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Research Paper

Mineral status in Yak through hair tissue mineral analysis: Effect of age and sex

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ABSTRACT

Hair tissue mineral analysis in conjugation with other clinical data has been recognized as a very good nutritional screen for the treatment of human beings in abroad. In the present study, efforts have been made to compare the relative elemental status in hair of yaks in different sex and different ages group. Some important elements namely Ca, Mg, Cu, Fe, Zn, Mn and Co were studied by using atomic absorption spectrophotometer. Iron concentration (ppm) was found to be significantly higher ($p<0.01$) in male (398.3 ± 42.7) than female (256.3± 37.3). Copper was found to be non detectable in sixteen animals. The calcium, magnesium, copper, zinc, cobalt, manganese and iron concentration (ppm) was found to be higher in the age group three years or less. Statistically, no significant difference was observed for any of the parameters except calcium, which was significantly higher ($p<0.05$) in the age group three years or less.

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Key words : Element, Hair, Yak

INTRODUCTION

Deficiencies and imbalances of specific mineral elements in natural grasslands limit livestock production which can be confused with the other diseases or energy/ protein deficiencies. Hair tissue mineral analysis has been found to be an excellent tool for monitoring general health, nutritional status and toxic metal exposure for both human and animal (Manson and Zlotkin, 1985). Hair tissue mineral analysis in conjugation with other clinical data has been recognized as a very good nutritional screen for the treatment of human beings in abroad. There are several reports that confirm hair tissue mineral analysis to be useful in evaluating a person's general nutritional status and health. Human hair has been accepted as an effective tissue for biological monitoring of toxic heavy metals by the U.S. Environmental Protection Agency, and used for this purpose throughout the world. Hair accumulates all the important trace elements and is a commonly available tissue which can be easily collected, stored and transported and if needed can easily be resampled. The use of hair has advantage over other tissues. Monitoring elements in the urine measures the component that is excreted. Blood on the other hand measures the component that is absorbed and temporarily in circulation before it is excreted and/or sequestered in to storage depot. Where as, hair can be used as an indicator of whole body accumulation. For example, Muller (1996) found that scalp hair was a useful indicator of internal mercury exposure. Numerous other studies have also shown a relationship to mercury exposure as well as other minerals as measured in the hair with body accumulation from polluted areas as well as minerals in local soils (Gebel, 1998 ; Tommaseo, 1998).

However in India, so far hair has not been taken up seriously for monitoring the trace element status of animals. The data on normal distribution of trace elements in hair of different species is lacking. No literature is available on the mineral status in yak hair. In the present study, efforts have been made to compare the relative elemental status in hair of yaks of different age and sex as well as to have a baseline data on normal distribution of different elements in yak hair.

RESEARCH METHODOLOGY

Hair samples of twenty five apparently healthy yaks (10 male and 15 female) were collected from five different

yak pockets *viz.*, Mandalaphudung (West Kameng district, Arunachal Pradesh), Lungurjiji (Twang district, Arunachal Pradesh), Nykmadung Yak farm (National Research Center on yak, Arunachal Pradesh), Ladakh (Jammu and Kashmir) and Nathan (Sikkim). Out of twenty five animals the seventeen animals were above three years of age. Hair samples were collected from the nape region of the animals, and cut with the stainless steel implement into pieces of about 1 cm in length and mixed well to ensure homogeneity. The samples were washed with acetone by agitating in a mechanical shaker for 30 minutes in room temperature and then filtered and rinsed with adequate deionized water. The samples were dried overnight in hot air oven at 110^0C and farther processed as per Harrison *et al.* (1969) . 0.5 g of dried sample was taken and 6 ml HNO_3 was added and allowed to react at room temperature. The digest was warmed and 1 ml of $HclO_4$ was added and heated at 200^0 C till dense white fumes were evolved. The solution should be water clear. The solution was transferred to a 10 ml volumetric flask and diluted to volume with deionized water.

This solution was used for the determination of Ca, Mg, Cu, Fe, Zn, Mn, and Co. Standards for different elements were prepared by diluting the stock solution (MERCK, Germany) with deionized water as per standard condition for the respective elements (Perkin Elmer, 1996). The concentration of different elements was determined by atomic absorption spectrophotometer (PERKIN ELMER, A 100). The concentration of different elements have been presented as ppm or mg / kg acetone washed hair dry matter. The statistical analysis was done as per Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The elemental concentration in hair of yaks of different sex and age groups are presented in Table 1. Calcium, cobalt, zinc, manganese and iron concentration (ppm) were found to be higher in male than female. However, magnesium and copper concentration (ppm) was found to be higher in female. Iron concentration (ppm) was found to be significantly higher ($p<0.01$) in male (398.3 ± 42.7) than female (256.3± 37.3). Copper was found to be non detectable in sixteen animals (5 male and 11 female). The calcium, magnesium, copper, zinc, cobalt, manganese and iron concentration (ppm) was found to be higher in the age group three years or less. But statistically, no significant differences were observed for any of the parameters except calcium, which was significantly higher ($p<0.05$) in the age group three years or less.

The over all mean concentration and range for different elements in yak hair are also presented in Table 1. The mean concentrations of calcium, magnesium, copper, zinc, cobalt, manganese and iron were 1400.6±60.4, 139.5±7.25, 8.88 ±0.42, 103.3±6.3, 0.376±0.13, 18.58±4.72 and 313.1±37.8, respectively.

Several factors may influence the elemental concentration in hair such as age, sex, production status,

Table 1: Elemental status (mg/kg) in hair by AAS

Parameters	Sex (Figures bearing different superscripts in a row differ significantly ,P< 0.01)		Age (Figures bearing different superscripts in a row differ significantly , P< 0.05)		Overall Mean ±SE n = 25
	Male n = 10	Female n =15	≤ 3 years n = 8	> 3 years n =17	
Calcium	1418.7^a ± 115.5	1388.6^a ± 72.0	1571.1 ^{a}± 106.4	1320.4^b±68.5	1400.6±60.4
	(975.6-2084.5)	(758.5-1814.0)	(1181.4-2084.5)	(758.5-1814..0)	(758.5-2084.5)
Magnesium	137.18^a±4.46	141.0^a± 12.1	141.2 ^{a} ±9.62	138.67 ^{a} ±10.03	139.5 ^{a} ±7.25
	(123.8-169.4)	(95.3-280.7)	(110.4-187.7)	(95.27-280.66)	(95.3-280.77)
Copper	8.49^a±0.86	9.14^a±0.46	9.15^a±0.86	8.76^a±0.51	8.88±0.42
	(2.16-11.17)	(6.93-13.66)	(6.93-13..66)	(2.16-11.45)	(2.16-13.66)
Zinc	110.96^a±14.9	98.0^a± 4.78	109.1^a±11.45	100.4^a±8.08	103.3±6.3
	(28.61-181.39)	(63.91-128.31)	(63.91-148.3)	(28.61-181.4)	(28.6-181.4)
Cobalt	0.637^a±0.28	0.203^a±0.11	0.452^a±0.31	0.341^a±0.15	0.376±0.13
	(0-2.18)	(0-1. 214)	(0-2.18)	(0-2 . 01)	(0 - 2.18)
Manganese	26.42^a±10.9	13.36^a±3.37	31.65^a±13.3	12.43^a± 2.84	18.58±4.72
	(0.57-102.53)	(0.765-41.25)	(0.77-102.5)	(0.57-41.25)	(0.57—102.5)
Iron	398.3^a ± 42.7	256.3^b± 37.3	303.7^a± 72.7	283.5^a± 44.2	313.1±37.8
	(77.3-694.4)	(89.19-655.0)	(126.4-694.4)	(64.1-655.0)	(77.3± 694.43)

Means bearing different superscripts in a single row differs significantly

environment and of course the diet. Hair tissue mineral analysis is comparatively a newer concept in India. Hair is a keratinized tissue consisting of protein. As the hair is being formed it is exposed to the internal metabolic environment including the blood, lymph and extra cellular fluids. Constituents entering the body are then accumulated into the hair and reflect a time weighed exposure record of nutritional and toxic metal intake. This particular study was just a preliminary study in this direction. The data generated in the present study can very well serve as a reference or baseline data on elemental concentration in yak hair.

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