



## Macromineral status of buffaloes (*Bubalus bubalis*) and fodders from Jammu

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Minerals are inorganic dietary constituents required for various metabolic processes in the body. Availability of minerals to animals in appropriate quantities is a major factor determining the health and productivity. Reports on mineral responsive conditions among dairy animals in India are available but systematic reports based on base-line surveys from different agro-climatic zones are lacking. With this view in mind, a base-line survey was conducted in 5 districts of Jammu Division i.e., Jammu, Kathua, Udhampur, Rajouri and Poonch of Jammu division involving 193 buffaloes from 60 villages to correlate the calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and potassium (K) levels.

Based of age animals were categorized in to group 1, group 2 and group 3 comprising <3 years, 3–6 years and >6 years age, respectively. Blood samples from selected animals were collected in mineral free glass vials (dipped overnight in 2N HCl) and plasma was separated immediately after collection. Plasma samples were stored at –30°C for subsequent analysis. Dry roughages and fodder samples were collected from the mangers and farmer's field during the field visits to the dairy farms at the time of sampling. Samples of sorghum spp. (17), *Zea mays. L* (19), berseem early cut (14) and late cut (2), bajra (10), wheat straw (42), rice straw (23), local grasses (29), fodder tree leaves (9), were collected from various districts. Green wheat crop (4) and oats (4) fed to animals in Poonch district were also collected for analysis.

Estimation of Ca was done as per cresolphthalein complexone method using commercial kits. Mg was also estimated using commercial kits. Inorganic fraction of phosphorus (Pi) was determined by employing method of Taussky and Shorr (1953). Na and K were measured using flame photometer. Phosphorous estimation of fodder samples was done by Vanado-molybdate phosphoric acid method

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(Jackson 1973). Statistical comparison of data was done as per Snedecor and Cochran (1989).

The overall mean value of plasma Ca in buffaloes was 9.45 mg/dl (Table 1), which falls within the normal range, i.e. 8.45–11.02 mg/dl quoted by Radostits *et al.* (2000) for cattle. Considering the critical level of 8.4 mg/dl, hypocalcaemia was observed in 34.22% animals. Earlier study on buffaloes from sub-mountainous region of Punjab adjoining Jammu also reported average plasma calcium level of 9.01 mg/dl with prevalence of hypocalcaemia in 22.78% animals (Singh *et al.* 2008). The highest incidence of hypocalcaemia (53.94%) was observed in group 3 followed by group 1 (27.77%) and group 2 (17.33%). Similar was the finding of Canfield *et al.* (1984) and Randhawa (1999). District-wise analysis revealed significant difference in the Ca level of buffaloes. The plasma level of Ca was higher in animals of Rajouri district (10.76 mg/dl) followed by Poonch (10.02 mg/dl), Jammu (8.50 mg/dl), Kathua (8.29 mg/dl) and Udhampur (7.34 mg/dl). The largest numbers of hypocalcaemic animals were also observed in Udhampur district (66.66%) followed by Kathua (57.14%), Jammu (48.71%), Poonch (28.57%) and Rajouri (12.30%). The differences observed in the mean values could be due to dietary level of Ca, physiological state, age, season of sampling etc.

The overall mean value of Pi in plasma samples of buffaloes was 5.06 mg/dl (Table 1). Malhotra (1991) reported Pi level in serum samples of buffaloes from Himachal Pradesh as 4.71±0.60 mg/dl. Significantly ( $P<0.05$ ) higher level of phosphorous 5.73 mg/dl in buffaloes from sub-mountainous areas of Punjab has been reported by Singh *et al.* (2008). District-wise analysis revealed lowest level of Pi in buffaloes from Poonch district having mean value of 3.70 mg/dl followed by Kathua (4.38 mg /dl), Rajouri (4.79 mg /dl), Udhampur (5.11 mg /dl) and Jammu (5.86 mg/dl). Prevalence of hypophosphataemia in buffaloes of different age groups was 29.72% (Table 1). Likewise, hypophosphatemia was prevalent in 64.28% buffaloes from Poonch district followed by 42.85, 33.84 and 15.78% in

Table 1. Plasma macro mineral status and prevalence rate (%) of deficiencies in buffaloes from various districts of Jammu Division

| Macrominerals                      | Jammu                            | Kathua                           | Udhampur                           | Rajouri                              | Poonch                                 | Total                                 |
|------------------------------------|----------------------------------|----------------------------------|------------------------------------|--------------------------------------|----------------------------------------|---------------------------------------|
| Ca mg/dl                           | 8.50±0.29 <sup>a</sup><br>(n=78) | 8.29±0.90 <sup>b</sup><br>(n=7)  | 7.34±0.66 <sup>c</sup><br>(n=9)    | 10.76±0.24 <sup>abc</sup><br>(n=65)  | 10.02±0.46 <sup>ac</sup><br>(n=28)     | 9.45±0.18 <sup>abc</sup><br>(n=187)   |
| Deficient animals%<br>(<8.4 mg/dl) | 48.71                            | 57.14                            | 66.66                              | 12.30                                | 28.57                                  | 34.22                                 |
| Pi (mg/dl)                         | 5.86±0.20 <sup>a</sup><br>(n=76) | 4.38±0.33 <sup>a</sup><br>(n=7)  | 5.11±0.14 <sup>ab</sup><br>(n=9)   | 4.79±0.23 <sup>ac</sup><br>(n=65)    | 3.70±0.23 <sup>abcd</sup><br>(n=28)    | 5.06±0.13 <sup>ad</sup><br>(n=185)    |
| Deficient animals%<br>(<4 mg/dl)   | 15.78                            | 42.85                            | Nil                                | 33.84                                | 64.28                                  | 29.72                                 |
| Mg (mg/dl)                         | 2.45±0.09 <sup>a</sup><br>(n=49) | 3.05±0.14 <sup>ab</sup><br>(n=8) | 2.51±0.31<br>(n=7)                 | 3.05±0.11 <sup>ac</sup><br>(n=40)    | 2.43±0.17 <sup>bc</sup><br>(n=20)      | 2.69±0.06 <sup>c</sup><br>(n=124)     |
| Deficient animals%<br>(<1.2 mg/dl) | 6.12                             | Nil                              | Nil                                | Nil                                  | 5.00                                   | 3.22                                  |
| Na (mEq/l)                         | 149.34±1.88<br>(n=66)            | 137.89±2.80<br>(n=7)             | 159.42±5.70 <sup>bc</sup><br>(n=9) | 138.88±2.72 <sup>acd</sup><br>(n=43) | 119.96±1.36 <sup>abcde</sup><br>(n=28) | 141.09±1.50 <sup>ace</sup><br>(n=153) |
| Deficient animals%<br>(<132 mEq/l) | 15.15                            | 14.28                            | Nil                                | 37.20                                | 92.85                                  | 34.64                                 |
| K (mEq/l)                          | 4.64±0.08<br>(n=66)              | 4.06±0.2 <sup>ab</sup><br>(n=7)  | 4.24±0.18 <sup>c</sup><br>(n=9)    | 4.85±0.12<br>(n=43)                  | 4.31±0.10 <sup>d</sup><br>(n=28)       | 4.59±0.05 <sup>b</sup><br>(n=153)     |
| Deficient animals%<br>(<3.9 mEq/l) | 12.12                            | 28.57                            | 33.33                              | 13.95                                | 10.71                                  | 14.37                                 |

Kathua, Rajouri and Jammu districts, respectively (Table 1). It was interesting to observe that the buffaloes from hilly districts like Poonch and Rajouri were having higher average value of calcium with lower phosphorous status compared with plains of Jammu district. The incidence of hypophosphataemia was also higher (31.08%) in mature buffaloes (age >6 years) compared with <3 years (25.00%) and 3–6 years (30.66%) age groups. This study confirms that hypophosphataemia is widely prevalent in buffalo population as also reported by Arneja *et al.* (1987) and Malhotra (1991).

The average value of phosphorous in various fodder samples analyzed is shown in Table 2. Considering the critical level of 0.28% (2800 ppm, NRC 1989), 35.29% (6/17) of sorghum, 42.85% (6/14) of berseem, 52.63% (10/19) of maize, 50% (5/10) of bajra, 100% (9/9) of fodder tree leaves, 86.20% (25/29) of local grass, 97.61% (41/42) of wheat straw, 60.86% (14/23) of paddy straw, 25% (1/4) of green oats and 75% (3/4) of green wheat samples were deficient in phosphorous (Table 2). Significantly ( $P<0.05$ ) higher level of Pi in buffaloes from Jammu district compared with other districts could be due to the fact that cultivable fodders having higher levels of phosphorous like berseem, maize and sorghum were fed in Jammu district. Moreover, local grasses fed to animals were also having significantly higher level of P i.e., 0.37% compared with other districts. Fodder samples from hilly zone of Jammu division comprising Poonch, Kathua and Rajouri districts had low status of P.

The average value of Mg in plasma samples of buffaloes was  $2.69\pm0.06$  mg/dl (Table 1). Similar was the observation of Patel and Jadhav (2003) and Singh *et al.* (2008). Comparatively higher mean value of 3.54 mg/dl was reported

by Randhawa (1999). District-wise the animals from Jammu, Udhampur and Poonch showed almost similar average values. Likewise buffaloes from Kathua and Rajouri districts showed similar average values. The differences observed in the mean values could be due to dietary level of Mg, physiological state, age, season of sampling etc. Overall prevalence of hypomagnesemia was 3.22%.

The overall mean value of Na in plasma samples of buffaloes was 141.09 mEq/l which was within the normal range of 132–151 mEq/l cited for cattle by Radostits *et al.* (2000) (Table 1). No significant ( $P<0.05$ ) difference among different age groups was observed. Similar trend was observed by Randhawa (1999) and Singh *et al.* (2008). District-wise analysis revealed that the buffaloes from Poonch district were having significantly ( $P<0.05$ ) lower mean value of Na ( $119.96\pm1.36$  mEq/l) than the buffaloes from Jammu, Udhampur, Rajouri and Kathua districts (Table 1). Subnormal level of sodium was observed in 34.64% buffaloes with maximum prevalence of 92.85% in animals from Poonch district compared with 37.20, 15.15 and 14.28% from Rajouri, Jammu and Kathua districts, respectively (Table 1). Numerous factors like difference in demand and utilization for physiological needs, effect of environment, age, species, nature of feed, time of sampling, storage, analytical technique employed etc. as suggested by Underwood and Suttle (1999) influence the level of sodium.

The average value of Na in various fodder samples analyzed is shown in table 2. Considering the critical level of 0.18% (1800 ppm, NRC 1989) Na deficiency was not observed in any of the fodder sample analyzed. Thus, the deficiency observed in the animals could be due to the

Table 2. Phosphorous, sodium and potassium status of fodder samples (%)

| District | Mineral | Sorgum              | Maize               | Barseem             | Bajra               | Wheat straw          | Rice straw          | Leaves of fodder trees | Local Grasses       |
|----------|---------|---------------------|---------------------|---------------------|---------------------|----------------------|---------------------|------------------------|---------------------|
| Jammu    | P       | 0.30±0.02<br>(n=16) | 0.33±0.03<br>(n=3)  | 0.41±0.07<br>(n=10) | 0.31±0.04<br>(n=6)  | 0.15±0.01<br>(n=14)  | 0.08±0.009<br>(n=7) | Nil<br>(n=5)           | 0.37±0.05           |
|          | Na      | 0.44±0.02<br>(n=16) | 0.48±0.13<br>(n=3)  | 0.57±0.02<br>(n=10) | 0.41±0.05<br>(n=6)  | 0.54±0.06<br>(n=14)  | 0.58±0.09<br>(n=7)  | Nil                    | 0.52±0.08<br>(n=5)  |
|          | K       | 0.53±0.02<br>(n=16) | 0.56±0.12<br>(n=3)  | 0.67±0.13<br>(n=10) | 0.69±0.14<br>(n=6)  | 0.59±0.06<br>(n=14)  | 0.48±0.08<br>(n=7)  | Nil                    | 0.50±0.03<br>(n=5)  |
| Kathua   | P       | Nil                 | 0.27±0.02<br>(n=6)  | Nil                 | Nil                 | 0.17±0.01<br>(n=7)   | 0.43±0.03<br>(n=6)  | 0.18±0.01<br>(n=5)     | Nil                 |
|          | Na      | Nil                 | 0.49±0.03<br>(n=6)  | Nil                 | Nil                 | 0.49±0.04<br>(n=7)   | 0.46±0.07<br>(n=5)  | 0.59±0.05<br>(n=5)     | Nil                 |
|          | K       | Nil                 | 0.47±0.05<br>(n=6)  | Nil                 | Nil                 | 0.64±0.13<br>(n=7)   | 0.36±0.05<br>(n=6)  | 0.60±0.10<br>(n=5)     | Nil                 |
| Udhampur | P       | 0.38±0.01<br>(n=1)  | 0.24±0.05<br>(n=6)  | 0.16                | 0.30±0.04<br>(n=4)  | 0.17±0.01<br>(n=8)   | 0.37±0.02<br>(n=3)  | 0.22±0.01<br>(n=4)     | 0.22<br>(n=2)       |
|          | Na      | 0.38±0.01<br>(n=4)  | 0.67±0.14<br>(n=6)  | Nil                 | 0.65±0.15<br>(n=4)  | 0.52±0.06<br>(n=8)   | 0.68±0.10<br>(n=3)  | 0.67±0.16<br>(n=4)     | 0.54±0.05<br>(n=2)  |
|          | K       | 0.55<br>(n=4)       | 0.55<br>(n=6)       | 0.51                | 0.55±0.10<br>(n=4)  | 0.57±0.06<br>(n=8)   | 0.68±0.29<br>(n=3)  | 0.50±0.10<br>(n=4)     | 0.40±0.02<br>(n=2)  |
| Rajouri  | P       | Nil                 | Nil                 | Nil                 | Nil                 | 0.05±0.007<br>(n=11) |                     |                        | 0.07±0.01<br>(n=4)  |
|          | Na      | Nil                 | Nil                 | 0.29±0.01<br>(n=3)  | Nil                 | 0.51±0.04<br>(n=11)  | Nil                 | Nil                    | 0.34±0.04<br>(n=4)  |
|          | K       | Nil                 | Nil                 | Nil                 | Nil                 | 0.48±0.04<br>(n=11)  | Nil                 | Nil                    | 0.43±0.01<br>(n=4)  |
| Poonch   | P       | Nil                 | 0.05±0.01<br>(n=2)  | 0.39±0.09<br>(n=3)  | Nil                 | 0.08±0.04<br>(n=2)   | 0.07±0.01<br>(n=6)  | Nil                    | 0.10±0.001<br>(n=3) |
|          | Na      | Nil                 | 0.58±0.07<br>(n=2)  | 0.46±0.09<br>(n=3)  | Nil                 | 0.58±0.04<br>(n=2)   | 0.42±0.01<br>(n=6)  | Nil                    | 0.48±0.04<br>(n=3)  |
|          | K       | Nil                 | 0.76±0.34<br>(n=2)  | 0.39±0.09<br>(n=3)  | Nil                 | 0.17±0.04<br>(n=2)   | 1.10±0.01<br>(n=6)  | Nil                    | 0.61±0.07<br>(n=3)  |
| Total    | P       | 0.31±0.02<br>(n=17) | 0.23±0.02<br>(n=19) | 0.39±0.05<br>(n=14) | 0.30±0.03<br>(n=10) | 0.13±0.01<br>(n=42)  | 0.20±0.03<br>(n=23) | 0.20±0.01<br>(n=9)     | 0.17±0.02<br>(n=29) |
|          | Na      | 0.44±0.02<br>(n=17) | 0.56±0.05<br>(n=17) | 0.54±0.05<br>(n=11) | 0.51±0.07<br>(n=10) | 0.52±0.02<br>(n=40)  | 0.55±0.05<br>(n=16) | 0.62±0.07<br>(n=9)     | 0.47±0.03<br>(n=26) |
|          | K       | 0.53±0.02<br>(n=17) | 0.55±0.07<br>(n=17) | 0.66±0.12<br>(n=11) | 0.63±0.09<br>(n=10) | 0.56±0.03<br>(n=40)  | 0.51±0.07<br>(n=17) | 0.55±0.07<br>(n=9)     | 0.54±0.04<br>(n=26) |

Figures in parenthesis indicate the number of animals

Means marked with similar superscript a, b, c did not differ significantly ( $P < 0.05$ ) in a row.

inadequate feeding of fodder or due to the presence of antagonistic factors in the soil-plant system hampering the availability of Na.

The mean value of K in plasma samples of buffaloes was 4.59 mEq/l (Table 1) which falls within the normal range of 3.9–5.8 mEq/l quoted for cattle (Radostits *et al.* 2000). Age-related decline in the level of K in buffaloes was observed. District-wise, the level of K in buffaloes of Kathua was lowest (4.06±0.21 mEq/l) followed by 4.24±0.18, 4.31±0.10, 4.64±0.08 and 4.85±0.12 mEq/l in Udhampur, Poonch, Jammu and Rajouri districts, respectively (Table 1). Hypokalemia was observed in 14.37% buffaloes with maximum prevalence of 33.33% in animals from Udhampur

district compared with 28.57, 13.95, 12.12 and 10.71% from Kathua, Rajouri, Jammu and Poonch districts, respectively (Table 1).

Considering the critical level of 0.9% (9000 ppm, NRC 1989), K deficiency was observed in 100% (17/17) of sorgum, 81.81% (9/11) of berseem, 88.23% (15/17) of maize, 90% (9/10) of bajra, 88.88% (8/9) of fodder tree leaves, 96.15% (25/26) of local grass, 90% (36/40) of wheat straw, 88.23% (15/17) of paddy straw, 88.23% (15/17) of green oats and 88.23% (15/17) of green wheat samples. Thus, it can be concluded that K is deficient in the plants grown in these areas leading to its deficiency in animals which is otherwise rare in animals.

## SUMMARY

To know the status of calcium, phosphorous, magnesium, sodium and potassium in buffaloes (*Bubalus bubalis*) a base-line survey was conducted in 3 agro-climatic zones of Jammu division in Jammu and Kashmir having mean height ranging from 300–4000 m above MSL. Blood samples (193) from buffaloes of various age groups were collected and analyzed. The average values of Ca, Pi, Mg, Na and K were  $9.45 \pm 0.18$  mg/dl,  $5.06 \pm 0.13$  mg/dl,  $2.69 \pm 0.06$  mg/dl,  $141.09 \pm 1.50$  mEq/l and  $4.59 \pm 0.05$  mEq/l, respectively. Based on plasma level Ca, Pi, Mg, Na and K deficiencies were observed in 34.22, 29.72, 3.22, 34.64 and 14.37% buffaloes, respectively. Analysis of fodder samples also revealed that 35.29% of *Sorgum* spp., 42.85% berseem (*Trifolium alexandrinum*), 52.63% maize (*Zea mays* L.), 50% bajra (*Pennisetum typhoides*), 100% fodder tree leaves, 86.20% local grass, 97.61% wheat straw, 60.86% paddy straw, 25% green oats and 75% green wheat samples were deficient in phosphorous content. Whereas, potassium was deficient in 100% of *Sorgum* spp., 81.81% berseem, 88.23% maize, 90% bajra, 88.88% fodder tree leaves, 96.15% local grass, 90% wheat straw and 88.23% paddy straw samples. Sodium level of the fodder samples was adequate as per NRC requirements.

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