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FORAGE MINERALS CONCENTRATION IN RELATION TO THE NUTRIENT REQUIREMENTS OF FARM LIVESTOCK IN MAIDUGURI METROPOLITAN AREA

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ABSTRACT

Pasture concentration of minerals in relation to nutrients requirement of ruminants need to be analyst. The use of browse plant to supplement the animal ration becomes enormous. Herdsmen, livestock farmers resort the use of the most common browse plant within the region. Although, the browse plants are found in almost all the

Introduction

Forages are the essential and basic source of food for animals; the nutritional values and mineral compositions of plants are importance in determining the plants and Animal health. Minerals are essential constituents of skeletal structures such as bones and teeth. Minerals play a key role in the maintenance of osmotic pressure, and thus regulate the exchange of water and solutes within the animal body. Minerals serve as structural constituents of soft tissues. pasture are an important source of providing minerals to grazing Ruminants .Mineral deficiencies can also depress forage digestibility and intake of habages thereby decreasing livestock production efficiency. Among species Mineral concentrations vary significantly ranging from toxic to inadequate for livestock production (Grusak & Dellapnna, 1999).In animals, minerals function as structural components of organs and

northern Sudano sahelian region, the most nutritive among the browse plant are known to farmers. The study was aimed at characterizing the mineral status of forage and to ascertain when, where and to what extent mineral problems. The study was aimed to evaluate the concentration of minerals in relation to pasture requirement of ruminants. The study was conducted in two successive phases. The forage was harvested daily within the vicinity of Maiduguri metropolitan; each wards five different sample was harvested at random following the grazing Animal on grazing field. Calcium is most concentrated in selected forages of Fezzan, Hausari, Gwange I and Limanti, less concentrated in forages of Lamisula (Biu), Bolori I, Bolori II and Gamboru wards. forage mineral values for Magnesium, Zinc, Copper, Iron, and Manganese are higher than the critical levels reported; Zn 30mg/kg. concluded that there was relatively abundant amount of phosphorus, sulphur, magnesium, copper, iron, and manganese in five of the study areas (Fezzan, Hausari, Gwange I, Gwange II and Gwange III).

Keywords: Forage; Minerals; Farm Animals; Pasture; Nutrients

tissues, as cofactors or activators in enzyme and hormone systems, as constituents of body fluids and tissues (where they maintain osmotic pressure, acid-base balance, membrane permeability, and tissue irritability), and as regulators of cell In small farming systems, forages and agricultural by-products are the main mineral sources for ruminant feeds in many regions of the world. Animal production depends on the quantity and quality consumed by ruminants and the extent to which the feed meets energy, protein vitamin and mineral requirements (Minson, 1990). The nutritive values of some forage have indicated that these depend on the combined effects of genetic and animal factors. In many dry regions of the world, the feeding of the ruminants mostly depends upon the native grasses and under these conditions ruminants may be exposed sometimes to the danger of deficiency or toxicity of some minerals (Fujihara *et al*., 1992, 1995). Plant analyses in some instances are necessary for botanical and environmental purposes. The uptake of minerals and particularly trace minerals by plants can provide important information on environmental contamination and requirements of ruminants (Yusuf *et al*., 2003; Khan *et al*., 2006, 2007). Some early abortions and embryonic deaths are due to trace mineral deficiencies of the mother. A trace mineral deficiency in cattle can go undetected for some time, but one critical deficiency can cause sudden death in cattle. If you're grazing cool-season forages, magnesium deficiency can cause sudden death in cattle.

Pasture concentration of minerals in relation to nutrients requirement of ruminants need to be analyst. The use of browse plant to supplement the animal ration becomes enormous. Herdsmen, livestock farmers resort the use of the most common browse plant within the region. Although, the browse plants are found in almost all the northern Sudano sahelian region, the most nutritive among the browse plant are known to farmers. Thus, in several locations livestock farmers considered the use of less nutritive ones. Hence, evaluation of the nutrition composition of browse and grass is of very important.

The objectives of the survey were to characterize the mineral status of forage and to ascertain when, where and to what extent mineral problems. This information will lead to a better understanding of the likely mineral-nutrient needs of grazing ruminants during particular seasons mostly in Maiduguri metropolitan with analogous climatic and ecological conditions. Due to imbalanced nutrient availability, different physiological disorders and diseases are being observed in the livestock of the region under study. Thus, this study will provide farmers, policy makers, feed formulation firms with necessary information needed on some important browse plant and grass that can be used as supplement to conventional feeds.

Materials and Methods

Experimental Site:

This experiment was conducted at twelve wards of Maiduguri metropolitan council (MMC) local government of Borno State, (Bolori, Mafoni, Fezzan, Hausari, Gwange I, Gwange II, Bolori I, Bolori II, Gwange II, Limanti, Lamisula, Gomboru)

Methodology

This study was conducted in two successive phases. The grasses were harvested daily within the vicinity of Maiduguri metropolitan; each wards five different sample was harvested at random following the grazing Animal on grazing field. The plant material was collected and air dried until the dry matter content is around 400g/kg

Heavy Metals analysis

The equipment and instruments was used in this study were all calibrated to check their status before and in the middle of the experiments. Apparatus such as volumetric flasks, measuring cylinder and digestion flasks was thoroughly washed with detergents and tap water and then will be rinsed with deionized water. All Glass was cleaned with 10% concentrated Nitric acid (HNO_3) in order to clear out any heavy metal on their surfaces and then rinsed with distilled-deionised water. The digestion tubes was soaked with 1% (w/v) potassium dichromate in 98% (v/v) H_2SO_4 and the volumetric flasks in 10% (v/v) HNO_3 for 24 hours followed by rinsing with deionized water and then dried in oven and will be kept in dust free place until analysis began. Prior to each use, the apparatus was soaked and rinsed in deionized water.

Equipment and Apparatus

1. Analytical balance, 250-g capacity, resolution 0.0001g, OHAUS, PA214 pioneer USA
2. Glass ware: Borosilicate volumetric flasks (25, 50 ml, 100 ml & 1000 ml), Measuring cylinders,
3. Micropipettes (1-10 ml, 100-1000 ml)
4. Atomic absorption spectrophotometer (Buck scientific model 210VGP AAS, USA; equipped with hollow cathode lamps and air-acetylene flame)
5. Microwave digester (Master 40 serial No: 40G106M)

Reagents and Chemicals

Reagents and chemicals was used for the laboratory works were all analytical grade: Deionized water (chemically pure with conductivity 1.5 µs/cm and below was prepared in the laboratory) and was used for dilution of sample and intermediate metal standard solutions prior to analysis and rinsing glassware and sample bottles.

Preparation of 1000mg/Litre stock AAS standard solution for selected heavy metals (such as Pb, Cr and Cd and other metals)

The determination of a given metal concentration in the experimental solution was based on its respective calibration curve. In plotting the calibration curves for lead, cadmium, zinc and other metals, a stock solution of each metal ion of (1000ppm) supplied by manufacturers company was used, from which a standard working solution of 100ppm was prepared.

Standard working solution: 100ppm was prepared as working solution from the 1000ppm already prepared. A simple dilution formula ($C_1V_1 = C_2V_2$) was used to calculate the volume of the stock solution to be diluted to the new desired concentration. 1mL of concentrated HNO_3 was added to each working standard and finally diluted to the desired volume with deionised water.

To prepare 100ppm, 10ml of the standards and other stock solutions were pipetted and added in to 100 ml calibrated flasks finally diluted with deionized water and the solution was mixed thoroughly. The other standard working solutions was prepared from100ppm by pipetting out appropriate volume in to calibrated flasks and made up to volume with deionized water.

Determination of metal content by AAS

Preparation of calibration curve

Calibration curves were prepared to determine the concentration of the metals in the sample solution. The instrument was calibrated using series of working standards. The working standard solutions of each metal will be prepared from standard solutions of their respective metals and their absorbencies will be taken using the AAS. Calibration curve for each metal ion to be analyzed will be prepared by plotting the absorbance as a function of metal ion standard concentration.

Determination of metal contents of each sample

Concentration of the metal ions present in the sample was determined by reading their absorbance using AAS (Buck scientific model 210GP) and comparing it on the respective standard calibration curve. Three replicate determinations was carried out on each sample. The metals was determined by absorption/concentration mode and the instrument readout was recorded for each solution manually. The same analytical procedure wil be employed for the determination of elements in digested blank solutions and for the spiked samples.

Data Analysis

Data obtained from the experiment was subjected to ANOVA using statistics 8.1. difference between mean will be tested using the DUNCAN multiple range test

Results and Discussion

Table 1 shows the mineral distribution of some selected forages across grazing zones of 12 local governments of Maiduguri. There was no significant (P>0.05) difference in the amount of lead (Pb) in forages across all wards, however, significant (P>0.05) difference was observed in the distribution of calcium (Ca), Phosphorus (Ph), Sulphur (S), Magnesium (Mg), Copper (Cu), Zinc (Zn), Iron (Fe), Manganese (Mn) and Arsenic (Ar) across the 12 wards covered. Calcium is most concentrated in selected forages of Fezzan, Hausari, Gwange I and Limanti, less concentrated in forages of Lamisula (Biu), Bolori I, Bolori II and Gamboru wards (Table 1a).

There was slight significant (P>0.05) difference in distribution of Phosphorus (Ph) across all wards. Phosphorus is more concentrated in forages of Limanti, Bolori, Mafoni, Fezzan, Hausari, Gwange I, Gwange II, Bolori and Gamboru (Table 1a). There significant (P>0.05) difference in Sulphur concentration across all the wards. Forages in Limanti, Fezzan, Hausari, and Gwange I and Gwange III have more sulphur than forages in the other 7 wards (Table 1a). Similarly, significant (P>0.05) differences was observed in the presence of magnesium in the forages of all the 12 wards. Magnesium is more prevalence in forages found in Mafoni > Limanti, Bolori, Lamisula, Hausari, Gwange II and Gamboru ward and less prevalence in grazed forages of Bolori II wards (Table 1a).

In table 2, there was significant (P>0.05) difference in the prevalence of copper in forages of the studied 12 wards. Copper element was observed

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to be more in selected forages of Fezzan, Hausari, Gwange I and Gwange III, but relatively least present in Bolori I and Limanti wards (Table 1b). However, slight significant (P>0.05) difference was observed in the distribution of zinc across the wards. They are found to be equally abundant in selected forages from Limanti, Bolori I and Mafoni among all the wards (Table 2).

The concentration of Iron was observed to be significantly (P>0.05) different across all LGAs, with highest Iron concentration found in the selected forages from Hausari, Fezzan and Gwange III and the lowest found in Limanti, Bolori I and Lamisula (Biu) LGAs (Table 1b). There was significant (P>0.05) difference in the distribution of Manganese, the highest concentration was seen in forages from Mafoni > Fezzan, while Bolori I had the lowest Iron concentration among the LGAs (Table 1b). finally, there was slight significant (P>0.05) difference observed in arsenic concentration across all LGAs, only the selected forages from Bulablin LGA has the highest arsenic concentration among all LGAs (Table 2).

Table 1: Mineral composition of some selected forages in 12 Local Government Area of Maiduguri

WARDS	Pb (mg/kg)	Ca (mg/kg)	Ph (mg/kg)	S (mg/kg)	Mg (mg/kg)
LIMANTI	1.29 ± 0.37 (5)	111 ± 19.34 (5)bc	1031.11 ± 85.16 (5)b	29.57 ± 3.86 (5)bc	1315.75 ± 132.37 (5)bcd
BOLORI I	0.68 ± 0.42 (5)	50.83 ± 31.3 (5)ab	1023.72 ± 134.04 (5)b	19.34 ± 5.97 (5)ab	1573.69 ± 906.82 (5)d
MAFONI	0.82 ± 0.35 (5)	60.81 ± 25.88 (5)ab	1018.03 ± 75.16 (5)b	21.97 ± 3.69 (5)ab	3772.82 ± 343.13 (5)e
LAMISULA	0.55 ± 0.35 (5)	41.1 ± 26.10 (5)a	724.3 ± 135.33 (5)ab	14.78 ± 5.53 (5)a	1959.93 ± 312.81 (5)d
FEZZAN	1.1 ± 0.45 (5)	138.46 ± 16.55 (5)c	1006.82 ± 94.18 (5)b	31.91 ± 2.62 (5)bc	381.69 ± 30.18 (5)abc
HAUSARI	1.23 ± 0.37 (5)	131.22 ± 6.82 (5)c	953.41 ± 37.49 (5)b	31.38 ± 1.35 (5)bc	1397.7 ± 67.83 (5)cd

GWANGE I	0.96 ± 0.39 (5)	136.02 ± 4.38 (5)c	1095 ± 33.83 (5)b	39.75 ± 6.34 (5)c	398.21 ± 11.29 (5)abc
GWANGE II	0.9 ± 0.3 (5)	93.21 ± 9.33 (5)abc	762.68 ± 75.93 (5)ab	22.81 ± 2.28 (5)ab	1451.34 ± 145.89 (5)d
GWANGE III	1.11 ± 0.32 (5)	82.3 ± 23.67 (5)abc	996.38 ± 28.9 (5)b	32 ± 2.25 (5)bc	374.36 ± 7.32 (5)abc
BOLORI II	0.85 ± 0.3 (5)	63 ± 22.21 (5)ab	512.85 ± 180.8 (5)a	15.41 ± 5.44 (5)a	193.82 ± 68.44 (5)a
BULABLIN	1.26 ± 0.29 (5)	93.63 ± 21.91 (5)abc	757.79 ± 177.16 (5)ab	22.91 ± 5.36 (5)ab	286.7 ± 67.77 (5)ab
GAMBORU	0.75 ± 0.24 (5)	55.25 ± 17.91 (5)ab	449.22 ± 144.77 (5)a	13.52 ± 4.38 (5)a	1269.24 ± 411.33 (5)bcd

Pb=Lead, Ca=Calcium, Ph=Phosphorus, S=Sulphur, Mg= Magnesium
Group means, standard error and count are presented as; Means ± s. e. m (n): a, b, c, - means with different superscripts within factor (3 or more levels) are significantly different.
Significant level = (P>0.05)

Table 2: Mineral composition of some selected forages in 12 Local Government Area of Maiduguri

WARDS	Cu (mg/kg)	Zn (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Ar (mg/kg)
LIMANTI	5.17 ± 1.73 (5)ab	22.57 ± 5.73 (5)b	12.69 ± 3.24 (5)a	1.35 ± 0.57 (5)abc	0.03 ± 0.01 (5)a
BOLORI I	0.09 ± 0.570 (5)a	26.73 ± 5.7 (5)b	11.26 ± 0.94 (5)a	0.1 ± 0.100 (5)a	0.03 ± 0.01 (5)a
MAFONI	12.27 ± 1.63 (5)abc	22.29 ± 2.89 (5)b	14.57 ± 2.09 (5)ab	5.16 ± 1.40 (5)d	0.08 ± 0.02 (5)a
LAMISULA	11.11 ± 2.13 (5)abc	5.89 ± 1.25 (5)a	8.64 ± 2.570 (5)a	2.06 ± 0.44 (5)abc	0.09 ± 0.03 (5)a
FEZZAN	31.36 ± 10.2 (5)d	8.25 ± 0.56 (5)a	56.97 ± 18.56 (5)bc	3.14 ± 0.63 (5)c	000 ± 000 (5)a

HAUSARI	18.73 ± 3.59 (5)bcd	8.7 ± 0.65 (5)a	66.38 ± 8.88 (5)c	1.68 ± 0.83 (5)abc	0.22 ± 0.07 (5)a
GWANGE I	18.42 ± 4.58 (5)bcd	8.19 ± 1.23 (5)a	21.41 ± 1.44 (5)ab	2.78 ± 0.42 (5)bc	0.04 ± 0.04 (5)a
GWANGE II	13.86 ± 2.86 (5)abc	6.46 ± 1.27 (5)a	20.8 ± 2.35 (5)ab	1.9 ± 0.22 (5)abc	0.54 ± 0.23 (5)ab
GWANGE III	22.95 ± 4.44 +(5)cd	9.45 ± 0.21 (5)a	36.8 ± 8.85 (5)bc	2.6 ± 0.67 (5)bc	0.27 ± 0.14 (5)a
BOLORI II	10.18 ± 3.94 (5)abc	4.87 ± 1.72 (5)a	23.05 ± 8.71 (5)ab	1.79 ± 0.76 (5)abc	1.01 ± 0.66 (5)ab
BULABLIN	11.79 ± 3.46 (5)abc	7.22 ± 1.69 (5)a	16.54 ± 0.59 (5)ab	1.93 ± 0.46 (5)abc	1.53 ± 0.55 (5)b
GAMBORU	9.86 ± 3.65 (5)abc	4.28 ± 1.39 (5)a	19.01 ± 5.18 (5)ab	0.81 ± 0.28 (5)ab	0.77 ± 0.72 (5)ab

Cu=Copper, Zn=Zinc, Fe=Iron, Mn= Manganese, Ar=Arsenic

Group means, standard error and count are presented as; Means ± s. e. m (n): a, b, c, - means with different superscripts within factor (3 or more levels) are significantly different.

Significant level = (P>0.05)

Among the 12 local government areas studied in Maiduguri, this research suggests that forages with high mineral concentration of calcium, phosphorus, sulphur, magnesium, copper, iron, and manganese are densely populated in 5 LGAs, namely; Fezzan, Hausari, Gwange I, Gwange II and Gwange III. Only about 25% of the browse forages had higher Ca than the recommended requirements (g kg-1 DM diet) for growing cattle (26 – 108), pregnant cows (21–35) and lactating cows (29–53), (Shamat *et al*., 2009). However, the variations in the levels of Ca from this present study could be partly explained by the mature forage species, species composition, and variations in soil characteristics due to location of the different browse forage.

Forage plants had higher concentrations of P than the normal requirements of P (mg kg-1 DM diet) of growing cattle (11–48), pregnant heifers and cows (09–20) and lactating cows (20 – 300), suggesting nutritional adequacy for livestock (Njidda *et al*., 2011). However, the variation in the content of observed P could be due to the available soil P and soil pH, browse growth stage and proportions of leaf and stem fractions harvested for mineral analyses.

Also forage mineral values for Magnesium, Zinc, Copper, Iron, and Manganese are higher than the critical levels reported; Zn 30mg/kg (Reuter and Robinson (1997), Cu (Khan *et al*., 2009), Fe 100- 700mg kg-1 DM (McDowell, 1992), Mn (14 – 148mg/kg DM) (Minson, 1990). The availability of Fe forages could vary because Fe is absorbed according to the need, and thus its absorption would depend on dietary factors, age of the animal and body Fe status.

Conclusion

This paper examined some selected forage mineral concentration in 12 twelve study areas in Maiduguri. It concluded that there was relatively abundant amount of phosphorus, sulphur, magnesium, copper, iron, and manganese in five of the study areas (Fezzan, Hausari, Gwange I, Gwange II and Gwange III). In all the study areas, most of the macro and micro minerals under examination found in the selected forages are either within or higher concentration than the ranges reported for various physiological developments of small and large ruminant animals, and therefore they can meet the requirement of ruminant animals.

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