maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh, Gujarat.Estimation of various parameters were carried out in Department of Animal Physiology and Biochemistry, College of Veterinary Science and A.H., Anand Agricultural University, Anand, Gujarat as well as in Department of Veterinary Physiology and Biochemistry, Vanbandhu College of Veterinary Science and Animal Husbandry, Navsari Agricultural University, Navsari.The project was approved by the Institution Animal Ethics Committee (IAEC).

Blood collection:

Blood collection was conducted during the month of October to December, 2011.Blood was collected aseptically through the jugular vein from the animals. A total of 8 ml of blood was collected in a single vein puncture and were centrifuged at 3000 RPM for 15 minutes to separate clear plasma. Plasma aliquots were stored in different vials at -20 ºC for the estimation of various mineral and electrolyte parameters.

Laboratory analysis:

Trace minerals :

Blood plasma samples (0.5 ml) were digested with 4.5 ml of triple acid mixture (concentrated sulphuric acid: perchloric acid: nitric acid in the ratio of 1:2:1) till it becomes colorless. After digestion the final volume was made to 25 ml with triple glass distilled water. Copper, iron, zinc, manganese and chromium concentration from the digested samples were determined by atomic absorption spectrophotometer (Model: AAS4141, Electronics Corporation of India Ltd.) using method as described by (Oser, 1979).

Bicarbonate, chloride and osmolality :

Parameters *viz.*, bicarbonate, chloride and osmolality were estimated with an apparatus Arterial Blood Gas Analyzer (Model: Stat Profile Critical Care Xpress, Nova biomedical, USA).

Statistical analyses:

The data generated on various parameters of this study were subjected to statistical analyses by using SPSS (Statistical Product and Service Solutions, version 17.0) computer programme and applying Completely Randomized Design as per Snedecor and Cochran (1984).

RESULTS AND DISCUSSION

The mean ± SE levels of minerals and electrolytes at different age in Gir and Jaffarabadi animals was presented in Table 1 and 2 and at different physiological stages of these two species was in Table 3.

Minerals parameters :

The range of plasma copper (ppm) in Gir females and males was from 0.69 ± 0.01(to 1.33 ± 0.10 and 0.74 ± 0.02to 1.01 ± 0.04 and ranged from 0.74 ± 0.02 to 1.05 ± 0.06 and 0.73 ± 0.02 to 0.98 ± 0.03 in Jaffarabadi females and males, respectively. Increasing trend was observed in plasma copper levels as age advanced in both the sexes of both the species. Decreasing trend was observed as stage of lactation advanced in both Gir and Jaffarabadi lactating animals. Non-significant difference was observed between non-lactating pregnant and non-lactating non-pregnant in Gir and Jaffarabadi females. Significant ($P < 0.05$) higher value was observed in Gir cattle at 3 month lactation stage than corresponding value in Jaffarabadi buffaloes. Plasma copper levels differed non-significantly between Gir males and Jaffarabadi males at all ages and physiological stages (Table 1 and 2).The observed values of this study of plasma copper at all ages and physiological stages were above the critical range as per Das *et al.* (2003); Gadberry *et al.* (2003); Tiwary *et al.* (2010) and Shukla *et al.* (2010).The higher values of copper in adults than that of young animals suggest the very possible role of copper in reproductive function (Kreplin and Yaremcio, 1992).

The range of plasma Iron (ppm) in Gir females and males was from 2.43 ± 0.14 to 3.39 ± 0.11 and 2.12 ± 0.23 to 3.10 ± 0.11 and ranged from 2.14 ± 0.20 to 3.10 ± 0.0.16 and 1.86 ± 0.18 to 3.04 ± 0.23 in Jaffarabadi females and males, respectively at all ages and physiological stages. Iron levels were found higher in adult as compare to younger animals in present study except in Gir females. As stage of lactation advanced, increasing trend was observed in Gir cattle, while in contrast to Gir cattle decreasing trend was observed in Jaffarabadi buffaloes. The Iron levels was significantly ($P < 0.05$) higher at 1, 3 and 6 month ages in Gir females than the corresponding values in Gir males. In Jaffarabadi females, plasma iron levels were significantly ($P < 0.05$) higher at 1 month age while it was non-significantly higher at 1 week, 3 and 12 month ages than that of Jaffarabadi males. Significant ($P < 0.05$) higher values in Gir cattle were observed in plasma iron levels at 1, 3 and 6 month ages than that of corresponding values in Jaffarabadi females. Among lactating females, significant ($P < 0.05$) higher value was observed at 3 month lactation stage than corresponding value in Jaffarabadi buffaloes. Significant ($P < 0.05$) higher value of plasma iron was found at 1 month age in Gir males than the corresponding value in Jaffarabadi males (Table 1).Plasma iron levels increase as age advanced in these animals and also the overall higher levels in lactating females than that of other ages and physiological stages, were in agreement to the values reported by Das *et al.* (2003) and Akhtar *et al.* (2010). While non-significant higher levels in cows than that of heifers found by Gadberry *et al.* (2003), are also in agreement to our findings. The values in bullocks by Das *et al.* (2003) were also in accordance to our findings.The relative higher values of iron in adults showed the reproductive utilities of iron *i.e.* the iron deficient animal becomes repeat breeder and require increased number of insemination per conception and occasionally may abort (Khillare, 2007).

The plasma zinc (ppm) in Gir females and males ranged from 1.17 ± 0.06 to 2.18 ± 0.14 and 0.77 ± 0.22 to 2.01 ± 0.11 and ranged from 1.17 ± 0.05 to 1.98 ± 0.14 (1 week age) 0.98 ± 0.19 to 1.88 ± 0.08 in Jaffarabadi females and males, respectively at all ages and physiological stages. The decreasing trend as observed in zinc levels with advancement of in age and lactation stage both in Gir cattle and Jaffarabadi buffaloes. The levels were found significantly ($P < 0.05$) higher in non-lactating pregnant than that of non-lactating non-pregnant in Gir cattle, while, Non-significant in Jaffarabadi buffaloes. Levels were significantly ($P < 0.05$) higher in Gir bulls than levels in castrated Gir males. The zinc levels was found significantly ($P < 0.05$) higher at 3 and 6 month ages in Gir females than corresponding values in Gir males. Plasma zinc levels was significantly ($P < 0.05$) higher in Jaffarabadi females than that of Jaffarabadi males at 12 month age. Significant ($P < 0.05$) higher values in Jaffarabadi females was observed in plasma zinc level at 1 month lactation stage than that of corresponding values in Gir females. Whereas non-significant differences were found among the corresponding values of non-lactating pregnant, non-lactating non-pregnant and male Gir and Jaffarabadi (Table 3).The estimated values of plasma zinc in Jaffarabadi and Gir animals were found optimum as compared to critical levels as per Das *et al.* (2003); Shukla *et al.* (2010) and Tiwary *et al.*

Table 1 : Levels of minerals and electrolytes in different age groups in Gir cattle

Parameter	Animal sex	Age groups						
		1 wk	1 m	3 m	6m	12m	24m	36 m
Copper (ppm)	F	$0.69^{ai}\pm0.01$	$0.72^{ai}\pm0.01$	$0.76^{ai}\pm0.01$	$0.80^{abi}\pm0.03$	$0.85^{abi}\pm0.01$	$0.92^{bc}\pm0.03$	$0.78^{ab}\pm0.02$
	M	$0.74^{ai}\pm0.02$	$0.75^{abi}\pm0.01$	$0.83^{abi}\pm0.04$	$0.79^{abi}\pm0.04$	$0.84^{bi}\pm0.04$	-	-
Iron (ppm)	F	$2.43^{ai}\pm0.14$	$3.00^{abci}\pm0.18$	$3.10^{bci}\pm0.20$	$3.11^{bci}\pm0.28$	$2.86^{abci}\pm0.14$	$2.80^{abc}\pm0.18$	$2.79^{ab}\pm0.19$
	M	$2.12^{ai}\pm0.23$	$2.13^{aj}\pm0.01$	$2.16^{aj}\pm0.03$	$2.26^{aj}\pm0.05$	$2.52^{abgi}\pm0.19$	-	-
Zinc (ppm)	F	$2.18^{fi}\pm0.14$	$2.00^{efi}\pm0.10$	$1.94^{efi}\pm0.12$	$1.80^{dei}\pm0.13$	$1.72^{dei}\pm0.14$	$1.66^{cde}\pm0.07$	$1.36^{abc}\pm0.05$
	M	$2.01^{ci}\pm0.11$	$1.93^{ci}\pm0.10$	$1.36^{bj}\pm0.05$	$1.36^{bj}\pm0.07$	$1.17^{abi}\pm0.27$	-	-
Manganese (ppm)	F	$0.27^{ai}\pm0.01$	$0.29^{ai}\pm0.01$	$0.30^{ai}\pm0.01$	$0.30^{ai}\pm0.01$	$0.31^{ai}\pm0.01$	$0.60^{cd}\pm0.04$	$0.54^{b}\pm0.02$
	M	$0.38^{aj}\pm0.02$	$0.37^{aj}\pm0.01$	$0.40^{aj}\pm0.02$	$0.41^{aj}\pm0.01$	$0.42^{aj}\pm0.02$	-	-
Chromium (ppm)	F	$0.11^{ai}\pm0.01$	$0.13^{ai}\pm0.01$	$0.15^{ai}\pm0.01$	$0.17^{abi}\pm0.02$	$0.19^{abi}\pm0.02$	$0.26^{bc}\pm0.03$	$0.32^{cd}\pm0.03$
	M	$0.15^{ai}\pm0.03$	$0.21^{abj}\pm0.03$	$0.13^{ai}\pm0.04$	$0.20^{abi}\pm0.03$	$0.20^{abi}\pm0.02$	-	-
Chloride (mmol/lit.)	F	$116.81^{ai}\pm4.20$	$115.40^{ai}\pm5.27$	$110.90^{ai}\pm4.58$	$118.60^{ai}\pm5.42$	$117.48^{ai}\pm8.56$	$113.79^{a}\pm5.13$	$119.38^{a}\pm5.10$
	M	$128.18^{bi}\pm5.44$	$128.38^{bi}\pm3.57$	$120.82^{bi}\pm3.34$	$106.53^{ai}\pm2.13$	$115.55^{abi}\pm5.08$	-	-
Bicarbonate (mmol/lit.)	F	$25.49^{ai}\pm0.70$	$25.61^{ai}\pm0.34$	$25.76^{ai}\pm1.45$	$27.21^{ai}\pm1.81$	$27.26^{ai}\pm1.52$	$25.56^{a}\pm0.82$	$25.08^{a}\pm0.44$
	M	$24.63^{ai}\pm0.48$	$25.52^{ai}\pm0.71$	$25.35^{ai}\pm0.99$	$24.03^{ai}\pm0.62$	$25.15^{ai}\pm1.20$	-	-
Osmolality (mOsm/kg)	F	$341.48^{di}\pm14.13$	$308.10^{ci}\pm8.60$	$280.04^{abi}\pm5.52$	$292.95^{abi}\pm5.54$	$289.25^{abci}\pm4.07$	$288.95^{abc}\pm4.18$	$290.83^{abc}\pm5.99$
	M	$303.52^{ai}\pm10.79$	$305.35^{ai}\pm10.42$	$294.23^{abi}\pm8.31$	$289.68^{abi}\pm7.36$	$283.75^{abi}\pm4.68$	-	-

Note: F: Female (n=8), M: Male (n=6), wk: Week; m: Month, Means having different superscripts differ significantly from each other ($P < 0.05$). a – f: between groups of same sex and same breed. i – j : between male and female animals of same species

(2010). Akhtar *et al.* (2010) observed a significant increasing trend of zinc values after three weeks postpartum, was in accordance with our findings at 1 month lactation. Tiwary *et al.* (2010) observed lower values of plasma zinc in lactating animals than that of heifers, which agreed this findings.

The plasma manganese (ppm) in Gir females and males ranged from 0.27 ± 0.01 to 0.70 ± 0.02 and 0.38 ± 0.02 to 0.66 ± 0.04 and ranged from 0.36 ± 0.02 to 0.69 ± 0.03 and 0.33 ± 0.01 to 0.59 ± 0.04 in Jaffarabadi females and males, respectively, at all ages and physiological stages. The manganese levels increased as age advanced. Among lactating animals, plasma manganese levels differed non-significantly in Gir cattle and Jaffarabadi buffaloes. Levels were significantly ($P < 0.05$) higher in Gir bulls than levels in castrated Gir males. Significantly ($P < 0.05$) higher values were observed in Gir males than that of corresponding values in Gir females at all ages. Significantly ($P < 0.05$) higher values of plasma manganese were observed at 1 and 6 month ages in Jaffarabadi females than that of corresponding values in Jaffarabadi males. Among lactating females, non-significant differences were observed between Gir cows and Jaffarabadi buffaloes at corresponding lactation stages. The observed values of plasma manganese in Jaffarabadi buffaloes were found optimum compare to critical levels as per Das *et al.* (2003) and Tiwary *et al.* (2010), while our findings were higher than values reported by Jayachandran*et al.* (2013) for Gir cattle were above the critical range as per Das *et al.* (2003); Shukla *et al.* (2010) and Bhat *et al.* (2011). The higher values of manganese in adults than that of young animals may suggest the role of manganese in maintenance of connective and skeletal tissue and in steroid hormone synthesis (Keen and Zidenberg-Cheer, 1990).

The plasma chromium (ppm) in Gir females and males ranged from 0.11 ± 0.01 to 0.53 ± 0.02 and 0.15 ± 0.03 to 0.35 ± 0.05 and ranged from 0.10 ± 0.02 to 0.42 ± 0.03 (and 0.12 ± 0.01 to 0.39 ± 0.06 in Jaffarabadi females and males, respectively at all ages and physiological stages. The chromium levels exhibited increasing trend with advancement of age and lactation stage in Gir cattle and Jaffarabadi buffaloes. Levels were significantly ($P < 0.05$) higher at 3 month lactation stage in Gir cattle than levels at 1 month and 2 month lactation stage, while levels in buffaloes did not differ significantly. Significant ($P < 0.05$) higher values were observed at 1 month age in Gir male than that of corresponding values in Gir females. Levels differed non-significantly between Jaffarabadi females and males at all ages.Among lactating females, At 3 month lactation stage, significantly ($P < 0.05$) higher values of plasma chromium were observed in Gir cows than that of corresponding value in Jaffarabadi buffalo.The observed values of plasma chromium levels at all ages and physiological stages in Gir cattle were in accordance with Pechova *et al*. (2002) and Agustin *et al*. (2012). Chromium increase glucose utilisation by tissues by potenting the effect of insulin by facilitating insulin binding to receptors at the cell surface (Tuormaa, 2000) the findings of Ninan (2012) also support this idea as the glucose and insulin levels were found higher in younger animals compared to adults, was in agreement with our findings. Also, the higher values of chromium in adults than that of young animals may suggest the role of chromium in healthy fetal growth, gametogenesis, follicular maturation, secretion of pregnancy specific proteins and maintenance of sperm counts (Tuormaa, 2000).

Electrolytes parameters :

The plasma bicarbonate (mmol/lit.) in Gir females and males ranged from 24.16 ± 0.46 to 27.28 ± 1.08 and 24.03 ± 0.62 to 25.77 ± 0.45 and ranged from 24.03 ± 0.65 to 25.88 ± 0.50 and 23.94 ± 0.65 to 25.75 ± 1.10 in Jaffarabadi females and males and plasma chloride (mmol/lit.) in Gir females and males ranged from 110.90 ± 4.58 to 125.30 ± 6.31 and 106.53 ± 2.13 to 128.38±3.57 and ranged from 111.31 ± 5.55 to 132.43 ± 6.93 and 106.13 ± 1.65 to 115.62 ± 4.78 in Jaffarabadi females and males, respectively at all ages and physiological stages. Plasma bicarbonate and chloride levels did not differ significantly at any ages and did not show any trend as age advanced. Plasma bicarbonate levels declined as stage of lactation advanced, however, non-significant differences were observed among lactating animals in both Gir cows and Jaffarabadi buffaloes. In non-lactating pregnant animals, the levels were non-significantly higher than in non-lactating non-pregnant in both the species. Levels did not differ significantly in any age between females and males of both the breeds. Similarly between females and between males of two species, plasma bicarbonate levels were differed non-significantly (Table 1 and 2).The observed values of plasma bicarbonate in the present study at all ages and physiological stages in Gir cattle were identical to the findings by Angelov *et al.* (2009) and Gianesella *et al.* (2010).

Plasma chloride levels did not differ significantly either age between Gir females and males, while plasma chloride levels in Jaffarabadi females were significantly ($P < 0.05$) higher at 6 month age than that of the corresponding values in Jaffarabadi males (Table 2). Levels of plasma chloride in Gir males at 1 week, 1 and 3 month ages were observed significantly ($P < 0.05$) higher than that of corresponding values in Jaffarabadi males (Table 3).The role of

Table 2 : Levels of minerals and electrolytes in different age groups in Jaffarabadi buffalo

Parameter	Animal sex	Age groups						
		1 wk	1 m	3 m	6m	12m	24m	36 m
Copper	F	$0.74^{ai}\pm0.02$	$0.76^{ai}\pm0.04$	$0.74^{ai}\pm0.04$	$0.79^{abi}\pm0.02$	$0.80^{abci}\pm0.03$	$0.91^{cd}\pm0.03$	$0.87^{bcd}\pm0.04$
(ppm)	M	$0.73^{ai}\pm0.02$	$0.76^{abi}\pm0.03$	$0.76^{abi}\pm0.03$	$0.76^{abi}\pm0.01$	$0.83^{bi}\pm0.03$	-	-
Iron	F	$2.14^{ai}\pm0.20$	$2.30^{abi}\pm0.07$	$2.18^{ai}\pm0.05$	$2.15^{ai}\pm0.12$	$2.55^{abci}\pm0.11$	$2.70^{bcd}\pm0.18$	$2.66^{bcd}\pm0.17$
(ppm)	M	$1.86^{ai}\pm0.18$	$2.03^{abj}\pm0.03$	$2.05^{abi}\pm0.05$	$2.23^{abi}\pm0.09$	$2.34^{bi}\pm0.03$	-	-
Zinc	F	$1.98^{ei}\pm0.14$	$1.94^{dei}\pm0.11$	$1.87^{dei}\pm0.18$	$1.91^{dei}\pm0.13$	$1.67^{cdei}\pm0.15$	$1.72^{cde}\pm0.06$	$1.26^{ab}\pm0.07$
(ppm)	M	$1.75^{bci}\pm0.22$	$1.88^{ci}\pm0.08$	$1.48^{bci}\pm0.12$	$1.59^{bci}\pm0.08$	$0.98^{aj}\pm0.19$	-	-
Manganese	F	$0.36^{ai}\pm0.02$	$0.39^{ai}\pm0.01$	$0.39^{ai}\pm0.03$	$0.41^{ai}\pm0.03$	$0.43^{abi}\pm0.02$	$0.50^{b}\pm0.03$	$0.49^{b}\pm0.02$
(ppm)	M	$0.36^{ai}\pm0.01$	$0.33^{aj}\pm0.03$	$0.34^{ai}\pm0.02$	$0.33^{aj}\pm0.01$	$0.36^{ai}\pm0.04$	-	-
Chromium	F	$0.13^{abi}\pm0.02$	$0.10^{ai}\pm0.02$	$0.21^{abcdi}\pm0.05$	$0.16^{abci}\pm0.03$	$0.18^{abci}\pm0.05$	$0.26^{bcd}\pm0.06$	$0.27^{cde}\pm0.04$
(ppm)	M	$0.12^{ai}\pm0.01$	$0.20^{aj}\pm0.04$	$0.18^{ai}\pm0.04$	$0.21^{ai}\pm0.05$	$0.25^{ai}\pm0.03$	-	-
Chloride	F	$114.75^{abi}\pm4.66$	$115.66^{abci}\pm4.36$	$117.56^{abci}\pm4.56$	$121.86^{abci}\pm5.13$	$111.31^{aci}\pm5.55$	$118.99^{abc}\pm3.86$	$114.29^{ab}\pm4.37$
(mmol/L)	M	$106.13^{ai}\pm1.65$	$109.33^{ai}\pm0.85$	$111.15^{abi}\pm2.04$	$106.17^{aj}\pm0.96$	$110.57^{ai}\pm1.98$	-	-
Bicarbonate	F	$25.01^{ai}\pm0.34$	$25.88^{ai}\pm0.50$	$24.23^{ai}\pm0.60$	$25.70^{ai}\pm1.09$	$24.03^{ai}\pm0.65$	$24.21^{a}\pm0.47$	$24.48^{a}\pm1.09$
(mmol/L)	M	$23.94^{ai}\pm0.65$	$25.12^{ai}\pm0.62$	$24.95^{ai}\pm1.08$	$24.42^{ai}\pm0.37$	$25.57^{ai}\pm0.54$	-	-
Osmolality	F	$286.40^{bi}\pm8.62$	$286.83^{bi}\pm4.31$	$282.94^{bi}\pm1.57$	$282.04^{bi}\pm3.95$	$284.71^{bi}\pm2.18$	$285.21^{b}\pm2.15$	$282.61^{b}\pm8.01$
(mOsm/L)	M	$276.27^{ai}\pm2.25$	$274.05^{aj}\pm3.03$	$279.38^{ai}\pm3.39$	$270.92^{ai}\pm3.42$	$274.37^{aj}\pm3.84$	-	-

Note: F: Female (n=8), M: Male (n=6), wk: Week; m: Month, Means having different superscripts differ significantly from each other ($P < 0.05$). a – f: between groups of same sex and same breed, i – j: between male and female animals of same species

Table 3 : Levels of minerals and electrolytes in different physiological stages in Gir cattle and Jaffarabadi buffalo

Parameter	Specie of animal	Lactating			Non-lactating		Bulls	Castrated
		1m	2m	3m	Preg.	Non-preg.		
Copper	Gir	$1.33^{dg}\pm0.10$	$1.06^{cg}\pm0.06$	$1.01^{cg}\pm0.07$	$0.92^{bcg}\pm0.04$	$0.93^{bcg}\pm0.05$	$1.01^{cg}\pm0.04$	$0.98^{c}\pm0.02$
(ppm)	Jaffrabadi	$1.05^{eh}\pm0.06$	$0.97^{deg}\pm0.03$	$0.93^{dg}\pm0.03$	$0.92^{dg}\pm0.04$	$0.89^{cdg}\pm0.03$	$0.98^{bg}\pm0.03$	-
Iron	Gir	$2.75^{abg}\pm0.18$	$3.16^{bcg}\pm0.15$	$3.39^{cg}\pm0.11$	$2.99^{abcg}\pm0.20$	$2.88^{abcg}\pm0.18$	$3.10^{cg}\pm0.11$	$2.78^{bc}\pm0.18$
(ppm)	Jaffrabadi	$2.95^{cdg}\pm0.23$	$2.95^{cdg}\pm0.22$	$2.87^{cdh}\pm0.17$	$2.88^{cdg}\pm0.14$	$3.10^{dg}\pm0.16$	$3.04^{cg}\pm0.23$	-
Zinc	Gir	$1.55^{bcdg}\pm0.10$	$1.49^{abcdg}\pm0.04$	$1.24^{abg}\pm0.17$	$1.55^{bcdg}\pm0.12$	$1.17^{ag}\pm0.06$	$1.37^{bg}\pm0.06$	$0.77^{a}\pm0.22$
(ppm)	Jaffrabadi	$1.80^{cdeh}\pm0.05$	$1.74^{cdeg}\pm0.13$	$1.47^{abcg}\pm0.08$	$1.57^{acdg}\pm0.16$	$1.17^{ag}\pm0.05$	$1.43^{bg}\pm0.07$	-
Manganese	Gir	$0.70^{eg}\pm0.02$	$0.66^{deg}\pm0.03$	$0.67^{deg}\pm0.03$	$0.64^{cdg}\pm0.03$	$0.58^{bcg}\pm0.03$	$0.66^{cg}\pm0.04$	$0.54^{b}\pm0.04$
(ppm)	Jaffrabadi	$0.69^{cg}\pm0.03$	$0.67^{cg}\pm0.03$	$0.66^{cg}\pm0.03$	$0.63^{cg}\pm0.05$	$0.61^{cg}\pm0.04$	$0.59^{bg}\pm0.04$	-
Chromium	Gir	$0.33^{cdeg}\pm0.05$	$0.40^{deg}\pm0.04$	$0.53^{fg}\pm0.02$	$0.42^{eg}\pm0.04$	$0.41^{deg}\pm0.03$	$0.35^{cg}\pm0.05$	$0.26^{bc}\pm0.02$
(ppm)	Jaffrabadi	$0.31^{defg}\pm0.03$	$0.39^{efg}\pm0.03$	$0.42^{fh}\pm0.03$	$0.31^{defg}\pm0.04$	$0.30^{defg}\pm0.06$	$0.39^{bg}\pm0.06$	-
Chloride	Gir	$125.30^{ag}\pm6.31$	$117.09^{ag}\pm6.30$	$120.56^{ag}\pm4.12$	$120.45^{ag}\pm6.77$	$110.96^{ag}\pm5.28$	$123.48^{bg}\pm4.51$	$115.63^{ab}\pm4.78$
(mmol/L)	Jaffrabadi	$132.43^{cg}\pm6.93$	$130.04^{bcg}\pm3.93$	$117.21^{abcg}\pm4.58$	$122.44^{abcg}\pm6.01$	$116.14^{abcg}\pm7.60$	$115.62^{bg}\pm1.61$	-
Bicarbonate	Gir	$27.28^{ag}\pm1.08$	$26.35^{ag}\pm2.34$	$24.88^{ag}\pm0.68$	$25.89^{ag}\pm0.91$	$24.16^{ag}\pm0.46$	$25.23^{ag}\pm1.10$	$25.77^{a}\pm0.45$
(mmol/L)	Jaffrabadi	$24.79^{ag}\pm1.11$	$25.26^{ag}\pm0.74$	$25.63^{ag}\pm0.67$	$24.89^{ag}\pm1.69$	$25.03^{ag}\pm0.62$	$25.75^{ag}\pm0.54$	-
Osmolality	Gir	$276.61^{ag}\pm2.06$	$276.65^{ag}\pm9.25$	$306.96^{cg}\pm9.20$	$302.25^{bcg}\pm8.55$	$288.10^{abcg}\pm1.77$	$291.35^{abg}\pm8.63$	$272.88^{a}\pm2.26$
(mOsm/L)	Jaffrabadi	$281.00^{bg}\pm2.92$	$274.16^{bg}\pm3.18$	$272.83^{bh}\pm2.42$	$273.96^{bg}\pm2.49$	$243.75^{ah}\pm2.95$	$277.47^{ag}\pm3.90$	-

Note: F: Female (n=8), M: Male (n=6), m: Month, Means having different superscripts differ significantly from each other ($P < 0.05$).
a – f: between groups of same sex and same breed, g – h: between Gir and Jaffarabadi

plasma bicarbonate and chloride is in maintaining acid-base equilibrium is not affected by age or physiological stage of animal but overall higher values in Jaffarabadi buffaloes than in Gir cattle indicate that Jaffarabadi buffaloes have higher efficacy in maintaining osmotic pressure and regulating acid-base equilibrium.In Jaffarabadi females, plasma Chloride levels found in present study were in agreement with Sarwar *et al.* (2002) and Khan *et al.* (2003) and in Gir cattle (Dodamani *et al.*, 2009) and also found non-significant difference between young and old animals, but the values found were much higher than this study.

The plasma osmolality (mOsm/kg) levels were observed to be high at younger age in Gir cattle, however, plasma osmolality levels did not differ at any age in Jaffarabadi buffaloes. Non-significant differences were observed among lactating and non-lactating animals in both the species. Levels did not differ significantly at any ages between Gir females and males, while plasma osmolality levels in Jaffarabadi females were significantly ($P < 0.05$) higher at 1 and 12 month ages than that of corresponding values in males. Significantly ($P < 0.05$) higher values in Gir females at 1 week and 1 month of ages and 3 month lactation stage and in non-lactating non-pregnant cows were observed than that of corresponding values in Jaffarabadi females. Levels of plasma osmolality in Gir males at 1 week, 1 and 6 month age were significantly ($P < 0.05$) higher than that of the corresponding values in Jaffarabadi males Collectively higher levels of plasma osmolality were observed at younger age, which supports the idea that plasma osmolality was mainly based on glucose, sodium and Blood Urea Nitrogen levels in plasma, as glucose and sodium levels were also observed higher by Ninan (2012) at younger age.

Conclusion :

The levels observed and the detailed comparison of trace minerals (Copper, Iron, Zinc, Manganese and Chromium) and electrolyte parameters (Bicarbonate, Chloride and Osmolality) of both the sexes between Gir cattle and Jaffarabadi buffaloes recorded in this article may serve as baseline data and reference point for further studies in these species and will help in planning for the improvement of reproductive and productive performance of these animals.

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