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ORIGINAL RESEARCH

Evaluation of serum mineral status and hormone profile in goats and some of their inter-relations

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Abstract

Aim: The present study was carried out with the objective to estimate the serum mineral status, and hormonal profile of goats in Kashmir valley.

Materials and Methods: Thirty female goats (n=30) were selected randomly from three districts (ten from each district) of Kashmir valley. Serum minerals were estimated by atomic absorption spectrophotometry and hormones by radioimmunoassay (RIA) technique using gamma scintillation counter (I^{125} calibrated), at Nuclear Research Laboratory, IVRI, Izatnagar.

Results: Mean±SE value of calcium (Ca), phosphorus (P), magnesium (Mg) was 10.46±0.76, 5.12±0.31, 2.11±0.24 mg/dl respectively, whereas copper (Cu,) iron (Fe), zinc (Zn) and cobalt (Co) was 0.548±0.094, 1.548±0.173, 0.864±0.211 and 0.027±0.003ppm, respectively. Non-significant ($p<0.01$) difference was found in the serum mineral concentrations between and within the goat of different districts. Serum mineral concentrations in goat were in slightly deficient range. Mean±SE value of serum estrogen (E_2) in pg/ml, progesterone (P_4), triiodothyronin (T_3) and tetraiodothyronin (T_4) in ng/ml of goat was 19.35±0.45, 1.37±0.141, 1.16±0.163 and 31.09±1.15, respectively. Steroid and thyroid hormone levels were towards the lower side of the normal range. Wide variations were noted in the correlations between serum minerals and steroid and thyroid hormones indicating diverse interrelations between minerals and hormones.

Conclusion: Most of the animals showed deficient serum mineral status. Mineral deficiency affects hormone status and impairs production potential of animals. Based on these findings supplementation of mineral to goat of Kashmir valley is imperative.

Keywords: goat, hormones, Kashmir valley, minerals

Introduction

Minerals and mineral-hormone interactions in the serum of small ruminants have not been worked well especially in developing countries where mineral deficiencies are of more significant consequence than infectious diseases [1,2]. Minerals are required for normal functioning of basically all biochemical processes in the body [3]. Minerals act as catalysts in both enzyme and hormone systems [4]. Metallo-enzymes, of which essential minerals are constituents, are important in the synthesis of many steroid hormones [5,6] and thyroid hormones [3,7]. Such role of minerals in goats has not been studied well.

Materials and Methods

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. A total of 30 nondescript goats were randomly selected for the survey purpose from three districts (Budgam, Pulwama and Srinagar) of Kashmir valley (ten from each district). All the selected animals were females in the age group of 1-3 year, grazing same pastures and reared under similar managemental conditions.

Blood samples were collected by jugular venipuncture, 2ml in heparinized tubes for hematological estimations and 3ml in tubes without any anti-coagulant for harvesting serum. The separated serum was stored at -20ºC pending analysis of minerals, hormones, enzymes and biochemical.

Calcium, magnesium, copper, iron, zinc and cobalt were estimated by atomic absorption spectrophotometry after digesting the serum samples by the procedure of Kolmer *et al.* [8]. AAS (Model No. AAS 4141) manufactured by Electronic Corporation of India (ECIL), Hyderabad was used in present investigation. Phosphorus was estimated by the method of Taussky and Shorr [9] using test kits provided by Span Diagnostics Ltd. India. Serum estrogen (E_2), progesterone (P_4), triiodothyronin (T_3) and tetraiodothyronin (T_4) was determined by radioimmunoassay (RIA) technique using gamma

Table-1. Serum mineral status of goats in different districts.

Mineral	Budgam Mean±SE	Pulwama Mean±SE	Srinagar Mean±SE	Total Mean±SE
Calcium (Ca)	11.98±0.85	9.07±0.75	10.04±0.81	10.46±0.76
Phosphorus (P)	6.06±0.43	5.02±0.40	4.52±0.38	5.12±0.31
Magnesium (Mg)	1.99±0.16	2.01±0.21	2.22±0.25	2.11±0.24
Copper (Cu)	0.621±0.110	0.523±0.091	0.491±0.089	0.548±0.094
Iron (Fe)	1.482±0.142	1.521±0.170	1.542±0.169	1.548±0.173
Zinc (Zn)	0.882±0.199	0.764±0.186	0.862±0.221	0.864±0.211
Cobalt (Co)	0.029±0.0033	0.026±0.0029	0.027±0.0031	0.027±0.0032

Table-2. Steroid and thyroid hormone profile of goats in different districts.

Mineral	Budgam Mean±SE	Pulwama Mean±SE	Srinagar Mean±SE	Total Mean±SE
Estrogen(E_2) pg/ml	18.67±0.40	20.13±0.51	19.21±0.43	19.35±0.45
Progesterone(P_4) ng/ml	1.34±0.139	1.42±0.142	1.26±0.12	21.37±0.141
Triiodothyronine (T_3) ng/ml	1.13±0.168	1.19±0.177	1.15±0.160	1.16±0.163
Tetraiodothyronin(T_4) ng/ml	32.21±1.01	30.08±1.12	31.12±1.18	31.09±1.15

Table-3. Correlation coefficient between minerals and hormones.

	Estrogen (E_2)	Progesterone (P_4)	Triiodothyronine (T_3)	Tetraiodothyronin (T_4)
Calcium (Ca)	0.48	0.51	0.16	0.14
Phosphorus (P)	0.43	0.46	0.28	0.17
Magnesium (Mg)	0.22	0.16	0.14	0.12
Copper (Cu)	0.54*	0.58*	0.55	0.52
Iron (Fe)	0.48	0.44	0.52*	0.50*
Zinc (Zn)	0.62*	-0.41	0.45	0.41
Cobalt (Co)	0.31	0.23	0.20	0.21

*significant correlation ($p<0.05$).

scintillation counter (I^{125} calibrated), at Nuclear Research Laboratory, Division of Physiology & Climatology, IVRI, Izatnagar. Estradiol, T_3 and T_4 radioimmuno assay kits were obtained from Immunotech, France whereas progesterone radioimmunoassay kit was obtained from Bhabha Atomic Research Centre (BARC), India.

Statistical analysis: Data collected from this study were analyzed as per the method described by Snedecor and Cochran [10] for mean, standard error, analysis of variance (ANOVA) and correlation coefficient by standard 't' test.

Ethical approval: The research was approved by Institutional Animal Ethics Committee.

Results

Mean±SE of serum mineral content of goat is given in Table-1. Mean±SE of serum estrogen (E_2) in pg/ml, progesterone (P_4) in ng/ml, tetraiodothyronin (T_4) in ng/ml and triiodothyronin (T_3) in ng/ml of goat is given in Table-2.

Correlation determined between serum mineral concentrations and the levels of steroid and thyroid hormones in goats is summarized in Table-3. Positive but non-significant ($p<0.05$) correlation was found between calcium, phosphorus and magnesium and estrogen and progesterone. Copper showed positive and significant ($p<0.05$) correlation between estrogen and progesterone. Positive and significant ($p<0.05$) correlation was found between zinc and estrogen but negative and non-significant ($p<0.05$) correlation was found between zinc and progesterone. Positive but non-significant ($p<0.05$) correlation was found between iron and estrogen and progesterone in goats. Positive but non-significant ($p<0.05$) correlation was found between cobalt and estrogen and progesterone in goats.

Discussion

Calcium, phosphorus and magnesium were slightly towards lower side of normal range in goats. Khan *et al*. [11] and Sowande *et al*. [12] reported adequate calcium, phosphorus and magnesium in goats. Non-significant ($p<0.01$) difference was found in the serum mineral concentration of goats between the districts. However most of the minerals were in deficient status as compared to their respective critical levels [13,14]. Similar findings were made by Khan *et al*. [15] who reported that overall mineral status of goats grazing the same types of pastures was inadequate. Shinde *et al*. [16] reported normal serum Ca and Mg levels but low P levels in goats. Also they found low levels of Cu and elevated levels of Zn. Significantly low levels of Fe and Zn concentration was observed in goats by Kalita *et al*. [17]. Microminerals in goats were also studied by Booshan *et al*. [18].

Serum hormone levels were in normal range. Similar results for mean estradiol level in Anglo-Nubian does were reported by Blaszczyk *et al*. [19]. Todini *et al*. [20] found similar mean values of T_3 and T_4 concentrations in goats.

The correlation among the mineral and hormones can be inferred by different reasons. Calcium is involved in the synthesis of steroid hormones in ovaries and adrenal glands and the release of

luteinizing hormone from the pituitary gland [21]. Positive correlation was observed between serum progesterone level and copper-zinc in cow and heifer throughout the oestrus cycle [22]. Progesterone secretion was impaired due to a copper deficiency during the oestrus cycle and especially in late pregnancy in ewes [23]. Kandzere *et al*. [24] reported negative correlation between plasma progesterone and zinc during dry period in goats. Zinc deficiency results in alteration of steroidogenesis [5]. Gottsch *et al*. [25] suggested the role of zinc in the reorganization of ovarian follicle, source of progesterone through the involvement of metalloproteinase-2 (MMP-2), member of zinc endopeptidase family. El-Marsy and Nasr [26] reported increase in plasma progesterone and oestradiol-17 beta level after supplementation with iron. Cobalt deficient goats showed prolonged oestrous cycle and altered progesterone levels [27].

Conclusion

Most of the animals showed deficient serum mineral status. Mineral deficiency affects hormone status and impairs production potential of animals. Based on these findings, supplementation of mineral to goat of Kashmir valley is imperative.

Authors' contribution

MIY implemented the study design. MCS, UD and PK provided the necessary guidance and drafted and revised manuscript. MBG, RJ and AS helped in the sample collection and laboratory estimations. All authors read and approved the final manuscript.

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Competing interests

Authors declare that they have no competing interests.

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