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Mineral Status of Dairy Animals in Pulwama District of Jammu and Kashmir

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ABSTRACT

A total of 206 samples of blood were collected from crossbred jersey dairy cows of Pulwama district of Kashmir Division to assess the blood plasma mineral status with respect to the stage of lactation and milk yield parity. Macro-minerals (Ca, P, Mg, Na and K) were estimated by standard methods using commercial kits, whereas microminerals (Cu, Zn, Fe, Co and Mn) were estimated by atomic absorption spectroscopy (AAS). Significantly (P=0.05) lower blood Ca, P, Mg and Na levels was reported in animals yielding milk upto above 10 kg followed 5-10 kg yielders and upto 5 kg and as compared to dry animals. Plasma P was recorded below critical levels in dairy animals of district Pulwama. There was no significant difference in mean plasma K levels of dairy animals among milk yielding and dry animals. Significant (P=0.05) lower plasma Ca, P, Mg and Na levels were found in animals in early and mid-lactation stages of dairy animals compared to the late lactation stage with a non significant difference in plasma calcium levels in early and mid-lactation. Plasma micromineral (Cu, Zn, Fe and Co) concentration was reported significantly (P=0.05) lower in high yielding animals (5-10kg and above 10kg) as compared to 0-5 kg yielders with the highest in dry animals. However, no significant difference was observed in plasma Mn level in dairy animals of district Pulwama in different production levels (above 10 kg, 5-10 kg, 5 kg yielders and dry) and at the stage of lactation (early, mid and late). The present study therefore indicates the need for the formulation of specific mineral mixtures for different stages of lactation.

Key words: Mineral Status, Parity, Pulwama, dairy, production, Stage of lactation

INTRODUCTION

Balanced nutrition with adequate mineral level is required for proper health, production, reproduction and immune defense of the animals. Minerals are forgotten nutrients in animal diets and their physiological role is often underestimated, even though the role of minerals in animal health is well established (Alonso, 2012). Minerals are necessary to maintain proper growth, reproduction, immune status and production performance in dairy animals. The deficiency of minerals has a negative impact on the health, growth production and reproduction of animals as a slight deficiency of trace minerals results in a considerable reduction in performance and production. On the other hand, in recent years, there are higher demands for appropriate nutrition due to genetic selection for higher milk yield. Animals in higher production stages have more requirements and diets. Body stores cannot cope with higher demands, resulting in metabolic disorders like milk fever and diseases like mastitis, lameness, and prolapses with reproductive disorders like infertility, dystocia and retention of the placenta. As such animals need to be offered mineral supplements to meet the requirements for growth, milk production and reproduce optimally.

In the Kashmir region of Jammu and Kashmir, animals are usually stall-fed on the fodder available from apple orchards and cultivated land during summer and rice straw as the primary roughage source during lean months with a small amount of grain by-products (mainly brans and oil cakes) without any mineral/vitamin supplements except for common salt (Ganai *et al.,* 2004). Hence mineral requirements of dairy cows depend on available feed and fodder resources, which are critically low in P, Mg, Mn, Cu, Na, K and Zn (Dhobi, 2018). Thus the quantity of minerals present in forages fed to dairy

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cows is insufficient for their optimum performance. Dhobi (2018) reported that dairy animals of district Budgam of J&K were deficient in almost all macro (Ca, P, Mg, K, Na) and micro minerals (Zn, Cu, Co, Mn, Fe). Reshi *et al.* (2016) reported that cattle and sheep of district Ganderbal of Jammu and Kashmir are deficient in macro minerals (Ca, P). To know the mineral profile of dairy cattle and recommend mineral supplementation for optimum production of animals, the present study of mineral profiling was carried taking district Pulwama as a sample study area. Since plasma is one of the important indicators of mineral status of an animal, therefore the study was planned to find the plasma mineral profile to have first hand information of mineral status of cattle in the study area. The district has a rich cattle population (1,12,664) with the highest milk (4.88 lakhs per day) production in Jammu and Kashmir state (19th livestock census), as one can estimate its richness of production by nicknames given to it like Anand of Kashmir/ Dudha-kul of Kashmir.

MATERIALS AND METHODS

The study was carried in the Pulwama district of the Kashmir Division. The topography of the district is mixed with both mountainous and plain areas. Paddy is the main crop in plains, whereas wheat and maize are the main crops of hilly areas of Pulwama district. Pulses and vegetables are also grown in different pockets of the district. The district has four veterinary blocks and from each of the four blocks, one animal per 300 animals was selected, which amounted to 206 samples as per the formula given by Thursfield (2007) as shown in table1. Sixteen Villages from the blocks were selected at random.

$$N = \frac{Z2\ Pexp\ (1\text{-}Pexp)}{d2}$$

where Pexp = expected prevalence = 35%
d = desired precision = 0.05

Animals were grouped according to milk yield into dry, upto 5 kg, 5-10 kg, 10 kg and above yielders and stage of lactation into Early (0-3 Months), Mid (3-6 months) and Late (until drying).

A total of 206 samples of blood were collected with 28 blood samples from dry, 65 from crossbred jersey animals yielding upto 5 kg, 67 from 5-10 kg yielders and 46 samples from animals yielding milk above 10 kg. 86 were in the early stage from sampled animals, 56 in mid and 36 in the late lactation stage. About 10-15 ml of blood was collected from the jugular vein in heparinized test tubes. These samples were maintained at a temperature of 2-8°C. The test tubes containing collected blood samples were then centrifuged at 3000 rpm for 30 minutes and plasma collected was stored in 5 ml vials at -20°C till further analysis.

Table 1. Number of samples collected population-wise and the places of collection

S.no	Block name	Total cattle population	Breedable cattle population	Samples taken
1.	Pulwama	43,023	23,662	78
2.	Pampore	15,062	8,284	28
3.	Kakapora	21,790	11,984	40
4.	Tral	32,789	18,034	60
	TOTAL	**1,12,664**	**61964**	**206**

Population as per 19th livestock census.

The plasma samples meant for mineral estimation were digested by the modified method of Idera *et al.* (2015). 1 ml of previously-stored plasma samples were taken in digestion tubes and 5 ml of triple acid was added. Triple acid was prepared by mixing sulphuric acid, perchloric acid and nitric acid in the ratio of 1:2:7 (Idera *et al.,* 2015). The samples were digested at 100ºC on automatic Kjeltech digestion apparatus (Kelplus-KES 20 LVA DLS AL by Pelican) for 2 hours and at 200ºC for 1 hour. The samples were checked for clarity and allowed to cool down. The digested samples were diluted with double distilled water to make a final volume of 10 ml. The digested samples were filtered through Whatman filter paper No. 40 before testing in AAS.

Macrominerals (Ca, P, Mg, Na and K) were estimated by standard methods using commercial kits from Accurex Biomedical Pvt. Ltd., India and microminerals (Cu, Zn, Fe, Co and Mn) by atomic absorption spectroscopy (AAS). Standard solutions for microminerals were prepared using the available reagent grade salts. Each standard solution was run one by one for these minerals and their absorbance was recorded. Standard curves for each mineral were constructed by plotting the absorbance of standards against their concentrations. The concentrations of respective minerals in the samples were calculated from their respective standard curves. Micro mineral (Cu, Zn, Fe, Co and Mn) were estimated by atomic absorption spectroscopy (4141 ECIL) (AAS). Standard solutions for micro minerals were prepared using the available reagent grade salts. Each standard solution was run one by one for these minerals and their absorbance was recorded. Standard curves for each mineral were constructed by plotting the absorbance of standards against their concentrations. The concentrations of respective minerals in the samples were calculated from their respective standard curves.

STATISTICAL ANALYSIS

The data was presented as Mean±SE and the significance of mean differences were tested by using one-way ANOVA followed by Duncan's New Multiple Range Test (DNMRT) using the Statistical Package for the Social Sciences, Base 20.0 (SPSS Software products, Marketing Department, SPSS Inc. Chicago, USA).

RESULTS AND DISCUSSION

Macromineral status in dairy cattle

The macro-mineral status in dairy cattleof district Pulwama is presented in table 2 below. The mean plasma calcium levels of dairy animals of Pulwama district were found above critical level with significantly (P=0.05) lower blood calcium level report in the animals yielding milk upto above 10 kg followed by 5-10 kg yielders and upto 5 kg and as compared to dry (10.06 mg/dl) animals of district Pulwama. The lower calcium levels in lactating animals may be due to drainage of calcium in milk and less bioavailability of calcium from the diet. Inactivation of bone calcium resorption may also contribute to low calcium levels (Kamiya *et al.,* 2005). Sarker *et al.* (2015) and Adedibu *et al.* (2013) found significantly higher calcium in dry (pregnant cows) than in the lactating cows. Hypocalcemia is inevitable after calving and lactation commencement due toa tremendous challenge to the cow's ability to maintain calcium homeostasis (Carlos *et al.,* 2013).

Significant (P=0.05) lower plasma Ca levels were found in animals in early (8.09 mg/dl) and mid (8.31 mg/dl) lactation stages of dairy animals as compared to the late lactation stage (8.91 mg/dl) with a non significant difference in plasma calcium levels in early and mid-lactation. The lower plasma Ca levels in lactating cows, especially in the early lactation stage, might be observed due to the high demand of absorbed Ca per liter of milk produced. As per NRC (2001) lactating cattle needs 1.37 gm of Ca/kg of milk produced in addition to maintenance requirement. Lower Ca level in lactating dairy cows could be attributed to negative calcium balance or excessive secretion of Ca through milk (Asif *et al.,* 1996). This might also be due to dietary imbalances of Ca, higher requirements due to the production phase of cows, and dietary interaction with other minerals (Maynard *et al.,* 1979).

Table 2. Plasma macro-mineral level in dairy cattle of district Pulwama with respect to milk yield and stage of lactation

Parameter	Critical levels	Macro-mineral level (mg/dl)				
		Ca (<0.30)	P (<0.25)	Mg (<0.20)	K (<0.8)	Na (<0.06)
Milk Yield	Dry (n=28)	9.85±0.79^{a}	5.84±0.20^{a}	2.23±0.07^{a}	8.34±0.30	148.78±0.21^{a}
	Upto 5kg (n=65)	9.20±0.82^{b}	5.17±0.13^{b}	2.18±0.52^{a}	8.32±0.11	133.32±0.11^{b}
	5 to 10 kg (n=67)	8.24±0.12^{c}	5.09±0.12^{b}	2.10±0.06^{a}	8.20±0.13	132.21±0.13^{c}
	Above 10 kg (n=46)	8.07±0.12^{c}	5.10±0.23^{b}	1.86±0.09^{b}	8.31±0.08	129.12±0.12^{d}
Stage of Lactation	Early (n=86)	8.09±0.12^{b}	4.58±0.15^{b}	1.90±0.11^{b}	7.85±0.18^{b}	129.04±0.13^{b}
	Mid (n=56)	8.31±0.13^{b}	5.10±0.26^{a}	2.14±0.07^{a}	8.27±0.12^{b}	132.27±0.14^{a}
	Late (n=36)	8.91±0.11^{a}	5.09±0.13^{a}	2.13±0.06^{a}	8.84±0.14^{a}	132.67±0.17^{a}

Values are expressed in Mean±S.E, values with different superscripts (a,b,c) vary significantly along the group(p=0.05)

Plasma Phosphorus was recorded below critical levels of 5.6-6.5 mg/dl plasma in lactating animals compared to dry animals. Significantly lower (P=0.05) plasma phosphorus levels were found in lactating animals than dry animals, with phosphorus levels significantly lower (P=0.05) in early than mid and late lactation stages in dairy animals of district Pulwama. Dhobi (2018) also reported the highest level in high producing dairy animals compared to dry animals. Similarly, Hagawane *et al.* (2007) found the serum Phosphorus concentration in the early stage of lactation was significantly (P<0.05) lowered than mid, late lactation and dry pregnant buffaloes.

In the present study, mean plasma Magnesium levels of dairy animals were found significantly (P=0.05) lower in animals yielding milk above 10 kg as compared to 5-10 kg yielders, upto 5 kg yielders and dry animals of district Pulwama, with a non significant difference between 5-10 kg yielders, upto 5 kg yielders and dry animals.The results agree with the findings reported in a number of studies (Kupczynski *et al.,* 2002; Sharma *et al.,* 2006).

The mean plasma Sodium and Potassium levels of dairy animals of Pulwama district were found above critical level with no significant difference in mean plasma potassium values among milk yielding and dry animals. However, significantly (P=0.05) higher plasma sodium values were reported in dry animals, followed by animals yielding milk upto 5 kg, 5-10 kg and above 10 kg. Lower plasma Sodium and Potassium level were reported in animals in the early stage of lactation compared to animals in mid and late lactation. The low value of Sodium and Potassium may be due to lesser availability from the diet and increased electrolyte loss with increased production. These results are in accordance with Dobi (2018) also reported that in dairy animals of Budgam district, Sodium and Potassium were highest in dry animals and were lowest in animals yielding 10 kg and above milk. Contrary to this, Sheikh (2018) in his study of mineral estimation of district Anantnag of Jammu and Kashmir, reported that dairy animals were deficient in Potassium.

Micro mineral status in dairy cattle

The micro-mineral status in dairy cattleof district Pulwama is presented in table 3. No significant difference was observed in plasma manganese level in dairy animals of district Pulwama in different production levels (above 10 kg, 5-10 kg, 5 kg yielders and dry) and at the stage of lactation (early, mid and late). Similarly, significantly (P=0.05) lower manganese was observed in Dhobi (2018) in animals yielding 10 kg and above as compared to animals yielding up to 5 kg milk. Dhobi (2018) also reported manganese lower than the normal range of 3.2-5.4 µmol/L (Constable *et al.,* 2017) in high-yielding animals.

Table 3. Plasma Micro-mineral level in dairy cattle of district Pulwama with respect to milk yield and stage of lactation

Parameter		Micro-mineral level (µmol/l)				
		Mn	Cu	Zn	Fe	Co
Milk Yield	Dry (n=28)	3.77±0.17	13.87±0.25^{a}	14.13±0.24^{a}	27.41±0.55^{a}	0.36±0.02^{a}
	Upto 5kg (n=65)	3.64±0.11	12.39±0.19^{b}	13.69±0.18^{a}	26.22±0.28^{b}	0.33±0.01^{b}
	5 to 10 kg (n=67)	3.53±0.08	10.57±0.12^{c}	12.30±0.17^{b}	24.95±0.27^{c}	0.30±0.03^{c}
	Above 10 kg (n=46)	3.43±0.08	10.27±0.12^{c}	11.49±0.20^{c}	24.38±0.31^{c}	0.28±0.01^{c}
Stage of Lactation	Early (n=86)	3.56±0.09	10.30±0.15^{b}	11.42±0.23^{c}	24.36±0.36^{b}	0.28±0.01^{b}
	Mid (n=56)	3.58±0.08	10.66±0.14^{b}	12.16±0.21^{b}	24.97±0.30^{b}	0.30±0.12^{a}
	Late (n=36)	3.52±0.10	11.86±0.18^{a}	13.26±0.17^{a}	25.88±0.24^{a}	0.33±0.01^{a}

Values are expressed in Mean±S.E, values with different superscripts (a,b,c) vary significantly along the group(p=0.05)

Copper plasma levels were reported significantly (P=0.05) lower in animals yielding milk above 10 kg and 5-10 kg yielders as compared to 0-5 kg yielders with highest in dry animals of district Pulwama. No significant (P=0.05) difference was found in plasma Copper levels in early and mid-lactation stages, although plasma Copper levels was significantly (P<0.05) higher in mid-lactation as compared to the early stage of lactation. Low levels of copper may be due to the drainage of copper in

milk. Also, more production means more stress, which makes more utilization of copper in the antioxidant role. Dhobi (2018) reported the highest copper in animals yielding up to 5 kg milk and lowest in animals yielding 10 kg and above.

The mean plasma Zinc levels of dairy animals of Pulwama district were found significantly (P<0.05) lower in animals yielding above 10 kg and 5-10 kg yielders milk followed by upto 5 kg and dry animals of district Pulwama. The serum level of Zn was critically low in animals in first parity with a higher production level. Literature data also shows that different dietary Zn amounts cause high variability in blood Zn values, with the effect of diet composition on blood zinc values being undefined, except for the fact that high dietary Ca concentrations reduce blood Zn concentrations in cattle (Mullis *et al.,* 2003; Spears, 2003; Kellogg *et al.,*1998).

The mean plasma Iron levels of dairy animals of Pulwama district were found well above the critical level and were significantly (P=0.05) lower in animals yielding milk above 10 kg as compared to animals producing 5-10 kg milk followed by upto 5 kg and dry animals of district Pulwama with no statistical significance between above 10 kg yielders and 5-10 kg yielders. Significantly (P=0.05) lower serum Fe values were reported in animals in the early and mid-stage of lactation compared to animals in late stage of lactation. This might be due to the abundance of Fe in feed and fodder grown on naturally Fe rich soil. It was in agreement with the earlier findings of many workers Dutta *et al.* (2000) and Mandal *et al.* (2004). It has been reported that iron deficiency is not a relevant problem in grazing livestock as Iron is fairly abundant in all grass species consumed by the animal species and it only occurs when there is some loss of blood (Shisia *et al.,* 2013).

Plasma cobalt concentration in most animals in the surveyed zone of district Pulwama was above the critical level. Significantly (P=0.05), lower Cobalt was reported in animals yielding milk above 10 kg, 5-10 kg yielders as compared to upto 5 kg yielders and dry animals with no statistical significance between animals yielding upto 5-10 kg and above 10 kg milk. Mean plasma cobalt levels of dairy cattle of district Pulwama were significantly (P=0.05) lower in the early and mid-stage of lactation thanthe late stage of lactation. Dey *et al.* (1997) has reported cobalt level in buffalo blood grazing around a fertilizer factory ranging from 0.007-0.034 ppm. Baruah and Baruah (2000) have reported serum cobalt levels in healthy Jersey heifer ranging from 0.05-0.07 ppm in different seasons. A similar finding was also reported by Hussain (2006), Das (2007), Sharma *et al.* (2009) and Turkar (2010) in the Vidharba region of Maharastra, Tripura, Uttar Pradesh and Madhya Pradesh, respectively.

CONCLUSION

The plasma macro and micro mineral status of dairy cattle revealed higher degrees of deficiency in early stages of lactation compared to mid and late lactation. Significantly (P=0.05) lower plasma macro and micro mineral levels were found at higher production levels (Above 10 kg and 5-10kg yielders) than in dry animals. Plasma serum level of all macro and micro minerals except phosphorus in macro minerals and zinc in micro minerals were above critical level. The ration offered was found to be deficient in copper (93.77mg/day), iron (233.70mg/day), zinc (613.14mg/day), cobalt (0.39mg/day) and manganese (93.36mg/day). The present study indicates the need for the formulation of specific mineral mixtures for different stages of lactation. based on the deficiency of macro and microminerals in common feed and fodders sources of the district and their bioavailability in roughages and concentrates using commonly available and economical mineral salts as source of these deficit minerals. The dairy cattle of the district should be fed balanced ration taken proper care of the dry matter requirement. Area specific mineral mixtures in powder form or as urea molasses mineral blocks should be introduced in the district for animal feeding to ameliorate the deficiencies in livestock to enhance productivity.

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