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Sodium and Chloride in Soil, Feed and Sheep Plasma of West Kordofan, Sudan as influenced by Growth Stages

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Abstract

This research centers on the determination of calcium and magnesium in soil, feed and sheep plasma as influenced by growth stages at El-khuwei locality, during 2014. Sampling was done on two stages at flowering and seed setting in selected locations ($4km^2$ each). Within each stage 60 samples randomly selected, randomly collected 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. No significant differences on soil chloride Cl (0.17- 0.16 mg/l) at two stages, sodium Na (0.08- 0.08 mg/l) was balance at two stages. Stages effect were significantly difference ($P<0.001$) higher feed sodium Na (0.15- 0.03 mg/l) at flowering stage and chloride Cl (0.11- 0.29 mg/l) at seed setting stage respectively. Blood serum of sheep was lower sodium Na (112.83 mm/l) at flowering stage and higher sodium (117.50 mm/l) at the seed setting stage, at two stages no significant difference ($P< 0.05$) on chloride Cl (1.80- 1.82 mg/dl). It can be concluding that No significant differences on soil chloride at two stages, sodium was balance at two stages. Feed have been reported highly concentrations on sodium at flowering stage and chloride at seed setting stage. Blood serum of sheep was lower sodium at flowering stage and higher sodium at the seed setting stage, at two stages no significant difference on chloride.

Keywords

Soil, Feed, Plasma, Minerals, Sheep, Sudan

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1. Introduction

Sudan is the large counters with an area of 1.88 million Km^2. It has a population of 33.42 million (CBS, 2011) and has the second largest animal population in Africa.

MARF (2011) in 2009 and 2010 estimation of animals, there were 51.56- 52.08 million sheep, 43.27-43.44 million goats, 41.56-41.76 million cattle and 4.52- 4.62 million camel respectively. Sheep are of the Sudan Desert type and are kept for meat production. El-khuwei locality own large export market of Hamari sheep in west Sudan. MARF (2011) estimation animals per head, there were 419960 sheep, 26634 goats, 5279 cattle and 430 camels in El-khuwei locality.

Animal production in the State is mainly practiced under traditional extensive systems, depending on natural rangeland

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(RPA, 2005). Mineral deficiencies in goats in many countries are caused by low or variable contents due to soil, seasons, maturity of plants and low digestibility; where mineral supplementations were applied correctly (Poland *et al*, 2001).

The aim of this research was to determine sodium and chloride in soil, feed and plasma serum of sheep grazing as influenced by growth stages at El-khuwei locality, west Kordofan State, Sudan.

2. Materials and Method

2.1. Study Location

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. MARF (2011) estimation animals per head, there were 419960 sheep, 26634 goats, 5279 cattle and 430 camels in El-khuwei locality. 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. 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. The site is naturally dominated by grasses namely Huskneet (*Cenchrus biflorus),* Shilini (*Zornia glochidiata*), Bigail (*Blepharis linarifolia*) and Aborakhus (*Andropogon gayanus*). The trees included Humied (*Sclerocarya birrea*), Higlig (Balanites aegyptiaca) and Sider (*Zizuphus spina-Christi).* The Shrubs include Kursan (*Boscia senegalensis*), Usher (Calotropis), Mereikh (Leptadenia pyrotechnica) and Arad (*Leptadenia pyrotechnica)* according to MARF (2009).

2.2. 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 stage 60 sheep, the age range between 6 month to year, randomly selected and collected samples of blood serum, feed and soil.

2.3. Samples and Preparation of Macro Minerals

2.3.1. 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).

2.3.2. 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.

2.3.3. Feed Sampling

Samples of feed were collected from those species that were most frequently grazed by goats 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 goats was kept for this study. The first goat was followed for five minutes, and then the second one followed for another five minutes and so on for all goats. The procedure was repeated tine minutes, thus each goats 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.

2.3.4. 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).

2.3.5. Blood Sampling

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

2.3.6. 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).

2.4. Analytical Procedure

Macro elements in soil, feed and blood serum of chloride (Cl) were analyzed using atomic absorption spectrophotometer, (Singh *et al*, 2005). Sodium (Na) concentration was analyzed using flame photometer (AOAC, 1990).

2.5. Statistical Analysis

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

3. Results and Discussion

3.1. Soil Sodium and Chloride

The macro mineral concentrations in soil for deferent stages are presented in Table 1. Sodium Na (0.08- 0.08 mg/l) was balance at two stages. No significant differences on chloride Cl (0.17- 0.16 mg/l) at two stages.

Table 1. Means Sodium and Chloride in soil at flowering and seed setting stages

Growth stages				
Minerals	**Flowering**	**Seed**	**Means**	**SE±**
Sodium (mg/l)	0.08^a	0.08^a	0.06	0.02 no
Chloride (mg/l)	0.17^a	0.16^a	0.16	0.02 no

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).

3.2. Soil Sodium

Sodium Na (0.08- 0.08 mg/l) was balance at two stages. The values of observed for Na concentration in both the dry and rainy season samples were lower than 58.5 mg100 g and 440 mg/100 g by Rumeza *et al.* (2006). The dry season samples generally gave values that were higher than those of their corresponding rainy season samples. Generally, the values compared well with the range of 33.00 to 41.30 µgg-1 reported by Dauda (2008), but were lower than 95.40 µgg-1 reported by Uzairu A (Ahmadu Bello University Zaria unpublished article).

3.3. Soil Chloride

No significant differences in chloride Cl (0.17- 0.16 mg/l) at two stages. This result is agreement with Elhag (2014) reported that both stages flowering and seed setting chloride Cl (0.02pmm) concentration was balance. Grass titan is a complex ruminant metabolic disorder that is affected by a number of Factors such as forage species and mineral composition, soil properties, fertilizer practices, season of the year, temperature, animal species, breed and age (McDowell and Valle, 2000). To fulfill the requirements of production mineral supplementation is done as it has all the salt solutions which animal need (Khan *et al*, 2008), these findings were agreement with result.

3.4. Feed Sodium and Chloride

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 sodium Na (0.15- 0.03 mg/l), and chloride Cl (0.11- 0.29 mg/l) at flowering stage than that at seed setting stage respectively. Feed have been reported highly concentrations in the sodium and chloride at seed setting stage than that at the flowering stage.

Table 2. Means Sodium and Chloride in Feed at flowering and seed setting stages

Growth stages				
Minerals	**Flowering**	**Seed**	**Mean**	**SE±**
Sodium Na (mg/l)	0.15^a	0.03^b	0.09	0.00***
Chloride Cl (mg/l)	0.11^a	0.29^b	0.20	0.01***

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).

3.5. Feed Sodium and Chloride

Stages effect were significantly difference (P<0.001) lower sodium Na (0.15- 0.03 mg/l) and chloride Cl (0.11- 0.29 mg/l) at flowering stage than that at seed setting stage respectively. Carles (1983) confirmed that pasture in the tropics is deficient in Na and this could be supplemented with water containing high NaCl White *et al* (1991) observed that grazing sheep in the South West of Australia readily consumed a loose mineral mixture based on salt and gypsum, and all sheep consumed the lick. White *et al* (1995) reported that Na was the most common deficient mineral in Syria. In addition, the author stated that Na deficiency is most likely to occur in sheep when salt losses are high as a result of heat stress or lactation. Tolera and Said (1994) reported that most forages and crop residues in the highlands of Ethiopia are deficient in sodium. Sadaqat *et al* (1996) also confirmed low levels of Na (0.002-0.062 %) in forages in Pakistan. Grazing livestock in tropical countries often do not receive mineral supplementation except for common salt and most of them depend almost exclusively upon forages for their requirements (McDowell, 1997). Howard *et al* (1962) reported low Na content in pasture in Kenya.

3.6. Serum Sodium and Chloride

Growth stages had significant (P< 0.0001) effect on blood serum of sheep was lower sodium Na (112.83 mm/l) at flowering stage and higher sodium (117.50 mm/l) at the seed setting stage. Both growth stages interval effects were not significant difference (P< 0.05) on chloride Cl (1.80- 1.82 mg/dl) (Table 3). Blood serum has been reported lower concentrations on sodium at flowering stage; however were not significant differences on chloride at two stages.

Table 3. Means Sodium and Chloride in Serum at flowering and seed setting stages

Minerals	Flowering	Seed	Mean	SE±
Sodium Na (mm/l)	112.83[a]	117.50[b]	115.17	0.49***
Chloride Cl (mg/dl)	1.80[a]	1.82[a]	1.81	0.01 no

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).

3.7. Serum Sodium

Lower sodium Na (112.83 mm/l) concentration during the flowering stage and highly sodium Na (117.50 mm/l) concentration at seed setting stage. This result is agreement and similar with study; and agreement with Elhag *et al* (2014). White *et al* (1991) observed that grazing sheep in the South West of Australia readily consumed a loose mineral mixture based on salt and gypsum, and all sheep consumed the lick. According to Underwood (1981), supplementation of Na using salt licks is the most common method as ruminants ingest the right quantity to satisfy their own requirements. Hence, salt in one form or another should always be available for sheep and individual needs are about 7g/day (William and Trevor, 1999). Depending on the availability of water, breed of animals and type of diet, the tolerance level of salt ranges from 0.7 to 5 % salt in dry matter ARC, (1980). Sodium deficiency in ruminants is documented in the semi-arid region of Punjab, Pakistan and can be overcome by regular supplementation throughout the year (Khan *et al,* 2005 and 2006).

3.8. Serum Chloride

Both growth stages interval effects were not significant difference on chloride (1.80- 1.82 mg/dl) at flowering and seed setting respectively. More than two thirds of the pastoralists in Jijiga and almost all pastoralists in Shinile zone used mineral supplements during dry seasons. Pastoralists explained that sheep could obtain sufficient minerals from available feeds and water during the wet season. In this aspect, pastoralists' perception was in agreement with McDowell (1997) who reported that as tropical forages had more minerals content during the wet season, it is logical to assume that grazing livestock most likely; it can be seen that 79 % of the respondents used mineral soils during the dry season or whenever animals showed certain unusual physical changes and in feed intake, while 20 % of the respondents used minerals all the year round. Also the results indicate that the research area is very poor in chloride at flowering stage, this result is in agreement and similar to the present study; indicated that necessary therefore to adding sodium chloride as supplement to animals in the water drinking. This result is agreement and similar with study; and agreement with Elhag *et al* (2014).

4. Conclusions

It can be concluding that No significant differences in soil chloride at two stages, sodium was balance at two stages.

Feed has been reported highly concentrations in sodium at flowering stage and chloride at seed setting stage.

Blood serum of sheep was lower sodium at flowering stage and higher sodium at the seed setting stage, however at two stages no significant difference in chloride.

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