An Investigation on Serum Profiles of Cu and Zn in Sudanese Goats Raised on Different Management Systems and Geographical Locations

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ABSTRACT: Sixty three female Nubian goats were used in this investigation. All animals were grouped in six groups at El Nisheishiba, two groups of ten animals, were reared indoor (four groups) or out-door (five groups) at six locations in central Sudan with the objectives of investigating the effects of site and rearing system on the concentrations of copper (Cu) and zinc (Zn) in the peripheral circulation of goats. Cu status in blood sera from the five groups of goat kept under open extensive grazing was lower than values of the element from the blood of animals kept indoors. The study provided clues implying deficiency of the element as compared with its general standard profile in the sera of goats. As for the rearing system, Cu in the blood from animals kept indoors and supplemented with concentrate at Jabal awlia, Elnisheishiba, Khartoum (1) and (2) were fairly fit with the general standard concentration (0.8-1.2 ppm), while Zn concentration values from blood of the goats openly reared and naturally grazed were generally lower than 0.60 ppm at El Fau, Sinnar, Whit Nile, Jabal awlia (2) and El Nisheishiba. The levels of Copper in indoor rearing system (1.584±0.613 ppm) were significantly (p<0.05) different when compared with levels in out-door (extensively) reared animals (0.367±0.205 ppm), but among sites the levels were fairly comparable (range:0.210±0.097 ppm vs 0.541±0.359 ppm) and was (1.27±0.507 ppm vs1.920±0.667 ppm) As for zinc, the result indicates significant (p< 0.05) site differences in the element concentration in sera of the animals outdoor system (0.4555±0.305 ppm) and (0.833±0.297ppm ) Also, there were significant (p<0.05) differences in sera values of Zn from animals under different rearing systems (0.337 ±0.244 pmm vs 0.747±0.657pmm)

KEY WORDS: Stiffness, reduction, deficiency, parakertosis, lipidio, anorexia.

INTRODUCTION

Numerous factors affect mineral requirements for grazing ruminants including sex, mineral level, age, status and chemical form of elements, interrelationship with other nutrients, level of mineral intake, breed, adaptation and productivity (McDowell, et al.,1977). The blood of the animal is known to regulate electrolyte concentrations through both its cells and its fluid component. The extra cellular fluid includes water electrolytes protein, glucose, enzymes and hormones (Virgil and Melvin, 1970). McDowell, et al., (1983) reported that Sudan soils were generally deficient in copper and zinc. Copper is an integral part of cytochrome.
It appears that Cu functions in the cytochrome in the same way as iron that is through the mechanism of a change in valence (Okunki, et al., 1958; Griffiths and Warton, 1981). Copper is required for normal melatination of the brain cells and spinal cord as a component of the enzyme cytochrome oxidase which is essential for myelin formation (O’Dell, 1976).

Findings regarding the effects of copper deficiency on the fertility of ruminant are controversial. It is difficult to conclude whether reproductive functions are affected directly by the lack of dietary copper or by some general dysfunction produced by copper deficiency (Moeller, 2003). Copper deficiency in goats is usually determined by measuring the concentration in blood. Goats normally have 0.8 to 1.2 part per million (ppm) copper in the serum (Moeller, 2003; Beck, 1961).

Zinc total contents in normal soils range from 10 – 300 ppm. But its presence in the soil is no more a criterion of its availability to plants than is the presence of many of the other plant nutrient (Samual et al., 1975). The mineral availability to the plant is affected by several factors including pH. In acidic soils, Zn is more available than alkaline soils, Zn deficiency was observed on high phosphate soils. Also deficiency was reported in soil rich in organic matter (Samual et al., 1975)

Transfer of Zn out of the intestinal mucosal cells to the plasma, is closely controlled by metallothionein; a low molecular weight binding protein which is synthesized in response to a rise in plasma zinc concentration. Thus, the overall process of Zn absorption appears to be regulated by intracellular compartmentalization as well as by endogenous secretion of Zn in excess of immediate metabolic needs from intestinal tract lumen (Solomon and Cousins, 1983). Absorption of Zn is affected adversely by high dietary calcium concentration and the presence of phytate further aggravates this effect (Furugouri, 1978).

The most common signs of Zn deficiency is growth retardation and anorexia in all species studied. Reduction in plasma alkaline phosphates activity and hyperkeratinization of the epithelial cells is common low zinc concentration symptoms (parakeratosis in swine). Goats, like cattle, show parakeratosis, increase bacteria in the mouth, stiffness of joints with swelling of feet and horn over - growth, excessive salivation, small testicular size and low libido on deficient Zn (haenlein, 1980).

The objective of this study was to determine the concentration of copper and zinc in the blood of goats grazed in different sites and system in central Sudan.

MATERIALS AND METHODS
Sixty three female goats 12 to 52 month of age, were used in this experiment. The animal were purchased from local breeders and selected to the characteristics of the Nubian goats of the Sudan. The animals were divided into nine groups six or ten goats in each different site were reared outdoors and received no supplementary ration. The pasture the animals exploited was mostly of the wintering Andropognease and acacia browse species in addition to dura, groundnuts and vegetables residues. These animals were kept at Sinnar site (Kasap Scheme), Fau ( Rahad Agric. Scheme), the White Nile rural grassland, Jabal Awlia and the university of Gezira experimental farm (UGEF) at El Nishisheba and were
outdoors reared, grazing the natural pasture in the vicinity of the site.

These groups were assigned as 1, 2, 3, 4 and 5, respectively. Group 6, 7, 8, and 9 were reared indoors at Faculty of Agricultural Technology and Fish Science (FATFS) of Alneilain University Experimental farm at Jabal Awlia, (UGEF) Khartoum site -a and -b. Here, the animal were fed Berseem (*Medicago sativa*) hay, groundnuts hay and sorghum straw; in addition, the animal received a supplementary ration comprised of groundnuts cake, dura grains, wheat bran of 33% each and 1% commercial salt. The animals of groups 8 and 9 at site –a & -b Khartoum, belong to the Ministry of Agriculture, Irrigation and Animal Resource State of Khartoum and kept in the experimental farm of the Ministry. The animal were kept indoors fed on *Medicago sativa* (Berseem) forage sorghum, groundnuts hay and sorghum straw and supplemented with the same ration mentioned above. All the animals were bled from the Jugular vein once only; 5ml blood were drawn from each goat, centrifuged and the resultant sera were deep frozen for further handling. Atomic Absorption Spectrophotometer was adopted to assess concentrations of mineral Copper and Zinc in peripheral circulation of the goat. The mean of the mineral concentrations values were judged using to assess effects of site and rearing system on Cu and Zn contents in the goat blood.

**RESULTS AND DISCUSSION**

The results from the investigation on Cu and Zn in the different goat groups were handled in three routes: data from animals versus intensive reared counterparts; data for different location of extensively reared (5 sites) for studying inter-location discrepancy of minerals concentration; and data from pasture animals compared with universal standard figures of the concentrations levels for either element.

As for rearing systems the results of this study recorded 1.583± 0.616 and 0.367 ± 0.205 ppm for Cu and 0.833± 0.297 and 0.455 ± 0.305 pp for Zn in intensive and extensive animals, respectively for the two elements.

Extensive animals groups recorded 0.210 ±0.097, 0.541± 0.359, 0.290 ± 0.85, 0.387 ± 0.235 and 0.407 ± 0.243 ppm for Cu at Jabl Awlia (1), Whit Nile River (2), Sinnar (3), ElNishesheiba (4) and El Fau (5) with over all mean 0.367 ± 0.205 ppm. The same animals recorded 0.337 ± 0.244, 0.747 ± 0.657, 0.5714 ± 0.3397, 0.497 ± 0.234 and 0.462 ± 0.296 ppm for Zn (Tables 1 and 2).

Intensive Animals, however, recorded 1.270± 0.507, 1.920± 0.667, 1.489± 0.223 and 1.663 ± 1.004 ppm for Cu at Jabl Awlia (6), ENishesheiba (7), Khartoum (8), and Khartoum (9), respectively an with an over all mean of 1.583 ± 0.613 ppm. The same animals recorded 0.537 ± 0. 44, 0.942 ± 0.134, 1. 040 ± 0.376 and 0.815 ± 0.241 for Zn with a general mean of 0.833 ± 0.297 ppm (Tables 1 and 2).

The t. test for the means of intensive versus extensive reared animals for the two elements was t 0.005= 4.6095 at confidence interval 1.578- 1.588ppm for Cu and t 0.005 =13.735 for Zn at confidence interval 0.828-0.838 ppm (Table 1 and 2).
The analysis of variance showed significant among sites variations and within group differences as with regards to both Cu and Zn concentrations (Tables 1 and 2).

The follow up of production performance of the subject goats in different sites over the period of research result revealed the following results. Among the extensive reared groups only 35 goats were pregnant to term and gave 17 kids with over all kidding percentage among there animals 48.57% of these results however are incomparable (p < 0.05) with the over all kidding of 23 (82.14%) among the intensively reared animals. This different, however, could be attributed only to the rearing system and type of grassland grazed by the animal. This conclusion is justified because of the homogeneity of the breeds under study. Most of the goats were of the Sudan Nubian type, Sudan Desert goats or Sudan Reverence type. Nevertheless the improved. Kidding percentage among the intensively reared animals might have been due to other factors in addition to the abound.

In this study copper concentrations recorded significant (p<0.01) difference between levels in animals extensively (outdoor) reared when compared with their (indoor) reared mates range 0.210±0.097 - 0.541±0.359ppm. Also there exists significant (p < 0.01) difference between Cu status of the grazing animals under study and the universal stander and range (0.800 - 1.200 ppm) for the Cu in the goat serum. These finding are in agreement with those reported by Underwood (1967) who mentioned that Sudan soils are deficient in Cu and Zn and with Al Tahira (2007) and Amal (2001) who reported deficiency trends in Cu at Jabal awlia and Elnisheshieba, respectively.

There is a general trend, in the data in table 2, that Cu is increasingly declining in the animals on pasture towards the north (Sinnar
However, White Nile and Jabl Awlia pasture are poorer in the element than the heavy soils of the eastern (ELFau) and western (Elnisheshieba) banks of the Blue Nile. This observation may be justified by the planning and execution of the Gezira Scheme where most of the cut-out areas from the Scheme due to poor soils (class iii and iv soils), were found towards the White Nile banks.

The poor Cu profile of the animals may be after the retarded growth and poor general production performance; a yearling kid, for example, weighted only 20.0 - 25.0 kg live body weight which is incomparable with 70-110 kg of a mature Damascus buck (Salma, 2009). This observation is supported by Moeller, (2003) who mentioned that deficiency signs of Cu appear in receiving weak kids. Anke and co-workers, (1986) stated that symptom of Cu deficiency appears in reduced weight gain and the mineral contents of the brain are reduced by 45% of normal status. However, effect of Cu deficiency in reproductive performance of the goat, is not documented. It is difficult to conclude whether reproductive functions are affected directly by Cu in-availability in the diet of the animal or due to some general dysfunction produced by deficiency. Nevertheless Cu deficiency may affect reproductive behavior, older goats kept on low Cu diet, developed nymphomania (Moeller, 2003).

Indoors feeding and supplementation by concentrates seem to boost the mineral status of the animal to the standard universal range 0.800-1.200ppm (range recorded 1.274±0.504 - 1.920±0.667). No signs of retarded growth checked reproductive performance or other symptoms of Cu deficiency were reported in these animals.

Also this document, however, presented lower Cu levels in lactating goats than non lactating. In a study by Ben – Gedalia (1994) it was found that non lactating ruminants showed higher plasma Cu, Adelstein and Vallee, et al. (1962) related the low Cu level in animals to milk formation and to the fact that some Cu could be stored in the liver before being excreted in milk.

Again this study, while supporting the findings of lower Cu statues in lactating animals versus non lactating, however, again recorded reversed relationship for Zn where lactating goats had higher Zn concentrations in their blood when compared with their non lactating counterparts. This finding is in agreement with a previous report by Adelstin and Vallee (1962) who mentioned the same relationship.

The concentration levels of Zn in the blood sera of animals of the outdoor groups were (0.337 ± 0.249 , 0.497 ±0.234 , 0.571± 0.340 , 0.462 ± 0.296 and 0.747 ± 0.657 ppm ) (Table 3) This data showed significant (p > 0.01) interlocation differences which indicate poor contents of the element in the animal feeds and /or in the soils of the grassland grazed by these animals. The between sites variation might be attributed to different degrees of leaching of Zn salts from the soils subjected to different rainfall density and consistency (e.g. Sinnar vs Jabal Awlia) and other terraisian factors. The figures documented in this study show true deficiency status of mineral Zinc The pooled mean of Zn levels in sera grazing flocks in this document of 0.4555±0.305 ppm is incomparable with the standard Zn content in goats sera (range 0.337±0.244 - 0.747±0.657 ppm) and is significantly (p > 0.01) different from the standard levels mentioned above. However,
0.747±0.657 ppm from the animal at Elnishishiba might be attributed to the richer aftermath of the vegetable crops where heavy fertilization was practiced this finding is supported by McDwell, (1962) who stated that Sudan soils are deficient in Zn and Cu and in agreement with Al- Tahira (2007- unpublished data) who classified the soil of Jabal Awlia as class (iv), which cast true doubt as to its trace minerals status. The trends of Zn deficiency reported hitherto may justify the conspicuously observed late puberty, extended gestation intervals , small litter size and generally poor reproductive performance of animals kept grazed extensively at Elnishishieba , ElFau , Sinnar or Jabal awlia. Grazing the fertilized aftermath of agricultural crops by outdoor groups at Sinnar (Kassab Scheme) Fau ( Rahad Agriculture Scheme) and Elnisheshieba (University Farm Gezira Scheme), seemed not to affect the mineral status of the animals. This might be due to the fact that the fertilizers used in these Schemes were either nitrogenous (urea) and/or phosphorous (super phosphates). Using phosphorous fertilizer however, may further exaggerate the problem as phosphates and phytate react with mineral Zn and affect adversely its bioavailability (Furugouri, 1978).

Deficiency trends seem to be offset by the supplementary ration and indoor feeding of the indoors reared group. This study presents significant differences (p > 0.05) between the two systems of animal production adopted in this study. However, within group differences (range 0.537±0.440 - 1.040±0.376ppm) may be attributed to the different production status of the animals and the different ages. In this experiment Zn is higher in lactating animals compared to non – lactating ones. Zn is known to be higher in lactating animals (Adlestin and Valle, 1962). Also younger flocks were reported to have higher Zn profile than elder flocks, which was in agreement with the finding by Ben – Ghedali (1994) who stated that apparent absorption of Zn is higher in lactating ruminants comparison to non – lactating ruminant due to factors such as liver reserves and milk production increase lactating than none lactating. Both (different stage of production and differ ages) factors were observed in the in-door flocks under investigation.

CONCLUSIONS
This study provides unambiguous evidence that animals, especially small ruminants grazing natural grasslands of Sudan, suffer Cu and Zn deficiencies in their peripheral blood circulation. However, supplementation by concentrates and zero grazing may help rectify the adverse symptoms encountered. Nevertheless, research in this field is needed and invited.

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