

MACROMINERAL STATUS OF BEEF CATTLE GRAZING SEMIARID RANGELANDS OF NORTH MEXICO

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ABSTRACT

In this study, macromineral concentrations in samples of soil, forage and serum of beef cattle in rangelands of the state of Nuevo Leon, Mexico, were determined during the wet and dry seasons of the year. Twenty-four ranches distributed in three geographic regions of the state (north, center and south), where cattle were not being supplemented with minerals, were sampled. A total of 220 soil samples, 680 forage samples and 220 blood samples were collected and analyzed. Loamy clay soils predominated with a pH that ranged from 7.3 to 8.0. Crude protein and macromineral concentrations in forage during the wet and dry seasons were, respectively: CP, 6.8 and 5.3%; calcium, 0.58 and 0.56%; phosphorus, 0.14 and 0.16%; magnesium, 0.29 and 0.23%; sodium, 0.22 and 0.13%; and potassium, 1.81 and 1.32%. Data from this study show that CP and phosphorus were deficient in the diet of range cattle.

KEYWORDS

Minerals, macrominerals, rangelands, beef cattle, mineral supplements

INTRODUCTION

Due to deficiencies and excesses of some minerals in soil and forage in rangelands of semiarid northeast Mexico, ruminants cannot support an acceptable level of production. Knowledge of the levels of mineral elements that exist in soil, forage and tissue samples of cattle may suggest mineral supplementation strategies to improve growth and reproductive efficiency of cattle under range conditions.

During the dry season, the inadequate consumption of forage by range cattle that results from the low protein and high fiber content, may reduce the total mineral intake. On the other hand, during the wet season, high forage availability with higher concentrations of energy and protein may improve growth of ruminants, but mineral requirements are increased and deficiencies may be more frequent if cattle are not supplemented (McDowell et al., 1993).

The objective of this study was to evaluate the macromineral status of beef cattle, considering the mineral profiles of soil, forage and serum samples obtained from ranches of the semiarid rangelands of Nuevo Leon, Mexico. A companion paper reports the trace mineral status (Kawas et al., 1997).

MATERIALS AND METHODS

Twenty-four ranches from eleven counties of the state of Nuevo Leon that were not practicing mineral supplementation were sampled for this study. The state of Nuevo Leon was divided into three main regions, north, center and south. Counties sampled within each region were: north (Lampazos, Anahuac, Sabinas and Vallecillos); center (Apodaca, China, Pesqueria, and Bravo); and south (Montemorelos, Allende and Galeana).

Samples were obtained during the wet (September to November)

and dry (February to April) seasons of 1992. Mean annual rainfall was high during the year of the study (622 mm). A total of 220 soil samples, 680 forage samples and 220 blood samples were obtained. From each ranch, five samples of soil and blood were collected, and five samples were obtained from each forage species consumed by cattle. Grass species sampled were *Aristida raemeriana* (AR), *Bouteloua trifide* (BT), *Hilaria mutica* (HM), *Setaria macrostachya* (SM), and *Cenchrus ciliare* (CC), whereas woody species sampled were *Cordia spp.* (CO), *Acacia spp.* (AC), *Flourencaia spp.* (FL), *Leucophilum spp.* (LE), and *Lippia spp.* (LI).

The soil sampling technique used for this study was that described by Bahia (1978). Soil samples (250 g) were collected with a stainless steel tube at a depth between 15 and 20 cm. Soil samples were analyzed for pH and mineral concentrations by procedures reported by Rhue and Kidder (1983). Macromineral elements analyzed in soil samples were calcium (Ca), potassium (K), sodium (Na) and magnesium (Mg). Macromineral concentrations in soil, forage and serum were determined using a Perkin-Elmer Zeeman 5100 Atomic Absorption Spectrophotometer (Perkin-Elmer Corp., Norwalk, CT).

Procedures for sampling and analysis of forage and serum samples were as described by Fick et al. (1979). Feed samples were dried in a forced air oven at 60° C and ground through a 1 mm screen in a Wiley Mill before analysis. Concentrations of Ca, P, Na, K and Mg were determined in forage samples. Phosphorus content of grasses was determined by a colorimetric procedure (Fick et al., 1979). Crude protein content of grasses was determined as Kjeldahl N x 6.25 (AOAC, 1990). In serum, concentrations of Ca, P and Mg were determined.

The concentrations of mineral elements, pH and crude protein were analyzed as a factorial design-3x2 for soil and blood serum (3 regions, and 2 seasons) and 3x2x2 for forage (3 regions, 2 seasons and 2 types of forage, grasses and woody species).

RESULTS AND DISCUSSION

Alkaline pH soils predominated in all three regions of the state of Nuevo Leon with values that ranged from 7.3 in the south to 8.0 in the north. High levels of Ca (11,126 ppm) and Na (90 ppm) resulted from soil analyses in soils sampled in the northern region. Calcium and Na content of soil in other regions were: center, 15,667 and 62 ppm; and south, 5,710 and 66 ppm.

The region where forages were sampled had no effect ($P < 0.05$) on the CP concentrations of forages. Crude protein content of forages was greater ($P < 0.05$) during the wet season than during the dry season (6.8 vs. 5.3%). The CP content of woody species was greater ($P < 0.05$) than that of grasses (6.9 vs. 5.5%) (Figure 1). These CP mean concentrations appear to be lower than the minimum requirement (7% CP) for maintenance of beef cattle (NRC, 1984). An interaction ($P < 0.01$) between season and type of forage was obtained for crude

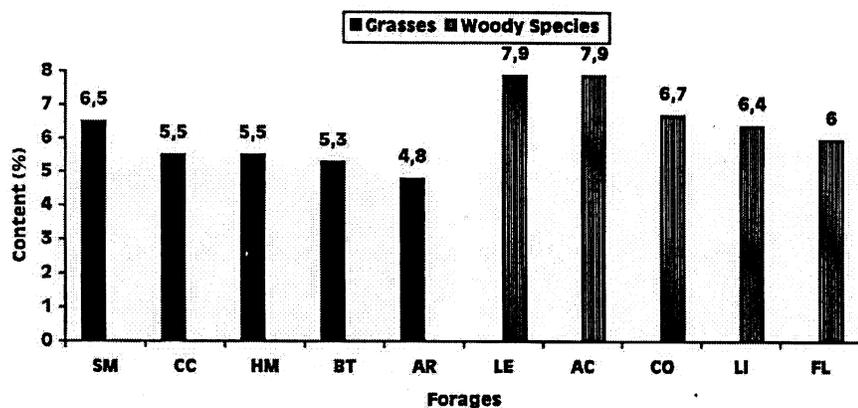
protein content. No interactions ($P>0.05$) were detected between region, season, and type of forage for concentration of any of the macrominerals.

The effects of region, season and type of forage on the macromineral content of forages are presented in Table 1. No differences in the macromineral concentrations were detected among regions, except for Mg, which was greater ($P<0.05$) in the center. Sodium and K concentrations were greater ($P<0.05$) during the wet season. The concentrations of Ca and K were greater ($P<0.05$) in the woody species, whereas Na content was greater ($P<0.05$) in the grasses.

Considering the critical levels (CL) in forages for Ca (0.30%), P (0.25%), Mg (0.10%), Na (0.08%) and K (0.65%) reported by the National Research Council (1984), P was the most deficient macromineral in the diet of range cattle. In this study, CL levels of deficiency denotes mineral concentrations in forages below the minimum requirements (NRC, 1984) or values in serum associated with specific clinical signs (McDowell et al., 1983). Macromineral concentrations in plasma during the wet and dry seasons were higher than the CL: Ca, 9.16 and 9.01 mg/dL; P, 6.89 and 6.95 mg/dL; and 2.29 and 2.45 mg/dL.

Crude protein and P were deficient in grasses and woody species sampled in the rangelands of the state of Nuevo Leon. This information can be used to make more precise recommendations for the preparation of supplements that range cattle need to improve their growth, reproduction and health.

Figure 1
Crude protein mean concentrations (%) of grasses were (*Aristida raemeriana*, AR; *Bouteloua trifide*; BT, *Hilaria mutica*; HM, *Setaria macrostachya*, SM, and *Cenchrus ciliare*, CC) and woody species (*Cordia spp.*, CO; *Acacia spp.*, AC; *Flourenzia spp.*, FL; *Leucophilum spp.*, LE; and *Lippia spp.*, LI) of rangelands of the state of Nuevo Leon, Mexico.



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Table 1
Effect of region, season and type of forage on the concentrations (%) of macrominerals in forages consumed by range cattle in the state of Nuevo Leon.

Effect	Ca	P	Mg	Na	K
Region					
North	0.59	0.16	0.24 ^b	0.19	1.611
Center	0.57	0.16	0.31 ^a	0.17	1.578
South	0.53	0.12	0.23 ^b	0.16	1.475
Season					
Wet	0.58	0.14	0.29	0.22 ^a	1.81 ^a
Dry	0.56	0.16	0.23	0.13 ^b	1.32 ^b
Forage					
Grasses	0.26 ^b	0.17	0.27	0.19 ^a	1.43 ^b
Woody Species	1.10 ^a	0.12	0.25	0.15 ^b	1.78 ^a

^{a,b} Values on the same column with different superscripts are different ($P<0.05$).