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# MINERAL STATUS OF SOME COMMON VEGETATION AVAILABLE IN JODHPUR DISTRICT OF RAJASTHAN

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**ABSTRACT:** The Arid region of western Rajasthan is endowed with indigenous and well adapted vegetations, which play an important role in livestock feeding by virtue of their high nutritional and mineral content. Here some common well adapted vegetation such as grass species (*Cenchrus ciliaris, Cenchrus setigerus and Lasiurus Sindicus*) and cereal crop (*Pennisetum Typholdenum*) were taken from Jodhpur district of Rajasthan for their mineral content investigation. Standard methods were used for the analysis of multi nutrient for triplicate samples and a statistical analysis was also carried out. Cereal crops (*Pennisetum Typholdenum*) distinguished itself with very high concentration of Ca, Mg, Na, and Fe in comparison to grass species. Result showed considerable variation within and between species of grasses. The concentration of Sulfur and phosphorous was found more or less identical, whereas Sodium content was found very low in all vegetations. Micronutrient such as Iron and Copper was found adequate to meet animals need, whereas Manganese and Zinc content was found near critical level.
**Kew Words:** Macronutrient, Micronutrient, Grass tetany, Dry matter, Minerals, Pasture plants

## INTRODUCTION

Living organism need various mineral to perform the normal functioning of their life. Some of these minerals require in large amount are macro-minerals, while minerals needed in very small quantity are referred as the micro nutrients [1]. The basic source of minerals, for man, and animal is the food chain. An important link in the transfer of trace elements from plant to man are livestock animal [2]. Livestock usually uptake most of their nutritive elements from the feedstuffs and forages they consume. All plants depend upon the soil for their supply of mineral nutrients. Feed source of mineral are generally divide into various base feedstuff, such as range or pasture plants, harvested forages, concentrates and mineral supplements. Concentrations of mineral elements in forage are dependent upon the interaction of a number of factors; including soil, plant species, and stage of maturity, yield, seasons, and grazing pressure, pasture management and climate [3]. Most naturally occurring mineral deficiencies in herbivores are associated with specific regions and are directly related to soil characteristics [4]. The nutritional quality of feedstuff depends not only on the total concentration of minerals, but also its bioavailability [5]. It varies considerably among animal species and breeds within a species, as well as among different feedstuffs. The combination of these factors makes it extremely difficult for livestock producers to determine the actual mineral status of their herd, their need and degree of supplementation to achieve the optimal production [6]. In the arid and semi-arid zone of Rajasthan grazing animal depends mainly on poor quality feedstuff and non-developed pastures and became well adapted to the harsh grazing condition. . Grasses are generally considered good sources of energy [7] primarily because of their high content of cellulose. In very rank grasses however, digestibility will be so low as to reduce intake and thereby reduce total energy intake. Mineral deficiencies affect production of grazing livestock in most of the regions of the world, which include those of the major elements Ca, P, Mg, Na, S, and the trace elements Cu, Mn, Fe, and Zn [8]. To improve productivity and forage utilization, it is necessary to have knowledge of nutritive value of range species and their impact on livestock production [9]. Minerals are vital for normal growth, reproduction, health and proper functioning of the animal's body [10]. Minerals protect and maintain the structural components of the body, organs and tissues, and are constituents of body fluids and tissues as electrolytes. Minerals catalyze several enzymatic processes and hormone systems; maintain acid-base balance, water balance and osmotic pressure in the blood and cerebral spinal fluids.

Mineral imbalance has bad impact on forage quality. Excessiveness of one element cause antagonistic effect for other elements and thus causing mineral imbalance. Mineral imbalances may arise singly or various combinations. Imbalance of major elements i.e. Ca, P, Mg, Na, may cause rickets, lameness, milk fever, lambing, sickness, tetany, reduced appetite,[11] while deficiency of trace elements i.e. Co, Cu, Mn, Se, I, Zn may cause ill thrift , abortion, placental retention, lamb death, reduced immunity in calves, infertility , susceptibility to bacteria and parasites and poor skin/hair/fleece, quality[12]. Signs of mineral imbalance/deficiencies are often non-specific and in cases of marginal deficiencies may go unnoticed by the stock owners. The interpretation of such signs is also difficult if more than one mineral is deficient or the deficiency is associated with other disorders such as increased burdens of gastrointestinal parasites, especially since trace element deficiencies may increase the susceptibility of animals to disease [13]. Excessive intakes of minerals can also commonly have an adverse effect on animal health, the more commonly encountered problems have been associated with excessive intake of the minerals such as Cu, Mo, Fe, S, Na and K. Due to deficiencies and excess of some minerals in forages in semi arid and arid region cannot support ruminants an acceptable level of production. Utilization of low quality roughages such as hays, straws and stovers could also be further limited by their low contents of macro and micro minerals due to their effects on rumen microbial growth and activity, leading to lowered feed digestibility [14]. There is scanty information on the mineral nutritive potential of forages in this region despite of its importance in livestock production, and very little has been done to establish levels of minerals of these feed resources for enhanced nutrition of grazing ruminants in arid and semi-arid areas of Rajasthan. This study was aimed to evaluate the minerals composition of different forage grass species. This evaluation of nutritive status would be useful to suggest mineral supplementation strategies to improve growth and reproductive efficacy of cattle's under rangeland condition for Rajasthan as well as other Asian countries with similar climate and ecological conditions.

## Experimental:

**Study site:** The study was conducted with four different forage grasses(shown in Fig. 1) collected from Central Arid Zone Research Institute, Jodhpur situated in hot arid zone of western Rajasthan(26° 17' 12" N / 73° 1' 48" E).Weather in Jodhpur, Rajasthan is dry and hot, a typical desert weather. The average annual rainfall is approximately 32 cm. In summer, the maximum temperature is around 42 deg and the minimum temperature is around 37 deg. C. In winters, the maximum temperature is around 27.5 deg C and the minimum temperature is around 15.5 deg C. Jodhpur is bright and sunny throughout the year. Characteristically the soils are very low in organic matter/ humus and most of the nutrients reserve is present in un-weathered mineral forms. These soils have low clay and silt, and therefore nutrient adsorption and retention by these soils are very low. Soils are generally alkaline in nature and high in soluble salts and calcium contents. Relative humidity in the region is often less than 30% during summer months, but gradually increases to 80% by monsoon and then decreases from October onwards, following the withdrawal of the monsoon.

**Sampling and Analytical methodology:**

Plant samples were collected, washed to free from durt particles and pests, dried, ground to appropriate size and stored in polythene beg for their mineral analysis [14,15 and 16].All the parameters were estimated by internationally accepted method[17,18 and 19]. For Sulfur determination sample is digested in binary acid mixture ($HNO_3$+$HClO_4$) and determined turbid metrically by Chesnin and Yien [20].For calcium and magnesium estimation dry ashing of plant sample after treatment with dilute $H_2SO_4$ and alcoholic solution [21] is done and Calcium and magnesium are determined in plant test solution by EDTA titration method [22].Phosphorous is determination by spectrophotometrically by Vanadomolybdate method [23]. Sodium and potassium is determined in plant digestions sample by Flame Photometer by Toth and Prince [24].To prepare samples for micro-nutrient determinations, 1 g of ground sample was heated in 10 ml $HNO_3$ and $HClO_4$ (3:1 ratio) at 250 $^{o}$C until the tissue was completely digested. The digested material was diluted to 50 ml with distilled water and stored at 4 $^{o}$C [25].Copper, Fe, Mn, and Zn concentrations were determined using an Atomic Absorption Spectrophotometer (EIC made AAS 4141 model) [26].

## RESULT AND DISCUSSION

The micro and macro element concentration in different forage grasses have been presented in Fig. 1 and 2. The average concentration (% DM) of different macro and micro element in forage grasses analyzed in this study were ranged from 0.19-0.24, 0.19-0.25, 0.79-1.20, 0.35-0.48, 0.078-0.12,and 0.98-1.11respectively for Sulfur, Phosphorus, Calcium, Magnesium, Sodium and Potassium(macro element) and 218-310, 26-37, 34-52 and 9-28 (μg/gm) respectively for, Iron, Zinc, Manganese,and Copper(micro element).

Calcium is an important mineral for beef cattle, both in terms of the relative requirement and the diversity of functions in the body. It is a major component of the skeleton, which also serves as a calcium storage site. In fact, about 99% of the total calcium in the body is found in the bones and teeth. Calcium is involved in blood clotting, muscle contraction, transmission of nerve impulses, regulation of the heart, secretion of hormones, and enzyme activation and stabilization [27]. The Calcium concentration (% DM) varied from 0.79 in Cencherus. Ciliaris to 1.20 in Pennisetum Typholdenum Magnesium is closely related to calcium and phosphorus in function and distribution in the body. This mineral is known to activate at least 300 different enzymes. Magnesium is essential in energy metabolism, transmission of the genetic code, membrane transport, and nerve impulse transmissions [28]. The concentration of Magnesium was also found adequate as per NRC, 2001 requirement for lactating beef cattle [29]. Ruminants are generally at risk from hypomagnesaemia when the forage contains less than 0.2% of Mg and high in K content. Magnesium is considered to be an important factor in the occurrence in grass tetany in animals [30]. Phosphorous is essential for strengthening the skeleton, teeth, improving blood plasma, assimilation of carbohydrates, fats protein synthesis and necessary for enzyme activation. Phosphorus is also required by ruminal microorganisms for growth and cellular metabolism. Its deficiency causes poor growth and development of animals [31]. Phosphorous is the most limiting mineral to productivity of grazing animals throughout the world because of low availability to range plants and loss through soil erosion [32].The estimated value of Phosphorous from the forages was ranges from 0.19 %( Lasiurus sindicus) to 0.25 %(*Pennisetum Typholdenum*) which is just touching the critical level of the requirement for cattle as per NRC (2001).

(A)Pennisetum Typholdenum

(B)Cenchrus ciliaris

(C)Cenchrus setigerus

(D) Lasiurus sindicus

**Figure-1: Some selected vegetation**:

Potassium (K) is the third most abundant mineral in the body. It is important in acid-base balance, regulation of osmotic pressure and water balance, muscle contractions, nerve impulses, and certain enzyme reactions [33]. The data revealed that all the forages were richer in Potassium in comparison to other macro elements analyzed here. Almost all the forages screened, had adequate levels of Potassium as compared to its requirement of NRC (2001)(Table 1). The higher concentration of K may be due to its selective uptake from the soil and was much higher than Na. Similar findings were also reported by Singh[34].

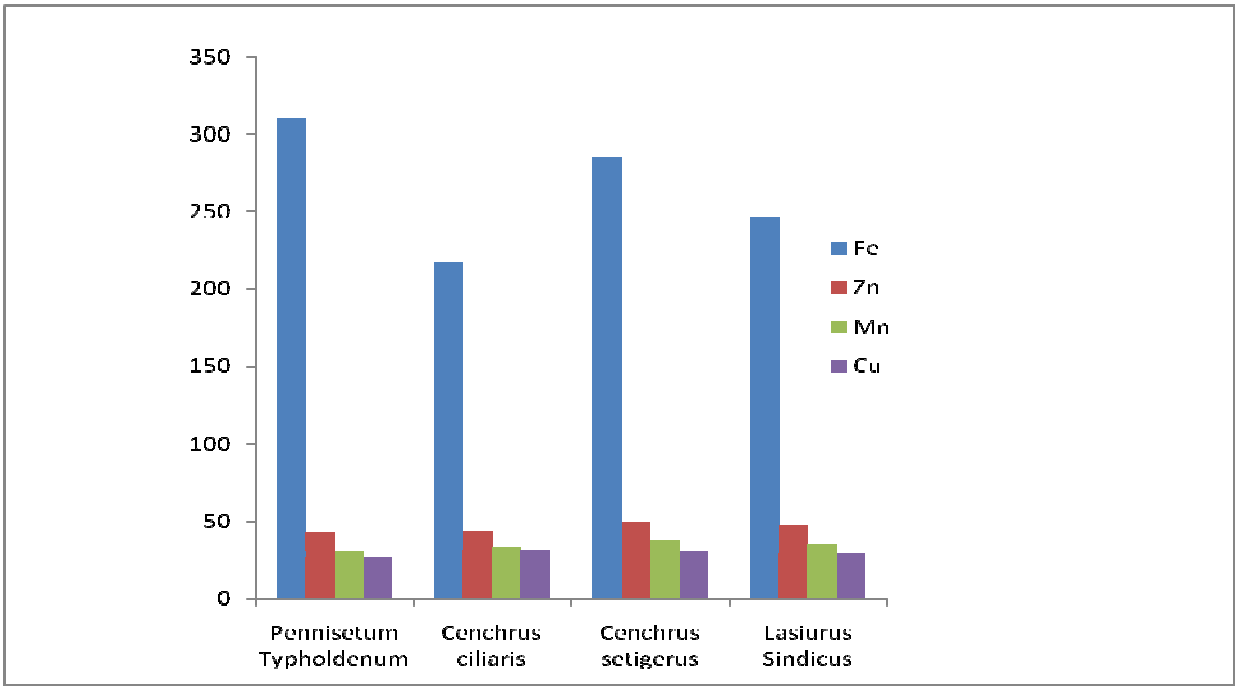


**Figure.2. Micro Element Concentration (µg/gm of DM) in Forages**

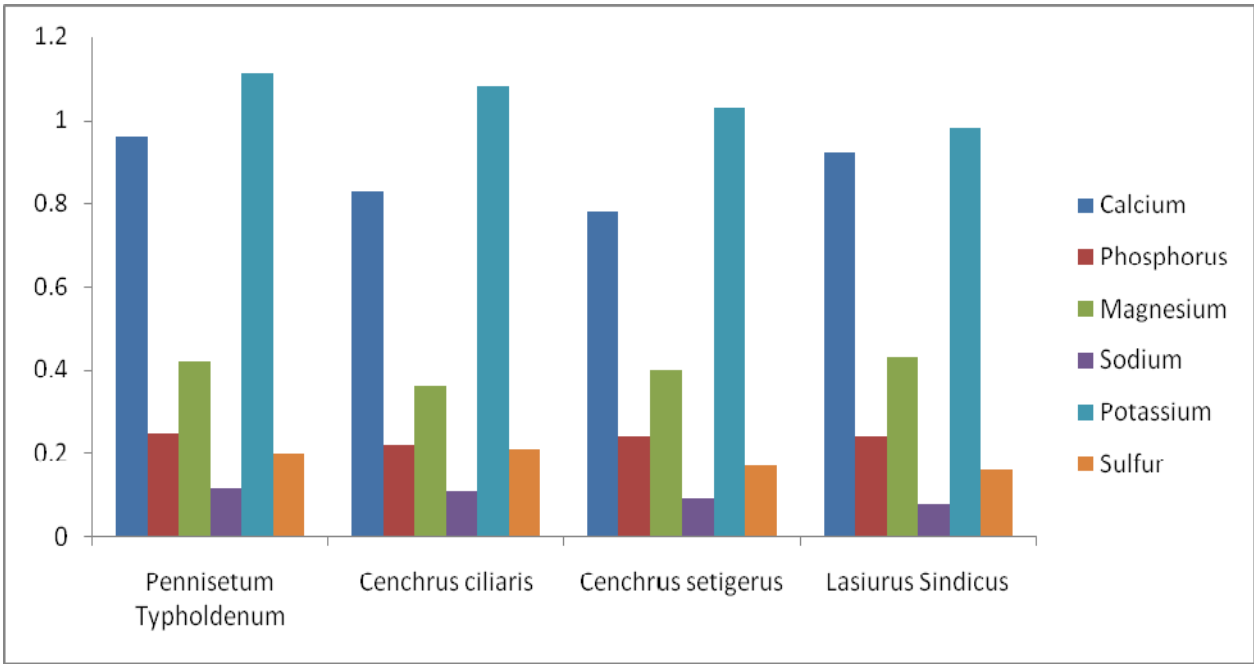


**Figure. 3. Macro Element Concentration (% of DM) in Forages.**

**Table 1. Mineral requirements their critical level and maximum tolerable concentrations of a lactating beef cow**

| Minerals | Critical level | Early lactation requirement % | Maximum tolerable Concentratio % |
|---|---|---|---|
| Calcium % | <0.30 | 0.5-0.7- | - |
| Phosphorus % | <0.25 | 0.15-0.3 | - |
| Magnesium % | <0.20 | 0.2 | 0.4 |
| Sodium % | <0.06 | 0.1 | - |
| Potassium % | <0.80 | 0.7 | 3.0 |
| Sulfur % | <0.20 | 0.15 | 0.4 |
| Fe(μm/gm) | <50.0 | 50.0 | 1000.0 |
| Cu(μm/gm) | <8.0 | 10.0 | 100.0 |
| Mn(μm/gm) | <40.0 | 40.0 | 1000.0 |
| Zn(μm/gm) | <30.0 | 30.0 | 500.0 |

Adapted from NRC (2001).

Critical level =Concentration below which are low or considered deficient (McDowell et al. 1993) based on requirement for cattle (NRC, 2001)

Adequacy of Sodium in diet is more important than Potassium not only due to its importance in Sodium pump and its concentration being more in extracellular compartment but also due to its inadequate levels in various forages, further, its kinetic feature, the stoichiometry of $Na^+$ and $H^+$ is 1:1 which maintains pH at approximately 7.2 intracellularly by the distribution of $H^+$ on the basis of electro-chemical gradient [35]. Potassium is mostly located in the intracellularly compartments, playing a synergistic role with sodium in cellular activity .Sodium content was just above in *Cenchrus setigerus* and *Lasiurus Sindicus* whereas *Cenchrus ciliaris* and *Pennisetum Typholdenum* contains adequate amount (0.11%-0.12%). Sulfur is needed for synthesis of methionine and cystine, which are sulfur-containing amino acids, as well as the B vitamins, thiamin, and biotin. Sulfur is required by ruminal microorganisms for normal growth and metabolism [36]. In fact, ruminal microorganisms are capable of synthesizing all organic sulfur containing compounds required by the animal from inorganic sulfur. Sulfur concentration was estimated in the samples found nearly adequate, because it is transferred to seed protein [37]. It was found minimum (0.19%) in Cencherus setigerus and maximum (0.24) in *Lasiurus Sindicus* (Fig. 2). The variation in S content of plants depends largely on the amount of S in plant protein in the form of S containing amino acids. Trace elements though required in very minute quantities but their importance could not be considered the least in the growth and metabolism of human and animal bodies [38]. Most of the trace elements have antagonizing effects for macro-minerals. The main sources of these minerals are water and soil upon which the forage plant species grow [1]. Mineral deficiencies can inhibit forage digestibility and herbage intake and ultimately decreases livestock production efficiency at the same time if these minerals are in excess then they cause severe physiological disturbances [39]. Copper is an important cofactor in many enzyme systems including those involved in hemoglobin formation, iron absorption and mobilization, connective tissue metabolism, and immune function [39]. Iron is an essential component in the structure of proteins involved in transportation and utilization of oxygen. Examples include hemoglobin, myoglobin, cytochromes, and iron-sulfur proteins involved in the electron transport chain. Additionally, as with many other trace minerals, several enzymes either contain or are activated by iron [38].

Zinc is an essential component of a number of important metabolic enzymes and it serves to activate numerous other enzymes. Enzymes that require zinc are involved in protein, nucleic acid, and carbohydrate metabolism as well as enzymes associated with immune function [39].The result revealed all the forages were found adequate in Cu and Fe (Fig.2). Zn content was found just near the critical level in *Cencherus ciliaris, Cencherus Setigerus* and *Pennisetum Typholdenum* and found adequate in *Lasiurus sindicus*. Manganese is important in bone growth and formation in young animals and in maintaining optimum fertility in female cattle. The role of manganese in metabolism includes a component of the enzymes pyruvate carboxylase, arginase, superoxide dismutase, and several others [39]. Cencherus Ciliaris contains unduly low Mn content than others as compared to the suggested requirement (40 ppm). It is clear from this study that the forages (*Pennisetum Typholdenum, Cenchrus ciliaris, Cenchrus setigerus and Lasiurus Sindicus*) available in this area are deficient in P and Zn. However the level of some other mineral elements such as Ca, Mg, K, Fe and Cu were found to be adequate in forages.

## CONCLUSION AND RECOMMENDATION

On the basis of this data inference could be drawn that at what extent the feedstuff of this area are adequate, due consideration should be given to it before supplementing the ration with minerals to enhance the bioavailability of the mineral and thereby optimizing the productivity of animals. The knowledge about mineral content in different locally available feeds and fodder should help in identifying the deficiency of particular mineral elements in diet and accordingly possible nutritional intervention can be made with the aim to enhance the productivity and general health of the animals.

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