



Soil-plant-animal micromineral status and their interrelation in Kashmir valley

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The rural economy of Kashmir valley is dependent on agriculture and livestock-rearing these two sectors of rural economy are interdependent (Wani and Wani 2010). Livestock production is an integral part of hill agriculture, where animals are managed in traditional ways (Singh and Bohra 2005). In spite of a large cattle population, milk production is low owing to poor individual cow productivity, which is attributed to malnourishment and mineral deficiency (Sharma *et al.* 2003). Mineral deficiencies are responsible for a variety of suboptimal performances such as poor production and reproductive inefficiencies (Mohebbi-Fani *et al.* 2010). Dairy cattle reared under smallholder production system are deficient in most of the minerals (Kumaresan *et al.* 2010). Minerals occupy an important place in animal nutrition for production as well as health (McDonald *et al.* 2009). In addition they play a significant role in number of digestive, physiological and biosynthetic processes of animal body (Boland 2003). In India, livestock are mainly maintained on grazing with little or no supplementation of mineral mixture, except common salt (Garg *et al.* 2008). As locally available feeds and fodder are varying in mineral content and mineral deficiency is an area specific problem, it is useful to know the mineral status of soil, plant and animals of a particular area for efficient performance of the animals of that area.

The study area of Kashmir lies between 33°21' to 34°55'N latitude and 73°30' to 75°35'E longitude and is characterized by sub-humid temperate climate with mean annual rainfall of 744 mm and mean annual temperature of 13.4 °C (Najar *et al.* 2009).

The soil, fodder, and blood serum samples were collected from randomly selected areas in all the three districts of the state (Budgam, Pulwama and Srinagar). Soil samples at 0–15 cm depth were taken from twelve different areas of each district, from where fodders were harvested for feeding cattle and were labelled properly. Thus, a total of 36 soil samples (12 from each district) were collected at the same season

from the three districts of the state. A total of 72 composite fodder samples were collected from the farmers of the respective areas and packed in polythene bags with proper identification for further analysis. A total of 90 blood samples (30 from each district) were collected from cattle of the farmers of the respective areas from where soil and fodder samples were collected. Approximately 10 ml blood was collected from each cow in clean, sterilized glass test tube by jugular vein puncture using sterilized 16 G needle, allowed to clot at room temperature and centrifuged for 10 min at 75 g. The serum was frozen at “20°C until analysis.

Soil and fodder samples were dried in an oven at 70°C, ground and sieved through 2 mm sieve. Two gram soil sample and one gram fodder sample was taken in a digestion tube. Wet digestion of soil samples was done by the method of Franeek (1992). The fodder samples were digested by the method of Trolson (1969). Three ml of serum sample was taken and digested as per procedure described by Kolmer *et al.* (1951). Final volume in each digested sample was made up to 10 ml using triple distilled water. The dilution factor for soil, fodder and serum samples were 5×, 10× and 3.3×, respectively.

While digesting of the soil, fodder and serum samples, simultaneous digestion of reagent blank was undertaken and the final volume was similarly made up to 10 ml to have blank.

Digested samples were analysed for Cu, Fe, Zn and Co concentration by the atomic absorption spectrophotometry using recommended settings.

Data collected from this study were analyzed as per the method described by Snedecor and Cochran (1994) for mean, standard error, analysis of variance (ANOVA) and correlation coefficient by standard ‘t’ test.

Mean±SE of micro mineral (Cu, Fe, Zn and Co) concentration in soil, plant (fodder) and animal is given in Table 1. Soil has adequate Cu, Fe and Co but deficient in Zn. Soils with less than 0.6ppm of extractable Cu are considered deficient for pastures and crops (Horowitz and Dantas 1973). Mean Fe values for the critical level is 2.5ppm (Viets and Lindsay 1973). The critical level of Zn for soil is 1.5ppm

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Table 1. Micro mineral (Cu, Fe, Zn and Co) concentration (mean±SE) and range in soil, plant (fodder) and animal

Sample	Cu	Fe	Zn	Co
Soil(n=36)Range	2.21±0.23 0.4–4.5	29.23±1.24 18.5–45.6	1.01±0.09 0.4–2.2	3.30±0.49 0.42–10.2
Plant(n=72)Range	6.75±0.31 3.3–15.1	347.21±27.74 100.3–1019.4	28.21±0.84 18.5–45.6	0.02±0.0012 0.01–0.4
Animal(n=90)Range	1.16±0.09 0.3–4.5	1.41±0.05 0.63–2.2	1.06±0.05 0.33–2.19	0.0733±0.003 0.02–0.16

(Sanchez 1976). Nazif *et al.* (2006) reported lower Zn content but adequate Cu, Fe, and Co in soil in district Bhimber (Azad Kashmir). Wide variations in soil mineral concentrations have been reported (Khalili *et al.* 1993, Pereira *et al.* 1997, Sharma *et al.* 2003).

Fodder has adequate Fe but deficient in Cu and Co and marginally deficient in Zn. Khan *et al.* (2009) reported marginal to deficient level of Cu in fodder. The critical level of Fe in fodder is 50ppm (Jones 1972). The critical level of Cu in fodder is 8ppm (Jones 1972). Zn concentrations suggested as a critical level in fodder is 25ppm (Mayland *et al.* 1980). Mean forage Co concentrations were all below the NRC (1984) requirement of 0.1ppm. These findings revealed that the status of most of micro minerals in soil and fodder are falling in range of marginal to deficient level. Khan *et al.* (2006) reported that the forages had lower levels of Cu and slightly low to moderate contents of Zn as compared to recommended dietary requirements of ruminants. The forages had levels of considerably in excess of requirements. Similar results were reported by Kumaresan *et al.* (2010) in subtropical hill agro ecosystem.

Mean values of Cu, Fe, Zn and Co in the serum of animals fall in the category of adequate range as given by Kincaid (1999). Though the animals showed adequate serum concentration of micro minerals, they are predisposed to deficiency by the scarcity of fodders during the winter months as green fodders were also taken included in study.

Correlation coefficients between soil, plant and animal for Cu, Fe, Zn and Co are given in Table 2. Cu and Co showed positive correlation whereas Fe and Zn showed negative correlation between soil and plant. Between plant and animal, Cu, Fe and Zn showed negative correlation whereas Co showed positive correlation. Between soil and animal, Cu showed negative correlation whereas Fe, Zn and Co showed positive correlation. Between soil and plant and plant and animal correlations for Fe, Cu and Zn were non significant but significant for Co. Kumar *et al.* (2006) reported nonsignificant correlation between soil and plant and plant and animal for Fe and Cu in Uttar Pradesh. This emphasises the involvement of different factors which affect the availability of micro minerals from soil to plants and thence to animals. The mineral content of the fodders depend upon the type of the soil and environmental conditions they are grown (Beeson and Matrone 1976, and McDowell *et al.*

Table 2. Correlation coefficients between soil, plant and animal for Cu, Fe, Zn and Co

Correlation between	Cu	Fe	Zn	Co
Soil - plant	0.173	–0.265	–0.035	0.360*
Plant- animal	–0.006	0.211	–0.101	0.257*
Soil-animal	–0.249	0.211	0.251	0.010

*Significant correlation ($P \geq 0.05$).

2005). Only a fraction of minerals present in soil is taken up by plants depending upon geophysical/chemical composition (Reid and Horvath 1980). Low concentration of particular mineral in soil will lower the mineral content in plant grown on such soil; however, the soil rich in a particular mineral may not result in its higher level in the plant, due to uptake mechanism existing in the roots (McDowell *et al.* 2005).

SUMMARY

The present findings revealed the status of most of the micro minerals in soil and fodder are in the range of marginal to deficient level. Also involvement of different factors affects the availability of micro minerals from soil to plants and thence to animals. Due to this reason, dairy cattle in Kashmir valley are predisposed to micro mineral deficiencies. Based on present study, supplementation of Cu, Fe, Zn and Co in the diet of cattle under existing feeding practices in Kashmir is imperative for better health and productivity. However, further, studies could elucidate the bioavailability and strategic dietary supplementation of micro minerals for livestock.

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