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Determine Some Macro Minerals Magnesium and Calcium in the Soil, Feed and Plasma Serum of Sheep Grazing at El-khuwei locality, West Kordofan, Sudan

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ABSTRACT

The main objective was to study determine some macro minerals magnesium and calcium in the soil, feed and plasma serum of sheep grazing in natural pasture at the flowering and seed setting stage during 2011 in El-khuwei locality, west Kordofan State, Sudan. Sampling was done on two stages at flowering and seed setting in selected locations (2km^2 each). Within each stage randomly selected randomly collected 60 samples of soil, feed and plasma serum. The data was analyzed used a completely randomized design (CRD). SPSS (Statistical Package for Social Sciences) was used for the statistical analysis. Soil concentrations significantly difference ($P<0.001$) higher magnesium Mg (3.73- 2.57 mg/100g) at flowering and least at seed setting respectively. No significant differences on calcium Ca (3.26- 2.92 mg/100g) at two stages. Stages effect were significantly difference ($P<0.001$) lower feed magnesium Mg (19.63- 22.88 mg/100g) and calcium Ca (0.10- 1.84 mg/100g) at flowering stage than that at seed setting stage respectively. Blood serum of sheep was highly calcium Ca (7.77- 6.95 mg/dl). No significant difference ($P< 0.05$) on magnesium Mg (2.05- 1.58 mg/dl) at flowering and seed setting respectively. It can be concluded that soil has been reported highly concentration on magnesium at the flowering stage than that at seed setting stage, however no significant differences at two stages on calcium. Feed have been reported highly concentrations on magnesium and calcium at seed setting stage than that at the flowering stage. Blood serum has been reported highly concentrations on calcium at the flowering than that at seed setting stage. Both growth stages were no significant differences on magnesium.

Keywords: Stages, feed, soil, magnesium, calcium, sheep.

INTRODUCTION

Magnesium is abundant in most common foods compared to the requirements of animals. Regarding the clinical signs of Mg deficiency, in adult sheep McDowell (1986) observed

hypomagnesaemia including reduced appetite, increased excitability, profuse salvation and convulsion to be the major ones. The author suggested that the severity of hypomagnesaemia can be reduced by increasing Mg intake in animal. The minimum amount of Mg needed by sheep for growth can generally be met by pasture or rations containing 0.076 % or 700 ppm of Mg. Howard (1962) has indicated that there may be a need to top dress pastures with Mg fertilizers in order to reduce the incidence of grass tetany (define grass tetany in this parenthesis) in animals. Calcium is normally one of the primary limiting factors in the diets of sheep and goat and hence need to be provided as supplement.

To this end responses have been reported to dietary supplementation with Ca and to the application of Ca fertilizer (Rees and Minson, 1976). Some of the important functions of Ca are blood clotting, membrane permeability, muscle contraction, nerve functions, and cardiac regulation and enzyme activations (Rick, 2007).

Moreover, excess of macro elements, such as Ca can reduce clotting ability of blood and cause hemorrhagic conditions (Hall *et al.,* 1991). As dietary Ca intake increases, its absorption is reduced (Rick, 2007). There is evidence that deficiencies of elements such as Ca occur under farming conditions. Nutritional calcium deficiency is associated with weakness, poor animal performance that has swollen joints, lameness, weak bones, and a propensity for broken bones (Puls, 1994).

MATERIALS AND METHODS

Study Area

This study was conducted at El-khuwei locality. It lies between longitudes 28˚:33' to 28˚:30'E and latitudes 12˚:14' to 14˚:12'N, about 105 Km west of El Obeid town. El-khuwei locality own large export market of Hamari sheep in west Sudan. The long term average annual rainfall is about 300-mm, consisting of storms of short duration between July and September with the highest rainfall generally occurring in August. The soil of the site lies within the sand dune area locally known as “Goz” soil. MARF (2011) estimation animals per head, there were 419960 sheep, 26634 goats, 5279 cattle and 430 camels in El-khuwei locality. MARF (2009) reported that during the rainy season, forage biomass is suitable to provide sufficient feed for animals, but during the dry season forage is scarce and small quantities of grain are also fed to animals.

Experimental Study

Sampling was done on tow growth stages of plant maturity at flowering and seed setting in selected locations (4km^2 each), within each growth stages 60 sheep, the age range between 6 month to year, randomly selected and collected samples of soil, feed and plasma serum.

Samples and Preparation of Soil, Feed and Serum

Soil Sampling

Soil samples were taken from different surfaces up to 15-20 cm depth at two growth stages from each pasture using a stainless steel sampling auger. The samples were air-dried and ground using a Wiley mill with a 2 mm sieve and mixed. A total number of 60 soil samples within each growth stage from the study area were taken and stored in plastic bags according to Sanchez (1976).

Soil Preparation

Minerals were extracted from soil using the Mehlich-1 extracting solution method (0.05N HCl + 0.025 N $H2SO_4$) following Rhue and Kidder (1983). Ten grams of air-dried soil were taken in 125 ml conical flask and 40 ml Mehlich-1extracting solution was added to it and shaken for 15 minutes on a reciprocating shaker, filtered through a medium porosity filter

paper (Whatman filter paper No. 2). Clear supernatant was obtained by centrifugation for 5 minutes at 180 rpm. The supernatant was stored in plastic bottles for macro determination.

Feed Sampling

Samples of feed were collected from those species that were most frequently grazed by sheep at this range. The parameters measured diet botanical composition was estimated using the bite-count techniques according to (Fadlalla and Cook, 1985). The parameters measured included diet botanical composition and voluntary intake of dry matter. Within each growth stages 60 sheep was kept for this study. The first sheep was followed for five minutes, and then the second one followed for another five minutes and so on for all sheep. The procedure was repeated tine minutes, thus each sheep followed for one hour in the first day, was also followed by observer for three days and 600 bites, and species of plant ingested and bite-count were recorded.

Feed Preparation

One gram of the dried forage sample was taken in a 50 ml conical flask, and kept overnight after adding 5 ml concentrated HNO3 and 5 ml perchloric acid (HClO4). Next day, again 5 ml HNO3 was added to each sample. All the samples were digested on hot plate at 250° C in fuming hood till the material was clear. After digestion the material was cooled down and the volume was made up to 50 ml with double distilled water and stored in clean airtight bottles for analysis of metal ions (Anon, 1990).

Blood Sampling

Mineral concentration in the plasma serum were randomly collected 60 sheep from each growth stages flowering and seed setting. The plasma samples (5 ml) were collected from jugular vein into heparinzied vacutainer tubes at the beginning and end of the experiment. Each time plasma was taken early in the morning before the animals were allowed to graze. The plasma samples were recovered by centrifuging and stored at -20°C until further analysis.

Blood Preparation

A quantity of 5 ml of blood plasma was digested with a 4 ml mixture of perchloric acid and nitric acid (1:1). After digestion, the volume was made to 25 ml with distilled de-ionized water. Further dilution was prepared for macro mineral determination following Kamada *et al*., (2000).

Laboratory Analysis

Macro minerals in soil, feed and blood serum of calcium (Ca) and magnesium (Mg) were analyzed using atomic absorption spectrophotometer (Singh *et al*, 2005).

Statistical Analysis

The data were analyzed using a completely randomized design (CRD) with the effect of stages as the whole plots and effects of calcium and magnesium as the sub-plots (Steel and Torrie, 1980). SPSS (Statistical Package for Social Sciences) was used for the statistical analysis. Statistical significance was tested at 0.05, 0.001 and 0.0001 level of probability using the software.

RESULTS

Soil Magnesium and Calcium

The macro mineral concentrations in soil for deferent stages are presented in Table 1. Soil concentrations significantly difference ($P<0.001$) higher magnesium Mg (3.73- 2.57

mg/100g) at flowering and least at seed setting respectively. No significant differences on calcium Ca (3.26- 2.92 mg/100g) at two stages. Soil has been reported highly concentration in the magnesium at the flowering stage than that at seed setting stage. No significant differences at two stages on the calcium.

Feed Magnesium and Calcium

Table 2 showed macro minerals in feed during the flowering and seed setting stages at El-khuwei locality, west Kordofan State, Sudan. Stages effect were significantly difference (P<0.001) lower magnesium Mg (19.63- 22.88 mg/100g) and calcium Ca (0.10- 1.84 mg/100g) at flowering stage than that at seed setting stage respectively. Feed have been reported highly concentrations in the magnesium and calcium at seed setting stage than that at the flowering stage.

Serum Magnesium and Calcium

Growth stages had significant (P< 0.0001) effect on blood serum of sheep was highly calcium Ca (7.77- 6.95 mg/dl). Both growth stages interval effects were not significant difference (P< 0.05) on magnesium Mg (2.05- 1.58 mg/dl) at flowering and seed setting respectively (Table 3). Blood serum has been reported highly concentrations in the calcium at the flowering than that at seed setting stage. However at two stages were no significant differences on magnesium (Table 1, 2, 3).

Table 1: Macro minerals in soil during the flowering and seed setting stages

Minerals	Growth stages			
	Flowering	Seed	Mean	±SE
Magnesium (mg/100g)	3.73[a]	2.57[b]	3.17	0.72***
Calcium (mg/100g)	3.26[a]	2.92[a]	3.24	0.39 N.S

a, b Values with the same raw bearing different superscript vary significantly at P <0.05, * = significant (P < 0.05), ** = high significant (P < 0.001) and *** = highly significant (P < 0.0001).

Table 2: Macro minerals in feed during the flowering and seed setting stages

Minerals	Growth stages			
	Flowering	Seed	Mean	±SE
Magnesium (mg/100g)	19.63[a]	22.88[b]	21.25	0.14***
Calcium (mg/100g)	0.10[a]	1.84[b]	0.97	0.05***

a, b: Values with the same raw bearing different superscript vary significantly at P <0.05, * = significant (P < 0.05), ** = high significant (P < 0.001) and *** = highly significant (P < 0.0001).

Table 3: Macro minerals in blood serum during the flowering and seed setting stages

Minerals	Growth stages			
	Flowering	Seed	Mean	±SE
Magnesium (mg/100g)	2.05[a]	1.58[a]	1.82	0.04 N.S
Calcium (mg/100g)	7.77[a]	6.95[b]	7.36	0.05***

a, b: Values with the same raw bearing different superscript vary significantly at P <0.05, * = significant (P < 0.05), ** = high significant (P < 0.001) and *** = highly significant (P < 0.0001).

DISCUSSION

Soil Magnesium

Higher magnesium (3.73- 2.57 mg/100g) levels at flowering stage and least at seed setting stage respectively. Mg determination, the values obtained for tomato closely relate with 194 mg/100 g reported by USDA (2008), while the values were lower than 786.5 mg/100 g reported by Sena *et al*., (1998). Like Ca, the values for Mg in their soils compared well those reported by Dauda (2008), but were lower than those reported by Uzairu A (Ahmadu Bello University Zaria unpublished article). Similarly, ranges of 5.00 to 134.37 μgg^{-1} and 12.50 to 65.08 μgg^{-1} were reported by Buszewski *et al*., (2000).

Soil Calcium

No significant differences on calcium Ca (3.26- 2.92 mg/100g) at two stages. Calcium concentrations in the samples were relatively high in the leafy vegetables particularly in the rainy season samples. The values observed for Ca in the soils of the vegetables compared well with those reported by Dauda (2008), but were lower than the mean value reported by Uzairu A (Ahmadu Bello University Zaria unpublished article). Ranges of 9.30 to 694 μg^{-1} and 3.75 to 37.50 µgg-1 were reported by Buszewski *et al*., (2000). These findings were in agreement with Elhag *et al*., (2014).

Feed Magnesium

Magnesium were lower (19.63- 22.88 mg/100g) at flowering stage than that at seed setting stage respectively. Nelson and Barber (1964) reported that deficiencies of this element are more prevalent in acid, sandy soils particularly in wet seasons. Potassium, which tends to decrease magnesium uptake, is one of the most important factors in determining magnesium deficiency. Deficiency symptoms include intervened choruses with the older leaves being affected first. Margins of leaves may turn a reddish brown color. Deficiency problems can be corrected by liming with dolomite limestone. This is agreement with study.

Feed calcium

Stages effects were significantly difference highly calcium (1.84 mg/100g) level at the seed setting stage and lower calcium (0.10 mg/100g) level at the flowering stage. Khan *et al.* (2009) reported mineral calcium concentrations and soluble carbohydrates may respectively increase and decrease dietary Mg requirements of livestock, whereas raised dietary phosphorus levels appears to lower the requirements for both calcium and magnesium. Effect of seasonal differences was increased calcium concentrations at cold season and decreased at hot dry season, all browse plants had adequate levels of calcium to meet adult goat requirements of 1.3 to 3.3 g /kg in the diet (NRC, 2007). This result is in agreement and similar with Elhag *et al.,* (2014). In study calcium is not usually deficient, for optimal livestock performance, in foliage from browse plants that grow in tropical regions (Ramirez *et al.*, 2001).

Serum Magnesium

Both growth stages interval effects were no significant difference on magnesium (2.05-1.58 mg/dl) at flowering and seed setting respectively. Wet and cold dry season plasma Mg concentrations reported in this study were lower than those reported by Khan *et al.,* (2008). However in the hot dry season this study shows higher Mg levels than those reported by Khan *et al*., (2008).

Serum Calcium

Stages differences for plasma Ca (7.77 mg/dl) higher were found to the flowering stage and least (6.95 mg/dl) in seed setting stage (6.95 mg/dl). The findings of the present study were similar to the findings of Khan *et al*., (2009) who reported high calcium levels in plasma during rainy stage. This may have been due to increased calcium during young growth animals.

CONCLUSIONS

It can be concluded that soil has been reported highly concentration on magnesium at the flowering stage than that at seed setting stage, however no significant differences at two stages on calcium. Feed have been reported highly concentrations on magnesium and calcium at seed setting stage than that at the flowering stage. Blood serum has been reported highly

concentrations on calcium at the flowering than that at seed setting stage. Both growth stages were no significant differences on magnesium.

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