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MACRO-MINERALS STATUS OF BUFFALOES IN RICE ZONE OF PUNJAB PROVINCE

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ABSTRACT

A study was conducted to assess the macro-minerals status of buffalo on the basis of blood plasma, feedstuffs, soil and water analysis in Districts Hafizabad and Sheikhupura rice zone of Punjab province. Calcium (Ca), phosphorus (P), sodium (Na), potassium (K) and magnesium (Mg) status at different physiological stages (early lactation, mid-lactation, late lactation and dry) of buffaloes were determined. Lactating buffaloes were found significantly deficient in plasma Ca as compared to dry buffaloes. Plasma Ca, K and Na levels were significantly affected by physiological stages ($P<0.05$). Plasma Na and K levels were also affected by season ($P<0.05$). Lower plasma Na and sufficient K values were found in all physiological stages of buffalo. Sodium levels in water, soil and feedstuffs were lower than required. Higher level of K was found in roughages, soil and water. Higher levels of magnesium were found in soil. From these blood analysis. It was concluded that macro-mineral levels were significantly different ($P<0.05$) in blood plasma of different physiological stages of buffalo in these areas of Punjab and that animals needed minerals supplementation for health and economic benefits.

Key words: Calcium (Ca), phosphorus (P), sodium (Na), potassium (K) and magnesium (Mg)

INTRODUCTION

Mineral availability varies to a great extent from soil to plants and animals. Limited research work done on this topic has indicated areas of mineral imbalance and deficiencies in the soil, water and feedstuffs (Khan, 2003). Nutritional imbalances, deficiencies, or erratic management of feeding programs for dairy animals can create various types of health problems generally categorized as metabolic diseases (Duane and Rick, 1996). Underwood and Suttle (1999) indicated that mineral concentrations of serum or tissues consistently higher or below the 'normal' concentrations or ranges provide suggestive but not conclusive evidence of dietary deficiency or excess of particular minerals. Diet is a useful diagnostic tool in predicting adequacy of different minerals. Mineral status of soils and forage influence mineral status of grazing livestock, but many other animal factors and mineral interactions also play an important role (Towers and Clark, 1983).

Mineral imbalances of soil and forage have long been held responsible for impaired reproduction (Kadzere, 1997). Bone abnormalities; tetany, infertility and pica are some of the clinical signs often suggestive for mineral deficiencies in livestock (McDowell, 1992). The quality and quantity of nutrients of feed and forages mainly depend on factors like type of soil, level of fertilization, source of irrigation, etc. Mineral deficiencies, imbalances and toxicities inhibit grazing cattle production in tropical and subtropical areas. Most tropical forages have been found to be borderline to deficient in many essential elements. Reports from these areas indicated that mineral supplementation to grazing cattle have resulted in improved weight gains and dramatically increased calving percentages (McDowell 1985).

MATERIALS AND METHODS

Investigation Area: This study was conducted in 2 districts (Hafizabad and Sheikhupura) of rice zone of Punjab province. Five different sub-locations were selected from each district under study. This selection was on the basis of topography, soil type and livestock availability. Samples were taken once in summer and once in winter and analyzed for Calcium (Ca), Phosphorus (P), Sodium (Na), Potassium and Magnesium (Mg).

Feed and Forage Samples Collection: A total of 9 feedstuff samples were taken from each sub-location in both the seasons with a total of 27 feedstuffs (2 districts x 5 sub-locations x 9 feedstuff types x 3 samples for each type x 2 seasons = 540). The representative sample of 1-2 kg was taken and dried in a hot air oven at 100 ^{0}C for 24 hrs, ground in a Willey mill through 1-mm screen and kept in tightly stoppard bottles. The sample of 0.5g was digested, then filtered and diluted up to 100 ml.

Soil and Water Sampling: From each sub-location, 6 soil (2 districts x 5 sub-locations x 6 soil samples x 2 seasons = 120) and 6 water samples (2 districts x 5 sub-locations x 6 water samples x 2 seasons = 120) were collected in both the seasons. Soil representative samples of 1 kg at 15-18 cm depth were collected using soil auger, then dried at 100^{0}C, ground in a Willey mill through

2mm screen and wet digestion was done for further analysis. For water analyses, 500 ml water sample was filtered and preserved (Singh *et al.*, 2005).

Blood Sampling: From each sub-location, 10 blood samples were collected from each physiological stage (early lactation, mid-lactation, late lactation and dry) of buffalo in winter and summer season (2 districts x 5 sub-locations x 10 blood samples x 4 physiological stage x 2 seasons = 800). Blood samples of 8-10 ml were taken by jugular puncture in sterilized vacutainer containing heparin, then treated with 10% TCA, centrifuged at 3000 r.p.m. for 15 minutes and filtered. For Calcium and Phosphorus, the analyses were conducted by Atomic Absorption Spectrophotometer and Spectrophotometer (Singh *et al*., 2005).

Statistical Analysis: The data thus obtained was statistically analyzed using one way ANOVA for differences among mean mineral concentrations of different sub-locations and t-test for comparison between seasons and districts. Regression model was used for interactions among different variables. The significant differences between means were tested by Duncan's Multiple Range test (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Phosphorus: Analysis of plasma samples revealed that phosphorus values were higher in Sheikhupura than Hafizabad in animals in early lactation, mid-lactation, late lactation and dry stage respectively. Non-significant difference ($P>0.05$) was observed among different physiological stages which suggests that physiological stage of buffalo has no or little effect on plasma phosphorus. Results of the present study are partially in agreement with Iqbal (1990) who reported the mineral plasma phosphorus level of buffaloes of Punjab as 3.03±0.02 and 2.95±0.02 mg/100m in district Sheikhupura and Gujranwala (which is adjacent to district Hafizabad). Similarly Hussain (1991) found plasma phosphorus values for dairy cattle as 4.81±0.21 and 4.74±0.34 mg/100ml in district Gujranwala and Sheikhupura respectively. Lower values of plasma phosphorus was recorded in district Hafizabad whereas results of district Sheikhupura were in line with the findings of Hussain (1991), Kozlowska (1982) and Pederson (1982) who reported values of 4.49±0.27, 4.53-4.83, 3.9-6.6, 4.38-6.1 and 3.78 mg/100ml respectively in dairy cattle. Phosphorus values in the present study in district Sheikhupura are higher than that of Pederson (1982) who reported 3.20±2.1 mg/100ml in buffaloes of the same district. The recorded values were found lower when compared with 5.6-6.5mg/100ml for cattle and 5.0-7.3mg/100ml in sheep as quoted by Radostits *et al.* (2000) and Dindokar and (1979) who reported the values of 5.71-8.01 mg in healthy cows.

Phosphorus deficiency was found in feedstuffs of district Sheikhupura and Hafizabad. Values in feedstuffs recorded were lower in district Hafizabad than district Sheikhupura.

Lower values of phosphorous were estimated in the soil of both districts. Similar results were reported by Ndebele *et al.* (2005) who observed deficiency of phosphorus in soil. Lower values were recorded in soil of district Sheikhupura (48.30±10.00 mg/100ml) than district Hafizabad (5.90±28.70 mg/100ml). Water phosphorus values were higher in district Sheikhupura (0.052±0.015 mg/100ml) than district Hafizabad (0.050±0.02mg/100ml).

Calcium: A decreasing trend of plasma calcium levels was observed from dry stage to late lactation. Maximum calcium concentration was observed in dry stage of buffalo and the minimum was observed in late lactation. The difference among the physiological stages and seasons was found significant ($P<0.05$). The values were slightly lower in district Sheikhupura than district Hafizabad. Plasma calcium values of large ruminants of district Sheikhupura are nearly in agreement with the findings of Shukla *et al*. (1980) who reported 12.1 and 11.9 mg/100ml plasma calcium in cattle and buffalo respectively. Results of the present study are in contrast with the findings of Kozlowska *et al*. (1982) who reported 9.94-11.00 and 8.09-11.45 mg/100ml serum calcium in different seasons and stages of pregnancy in cattle. The findings are also not in agreement with Husnain *et al*. (1981) and Neto *et al*. (1988) who reported 6.70-8.00 and 11.02 mg/100 ml calcium in serum of buffalo.

Calcium values of roughages and concentrates of both districts were lower than that reported by Khan (2001). This variation in calcium values may be due to difference in soil fertility, season, rain fall, climate, stage of maturity and species. Results of the present study are in line with the findings of Ashraf *et al*. (2006), Khan (2001) and Garg *et al*. (2003) who reported calcium deficiencies in feedstuffs.

Soil calcium values were found lower in district Sheikhupura as compared to district Hafizabad. These findings also justify the higher values of calcium in feedstuffs and plama in district Hafizabad as compared to district Sheikhupura. Water calcium values of the present study are in contrast with Khan (2001).

The minerals profile of animals varied depending upon the physiological condition of animals, nutritional practices adopted by the farmers as well as mineral profiles of feedstuff, soil and water. Deficiency of phosphorus in live stock may be due to the deficiency in feedstuffs, soil and water in both districts as estimated in this study. Other factors like breeds, locations, age of animals may have also contributed.

Potassium: Plasma potassium values were found comparatively lower in Sheikhupura than Hafizabad district but statistically there were non-significant difference between the districts. Whereas, significant ($P<0.05$) difference was found among different physiological stages of buffalo. Results of the present study are in agreement with the values quoted by Radostits *et al.* (2000). Similarly results are also in line with the findings of Hussain (1991) and Oba *et al*. (1998) who reported 4.83 mEq/L in dairy cattle. The plasma potassium values recorded are not in agreement with that of Iqbal *et al*. (1988) who observed higher value of 36.93 mg/100ml.

Analysis of the feedstuffs of district Sheikhupura and Hafizabad revealed that potassium values of roughages were higher (97.83 and 179.98 mEq/Kg DM) and that of concentrates are lower (117.37 and 201.2 mEq/Kg DM) than the values quoted by Underwood and Suttle (2001) as 79.48 and 294.87 mEq/Kg DM for roughages and concentrates, respectively. Feedstuff potassium values were higher than Sheikhupura district. This situation is also obvious in plasma potassium level in both districts.

Soil potassium values were found slightly higher in district Sheikhupura (89.40±5.94) as compared to Hafizabad (85.1±18.2mEq/Kg DM). The result of the present study are in contrast with the mean soil potassium value 1.240 mEq/Kg DM reported by Khan (2001).

Water potassium values estimated in this study were higher in district Hafizabad (0.95 mEq/L) than district Sheikhupura (0.157 mEq/L). Ashraf *et al*. (2006) also reported that water concentrations were lower than optimal requirements of the animals. Results of the present study for plasma, feedstuffs, soil and water potassium values indicates that there may be a relationship among the potassium concentrations of plasma to feedstuffs, soil and water. District Hafizabad is higher in potassium values of plasma, feedstuffs and water. Soil potassium level is also nearly same to that of Sheikhupura. Consequently the plasma potassium level was also higher in Hafizabad district as compared to Sheikhupura district.

Table 01: Concentrations of macro-minerals in blood plasma of different buffaloes in different physiological stages in relation to season, soil, physiological stages and District

Variables	Significance of season, physiological stage and district	Interaction of soil with different physiological stages	Interaction of season with different physiological stages	Seasons	Physiological stages of buffalo			
					Early lactaion	Mid-lacation	Late lacation	Dry
P^+, C.L: 3.35-8.58 mg/100ml	A:ns, S:ns, D:ns	SiA*	SA:ns	Winter	4.65 ±0.32	4.32 ±0.21	3.99 ±0.80	4.44 ±0.71
				Summer	4.043 ±0.122	4.27 ±0.33	4.01 ±0.45	4.33 ±0.60
Ca^{2+}, C.L: 9.76-12.45/100ml	S:ns, A*, D:ns	SiA**	SA:ns	Winter	11.55±1.45	10.78±2.11	10.65±1.69	11.88±1.55
				Summer	11.40±1.23	10.05±2.01	10.10±1.92	11.90±1.21
Na^+, C.L: 132-152 mEq/L	S:ns, A*, D:ns	SiA*	SA:ns	Winter	124.04 ±3.89	120.04 ±8.11	104.04 ±8.11	128.04 ±3.89
				Summer	121.95 ±2.96	112.95 ±4.34	106.95 ±4.34	131.95 ±2.96
K^+, C.L: 3.9-5.8 mEq/L	S:ns, A*, D:ns	SiA*	SA:ns	Winter	4.45 ±0.15	4.05 ±0.42	4.11 ±0.36	4.88 ±0.22
				Summer	5.12 ±0.23	4.98 ±0.32	4.62 ±0.18	5.32 ±0.43
Mg^{2+}, C.L:1.8-2.68mg/100ml	A:ns, S:ns, D:ns	SiA*	SA:ns	Winter	3.84 ±0.34	3.66 ±0.31	3.71 ±0.42	3.68 ±0.36
				Summer	4.10 ±1.29	3.89 ±0.99	3.80 ±0.61	3.62 ±1.21

S: season, Si: Soil, D: district, A: Physiological stage, SA: season x Physiological stage, SiA: Soil x Physiological stage, ns: non-significant, ±: S.E, C. L. critical limits: Radostits *et al.,* (2000)
*: Significant at 0.05 level.

Sodium: Findings of the study reveals that there is deficiency of sodium in both districts. A decreasing trend of plasma sodium was observed from dry stage to buffaloes in late lactation. Significant difference was observed among different physiological stages of buffalo. The values were relatively higher in Sheikhupura than Hafizabad. Plasma potassium values of large ruminants of district Sheikhupura are nearly in agreement with the findings of Hussain (1984) who reported 120.86 mEq/L plasma sodium in cattle in Pakistan. Results of the

present study are in contrast with the values quoted by Radostits *et al.* (2000) as 132.52 mEq/L in dairy cattle. Similarly results are also in contrast with the findings of Oba *et al*. (1988) who reported 244.2-252.9, 135.5-141.2, 144-148 and 136.34 mEq/L in buffaloes, respectively.

Feedstuffs and soil of both districts were found deficient in sodium. Similar findings were reported by Abdelrahman *et al*. (1998) who studied the mineral profile of forages in Sudan. The results of the present study are in contrast with the mean soil sodium value of 0.928 mEq/Kg DM reported by Khan (2001). Water of both the districts was also found lower in sodium Similarly deficiencies were reported by Gar *et al*. (2002), Garg *et al*. (2003) and Khan (2001).

Magnesium: Findings of the study reveals that higher values of magnesium are present in both the districts particularly in district Hafizabad. Plasma magnesium values in buffaloes from district Sheikhupura are nearly in agreement with the findings of Radostits *et al.* (2000) whereas plasma magnesium values of district Hafizabad are higher than these quoted values. Results of the present study for district Sheikhupura are in agreement with Iqbal *et al*. (1988) and Mc Dowell *et al*. (1983) who reported 3.31 and 2.0-3.5 mg/100ml serum magnesium values in cattle. The findings of district Sheikhupura are also in line with Oba *et al*. (1988) who reported serum magnesium values of buffalo as 3.84$\pm$1.0mg/100ml. Results of the present study are in contrast with the findings of Hussain (1991) and Stodola *et al*. (1982) who reported 1.75-2.80, and 1.9-2.088 mg/ 100ml serum magnesium in cattle. Similarly the findings of the present study are also in contrast with Iqbal (1990) who reported serum magnesium level of buffalo of Punjab as 2.57-2.58 mg/ 100ml. Higher magnesium values were observed in feedstuffs, soil and water of both the districts. Results of the present study are in line with the findings of Khan (2001).

Conclusion: Keeping in view the findings of the present study it was concluded that there is variation in mineral profile of livestock in districts Sheikhupura and Hafizabad. Mineral supplements formulated according to the mineral levels in each districts are required to fulfill the nutritional requirements of livestock to increase productivity. Likewise different strategies should be practiced on the basis of mineral profile of the soil to overcome the mineral deficiencies. It will improve fodder mineral profile as well.

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