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Determine of Potassium and Phosphorus in the Soil, Feed and Plasma Serum of Sheep Grazing at El-khuwei Locality, West Kordofan, Sudan

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Abstract

A study was conducted to determine potassium and phosphorus in the soil, feed and plasma serum of sheep grazing in natural pasture during the flowering and seed setting stage in the year 2014 at El-khuwei locality, west Kordofan State, Sudan. Sampling was done on two stages at flowering and seed setting in selected locations (4km^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 potassium K (3.15- 2.51 mg/100g) and phosphorus P (17.37- 11.00 mg/100g) at the flowering stage than that at seed setting stage respectively. Feed were lower potassium K (1.16- 2.09 mg/100g) and phosphorus P (7.17- 16.83 mg/100g) at flowering stage than that at seed setting stage respectively. Blood serum of sheep was highly potassium K (7.77- 6.95mm/l) and phosphorus P (4.72- 4.55 mg/dl) at flowering stage and least at seed setting respectively. It can be concluded that potassium and phosphorus on soil and plasma serum has been reported highly concentrations at the flowering stage than that at seed setting stage. However feed have been reported highly concentrations at seed setting stage and least at the flowering stage.

Keywords

Stages, Soil, Feed, Plasma, Potassium, Phosphorus, Sheep, Sudan

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1. Introduction

During the rainy season, when temperature is normal it is the distribution of rain fall that becomes important. In the dry season temperature and water-use requirements of individual plant becomes paramount (ICAR, 2006). Seasonal changes in concentration result mainly from movement of nutrients into component during growth and the reverse process when senescence approached although individual nutrients differ in their motilities. These changes are most evident in photosynthetic tissues such as leaves. Translocation affects N, P and K in particular whilst the less mobile elements such as Ca tend to be retained and even increased in apparent concentration as the leaf becomes older though changes of this nature vary from species (Stewente *et al*., 1974). Phosphorus is the most limiting mineral to grazing animal productivity throughout the world. Calcium deficiency is a problem only in tropical areas with heavily leached soil. In arid and desert

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areas, range forages often contain high levels of calcium in relation to phosphorus (Underwood, 1966). Mineral deficiencies in sheep 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 objective of this study was to determine potassium and phosphorus in the soil, feed and plasma serum of sheep grazing at El-khuwei locality, west Kordofan State, Sudan.

2. Materials and Methods

2.1. Investigation 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. 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 (MARF, 2009).

2.2. Sampling and Experimental Study

Sampling was done on two 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.

2.3. Samples and Preparation of Soil, Feed and Plasma

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 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.

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. Plasma 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.

2.3.6. Plasma Preparation

A quantity of 5 ml of 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. Laboratory Analysis

Macro minerals phosphorus (P) in the soil, feed and plasma serum of sheep were analyzed using atomic absorption spectrophotometer, (Singh *et al*, 2005). Potassium (K) concentrations were analyzed using flame photometer (AOAC, 1990).

2.5. Statistical Analysis

The data were analyzed using a completely randomized design (CRD) with the effect of stages as the whole plots and effects of phosphorus and potassium 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.

3. Results and Discussion

3.1. Soil Potassium and Phosphorus

The macro mineral concentrations in soil for deferent stages are presented in Table 1. Soil concentrations significantly difference (P<0.001) higher potassium K (3.15- 2.51 mg/100g) and phosphorus P (17.37- 11.00 mg/100g) at the flowering stage than that at seed setting stage respectively. Soil has been reported highly concentrations in the potassium and phosphorus at the flowering stage than that at seed setting stage.

Table 1. Determine soil potassium and phosphorus at the flowering and seed setting stages.

	Growth stages			
Minerals	**Flowering**	**Seed**	**Means**	**SE±**
Potassium (mg/100g)	3.15^a	2.51^b	2.93	0.27***
Phosphorus (mg/100g)	7.37^a	11.00^b	14.46	1.84***

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 Potassium

Concentration of potassium was significantly difference higher potassium K (3.15- 2.51 mg/100g) at the flowering stage than that at seed setting stage respectively. In both stages, K concentration was significantly higher in the hot dry season than in the wet and cold dry seasons. There was no significant difference between the cold dry and the wet season concentrations (Landon, 1984). In all the seasons, soil K was above the critical level of 59mg/kg (Landon 1984). Soil K becomes more available with increasing pH. This is in agreement with the findings of this study which show that soil K was higher at the flowering and lower at seed setting stage. The rainy season samples generally indicated higher values when compared with their corresponding dry season samples. With the exception of amaranth, others indicated significant differences at P<0.05. Soil is the main source of K to plants and the anthropogenic activities by farmers influences its concentration.

3.3. Soil Phosphorus

At the flowering stage were higher phosphorus (17.37 mg/100g) and lest phosphorus (11.00 mg/100g) at the seed setting stage. Tiffany *et al.,* (2000) reported that low phosphorus level of soil during the dry season. Pasha *et al.,* (2009) concluded that the seasonal variation in these elements could be related to the fluctuations in climatic condition and P showed the lowest concentration for the dry season. Baruah *et al.,* (2000) reported that in wet seasons 80% and in dry season 54% of the soil samples were deficient in P levels, in contrast; phosphorous was marginally deficient in soil. Gueorgui Anguelov *et al.,* (2012) reported land-use impact on soil solution constituents from an Ultisol of North Florida; the land- use management had an effect on soil-solution phosphorous concentration reflecting managerial and climatic conditions; these reported is agreement which result. Yerokun (2008) who reported during the wet season soil phosphorous increased and decreased phosphorous level at dry season; these findings were agreement with Elhag *et al*, (2014).

3.4. Feed Potassium and Phosphorus

Table 2. Determine feed potassium and phosphorus at the flowering and seed setting stages.

	Growth stages			
Minerals	**Flowering**	**Seed**	**Means**	**SE±**
Potassium (mg/100g)	1.16^a	2.09^b	1.63	0.05***
Phosphorus (mg/100g)	7.17^a	16.83^b	12.00	0.83***

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 showed potassium and phosphorus 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 potassium K (1.16- 2.09 mg/100g) and phosphorus P (7.17- 16.83 mg/100g) at flowering stage than that at seed setting stage respectively. Feed have been reported highly concentrations in the potassium and phosphorus at seed setting stage than that at the flowering stage.

3.5. Feed Potassium

Stages effect were significantly difference (P<0.001) lower potassium K (1.16- 2.09 mg/100g) at flowering stage than that at seed setting stage respectively. Khan *et al.* (2009) reported variation of potassium in feed within different stages may partially be attributed to different stages of feed maturity at the time of sampling and the translocation of minerals to the root system. Higher feed potassium concentration were observed at dry period and lower concentration are found at the rainy period, however, all mean feed concentrations were higher than the optimal values as suggested by Khan *et al.* (2009), this result is in agreement and similar with study; and agreement with Elhag *et al* (2014).

3.6. Feed Phosphorus

During the flowering stage were lower phosphorus (7.17 mg/100g) levels and higher phosphorus (16.83 mg/100g) levels during the seed setting stage. During the hot dry season all the plants that were analyzed had P levels within or above the critical limits of 1.6-3.8 g/kg (NRC, 1981). calcium and P are both important in the development and maintenance of the animal's body; the recommended calcium to phosphorus ratio in the diet is a minimum of 2:1 and a deficiency of either or both in growing animals leads to poorly developed bones. According to Underwood (1981), P is known to be the most deficient element in the soils all over the world. Moreover, in P deficient animals the feed ingested and digested is used less efficiently than in none deficient animals presumably due to a disturbance in energy metabolism. P must be supplemented to livestock grazing native forages in order to meet their requirements (Rick, 2007).

3.7. Serum Potassium and Phosphorus

Table 3. Determine serum potassium and phosphorus at the flowering and seed setting stages.

	Growth stages			
Minerals	Flowering	Seed	Mean	SE±
Potassium (mm/l)	7.77[a]	6.95[b]	7.36	0.05***
Phosphorus (mg/dl)	4.72[a]	4.55[b]	4.63	0.02***

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).

Growth stages had significant (P< 0.0001) effect on plasma serum of sheep was highly potassium K (7.77- 6.95 mm/l) and phosphorus P (4.72- 4.55 mg/dl) at flowering stage and least at seed setting respectively (Table 3). Plasma serum has been reported highly concentrations in the potassium at the flowering and phosphorus at seed setting stage.

3.8. Serum Potassium

Growth stages had significant effect on plasma serum of sheep was highly potassium (7.77 mm/l) at flowering stage and lower potassium (6.95 mm/l) at seed setting stage. This result is agreement and similar with Elhag *et al* (2014). The mineral level of ruminants has changed by changing place and season (Khan *et al,* 2008). Dominguez and Huerta (2007) reported higher plasma potassium content during the rainy season and least at the wet season. Higher Plasma potassium concentration was observed during the flowering stage than those found already by Grunwaldt *et al*. (2005) in Argentina and Khan *et al*. (2009) in different ruminants in Pakistan. Similar concentration of plasma potassium has been observed by Gizachew *et al*. (2002). This is agreement with study. These differences in plasma K+ may be attributed to the physiological state of animal and different climatic conditions.

3.9. Serum Phosphorus

Plasma serum of sheep was significantly highly phosphorus P (4.72- 4.55 mg/dl) at flowering stage and least at seed setting respectively. According to Georgevskii *et al* (1982) the contents of macro elements in plasma serum of sheep ranges in P (4 to 6 mg/100ml); this is agreement with study. Cohen (1980) stated that, the tropics P deficiency is common in cattle, but less in sheep. Range pastures are frequently deficient in P. However, sheep in such areas are less deficient than cattle because sheep select more leaves which have higher P than pasture (Carles, 1983). Plasma P levels are partly influenced by dietary selection and the variable uptake and availability of the element in the diet. In this study, levels of plasma P were highest when plant P was at its highest. This result is in agreement and similar with Elhag *et al* (2014).

4. Conclusions

It can be concluded that potassium and phosphorus on soil and plasma serum has been reported highly concentrations at the flowering stage than that at seed setting stage. However feed have been reported highly concentrations at seed setting stage and least at the flowering stage.

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