TRACE MINERAL STATUS OF BEEF CATTLE GRAZING SEMIARID RANGELANDS OF NORTH MEXICO

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ABSTRACT

Trace mineral concentrations of soil, forage and serum of range cattle of the northeast Mexico state of Nuevo Leon were determined in both wet and dry seasons of 1992. For each season, collections were made at twenty-four ranches within eleven counties of three regions. A total of 220 soil, 680 forage and 220 blood samples were collected and analyzed. No differences (P<0.05) between regions were obtained for Zinc (28.0 to 34.9 ppm) or Copper (4.4 to 5.4 ppm). Molybdenum concentrations were greater in the northern (2.1 ppm) than in the central (1.6 ppm) or southern (1.5 ppm) regions. Considering the critical levels in forages for Zinc (30 ppm) and Copper (10 ppm) reported by the National Research Council (1984), Zinc concentrations may be marginally deficient, whereas Copper concentrations were deficient in all three regions, in both seasons, and in grasses and woody species.

KEYWORDS

Minerals, trace minerals, rangelands, beef cattle, mineral supplements

INTRODUCTION

Mineral deficiencies, excesses and imbalances in soil and forages in rangelands of Northeast Mexico are partially responsible for the poor production of cattle under extensive conditions since most of the ruminants must depend largely upon forages to satisfy their mineral requirements.

In semiarid rangelands of Northeast Mexico, cattle often do not receive mineral supplements, and frequently, supplementation is limited to common salt. Mineral status of cattle can be determined by evaluation of soil, forage and animal tissue analysis (McDowell et al., 1983). Little research has been conducted on the mineral nutrition of range cattle in Northeast Mexico and appropriate mineral supplementation strategies can only be implemented when more information of the mineral status of ruminants of these regions is available.

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

MATERIALS AND METHODS

Trace mineral concentrations of soil, forage and serum of beef cattle under range conditions of Nuevo Leon were determined in both wet and dry seasons of 1992. For each season, collections were made at twenty-four ranches within eleven counties of three geographic regions (north, center and south) of the state of Nuevo Leon. Location of sampling sites, methods of sample collection, description of soil, forage and animal sample analysis, and methods of statistical evaluation of data are presented in the companion paper (Armienta et. al., 1997). A total of 220 soil samples, 680 forage samples and 220 blood samples were collected and analyzed. 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), *Fluorencia 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 were analyzed for pH and mineral concentrations by procedures reported by Rhue and Kidder (1983). Soil samples were analyzed for copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn). Procedures for sampling and analysis of forage and serum samples were as described by Fick et al. (1979). Forage samples were analyzed for Cu, Zn, and Mo. Serum samples were analyzed for copper Cu, Zn and selenium (Se). Copper and Zn concentrations in soil, forage and serum were determined using a Perkin-Elmer Zeeman 5100 Atomic Absorption Spectrophotometer (Perkin-Elmer Corp., Norwalk, CT). Molybdenum in forage was determined using the same spectrophotometer with an adapted graphite furnace (Perkin-Elmer HGA-600). Selenium in soil and serum was determined with an adapted Perkin Elmer MHS-10 Hydride System.

RESULTS AND DISCUSSION

Mean concentrations of trace minerals in forage from three geographic regions of Nuevo Leon are shown in Figure 1. No differences (P>0.05) were observed in Cu and Zn concentrations of forages between the north, center and south regions. However, a greater (P<0.05) Mo content was noticed in forages from the north region in comparison with forages sampled from the center and south regions. The higher concentrations of Mo in forages of the north region may be due to an increase in the availability of Mo to the plant with alkaline pH soils (McDowell et al., 1983).

Trace mineral concentrations during the dry and wet seasons, respectively were: Zn, 28.4 and 34.2 ppm; Cu, 5.3 and 4.2 ppm; and Mo, 1.3 and 2.1 ppm (Figure 2). A Cu deficiency is generally present when the Mo concentration is greater than 3 ppm and that of Cu is lower than 5 ppm, when the Cu:Mo ratio is lower than 2:1, or when cattle drink water with high levels of sulfur (McDowell et al., 1983). No interactions (P>0.05) were obtained between site and season for concentration of any of the trace minerals.

Woody species contained greater (P<0.05) mean concentrations of Cu (6.5 vs. 3.7 ppm) and Zn (34.6 vs. 29.3 ppm) than grasses. No difference (P>0.05) was obtained in Mo concentration between grasses and woody species (1.7 vs. 1.8 ppm). Mean concentrations of Zn, Cu and Mo for grasses were: AR, 13.9, 4.7, and 2.9 ppm; BT, 9.0, 2.1, and 1.4 ppm; HM, 47.0, 3.6, and 2.7 ppm; SM, 23.0, 5.2 and 0.9 ppm; CC, 35.0, 3.7 and 1.3 ppm. Mean concentrations of Zn, Cu and Mo for woody species were: CO, 31.6, 7.4 and 2.9 ppm;

AC, 46.6, 3.0 and 2.0 ppm; FL, 21.2, 4.3 and 1.0 ppm; LE, 22.1, 7.7 and 1.8 ppm; LI, 47.3, 13.7 and 0.8 ppm.

Copper concentrations (0.61 ug/ml) in serum were lower (P<0.05) in samples collected from cattle in the rangelands of southern Nuevo Leon than in samples from cattle from the center (0.72 ug/ml) and northern (0.70 ug/ml) regions.

In conclusion, trace mineral deficiencies in the semiarid rangelands of the state of Nuevo Leon may be partially related to the high soil pH (7.3 to 8.0). High levels of Mo (>2-3 ppm) may aggravate an existing Cu deficiency by forming Cu-Mo complexes which make the Cu unavailable to the animal. In the southern region of the state, serum Cu concentrations showed a clear deficiency, probably aggravated by the high sulfur content of water consumed by the cattle.

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Figure 1
Mean trace mineral concentrations (ppm, Zn x 101) in forages from three geographic regions of the state of Nuevo Leon.

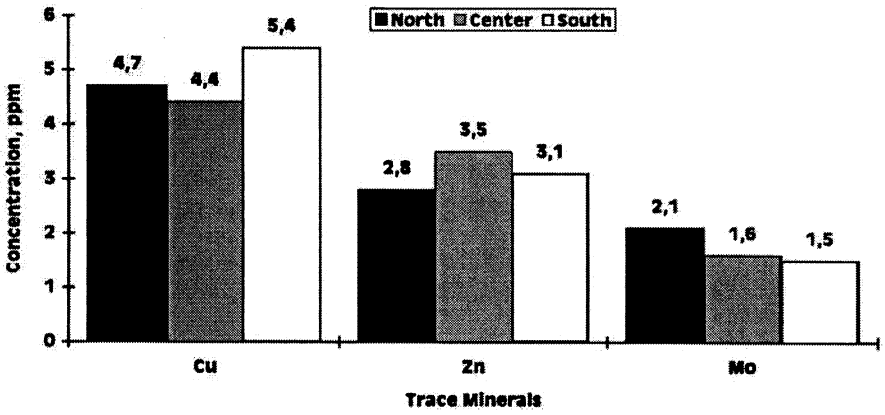

Figure 2
Mean trace mineral concentrations (ppm, Zn x 101) in forages sampled during wet and dry seasons, in the state of Nuevo Leon.