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Technical Note

Mineral Contents of some Macro and Micro Elements in Forages Produced on *Finca Modelo* Farm, Asela, Ethiopia

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INTRODUCTION

The lack of some minerals previously brought by water and soil has been caused by constant digging without supplementation. Accordingly, there is a need for adequate supplementation in order to prevent negative balances, and therefore, nutrient deficiency, which is increased over time (McDowell and Arthington, 2005).

In Ethiopia, grazing animals subsist mainly on low quality foods, including some graminaceae, very few leguminosae, and harvest residues in less arid areas (Kabaija and Little, 2012).

Some regions of the country are deficient in one or two minerals, such as copper in the Rift Valley region. Other minerals, like sodium, phosphorous, copper, cobalt, zinc, and manganese are scarce, only found in scattered areas. Other areas have also been affected by copper, iron, and manganese toxicity (Alemu, 2012).

A change in the feeding paradigms of grazing animals is critical for the sustainable development of a country.

The information used to improve cultivation and production, farm management, processing, and commercialization techniques based on traditional approaches are goods' shares in the short run. The public sector (universities) should be in charge of information delivery (FAO, 2017). The Asela Model Agricultural Enterprise (AMAE) managed by the Adama Science and Technology University (USTU) is an example of how the poorest farmers can use the resources of low-input agriculture wisely to prevent soil deterioration. The company cultivates pastures, which can be sold as seeds or forage at reasonable prices. They include various high quality legume species, like alfalfa and clover. Constant evaluation of forage quality is important to validate these efforts.

Determination of phosphorous (P), calcium (Ca), sulfur (S), magnesium (Mg), sodium (Na), potassium (K), iron (Fe), and copper (Cu) was made through the analysis of samples of graminaceae and leguminosae cultivated at AMAE.

DEVELOPMENT

The reference farm is located near Asela city, 1 800 meters above sea level. The study was made at the end of the rainy season. The green forages were cut as usual, for later consumption by animals (near the stem).

Triplicate samples of alfalfa (*Medicago sativa*), clover (*Trifolium repens*), common vetch (*Vicia sativa* L), Rhodes (*Chloris gayana*), elephant grass (*Pennisetum purpureum*), wheat stalks (*Triticum aestivum*), and teff (*Eragrostis tef*), were collected in different AMAE locations chosen at random. The total green mass collected made 5kg, which were dried in the sun for a week. The material was carried to ASTU and then cut with a stainless steel pair of scissors. The possible residues of dust or other contaminating materials were removed by rinsing with distilled water; then they were dried in circulating air heating stove, at 80 ± 1 °C for 24 h. Later, they were split in quarters, and 500 g were crushed in a hammer mill, 1 mm sieve. They were quartered again, and 100 g were dried at 105 ± 1 °C, until constant weight was achieved. The material was stored in air-tight plastic jars, and 5 g of each replication were incinerated in China melting pots, at 525 ± 5 ºC, in mufla oven with digital temperature control. The ashes were dissolved in 1 +3 pure hydrochloric acid solution for analysis by warm digestion up to humid salts. The salts were lixiviated in 100 ml volumetric flasks using filter paper.

Phosphorous and iron were determined by colorimetric methods (molybdovanadate and o-phenatroline, respectively). Sulfur was determined using the same instrument (UV-Vis), by barium sulfate turbidity, at 540 nm. Sodium and potassium were determined by air/butane-propane flame photometry. Magnesium, calcium, and copper were analyzed by atomic absorption spectrophotometry, with air-acetylene flame. All the analytical methods were made through standard procedures (ASTM, 2014).

Calculations and statistical analyses were made with Microsoft Excel, 2007. The graminaceae-leguminosae comparison (Table 1) was made using one-tailed Student-T test.

Only phosphorous was far from meeting the set requirements, though copper was low. The levels of sodium suggested its use only as control of consumption of the mineral supplement.

The tenor of phosphorous, essential for ruminant nutrition, was below the reports made by Suttle (2010), which might indicate a declining trend due to insufficient soil supplementation, especially for graminaceae (Table 2).

The main deficiencies were evident in the graminaceae used by local farmers, particularly in the dry season: teff and wheat hay, and *elephant grass*. The comparison between the element means showed that their concentrations were lower in graminaceae than in leguminosae (except for S). This situation was different from the results of Martínez *et al* (2007), in Camagüey, Cuba. In this study, the legume species used came from cultivated and organically supplemented pastures, whereas the graminaceae were collected from crop residues or long cultivated *elephant grass* plantations in these soils. In Cuba, all the samples were collected in the fields.

CONCLUSIONS

All the forage produced on *Finca Modelo* farm generally met the requirements for grazing ruminants, except for phosphorous. Most deficiencies were observed in the more commonly used graminaceae. Because of its lower costs and tenor, sodium may be used to control feedstuff consumption, particularly for P supplementation.

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Table 1. Tenor of minerals studied (range) and their requirements, according to McDowell and Arthington (2005)

Minerals studied	Tenor in analyzed forages	Requirements of grazing ruminants
Calcium (g/kg DM)	2.63-10.12	1.4-11.0
Phosphorous (g/kg DM)	0.33-1.97	0.9-3.8
Magnesium (g/kg DM)	1.23-4.8	0.9-2.2
Potassium (g/kg DM)	14.32-19.44	8-10
Sodium (g/kg DM)	0.23-1.1	0.7-4
Sulfur (g/kg DM)	1.4-7.5	1.5-2.0
Iron (g/kg DM)	14-264	30-50
Copper (g/kg DM)	2.05-6.38	4-14

Table 2 Comparison between leguminosae and graminaceae

	Leguminosae	Graminaceae	Sig.
P	1.46 ± 0.28	0.76 ± 0.30	*
Ca	8.55 ± 0.94	3.52 ± 0.56	*
S	3.84 ± 2.17	2.48 ± 0.77	
Mg	4.00 ± 0.57	1.87 ± 0.41	*
Na	1.03 ± 0.08	0.57 ± 0.16	*
K	18.2 ± 0.59	16.8 ± 1.17	*
Fe	190 ± 87	37.5 ± 23	*
Cu	5.53 ± 58	3.02 ± 0.67	*

(*) T-test for mean comparison (α=0.05)