R.M. Njwe [1]
J.L. Issa [1]

Mineral status of natural pastures in the Adamawa region of Cameroon

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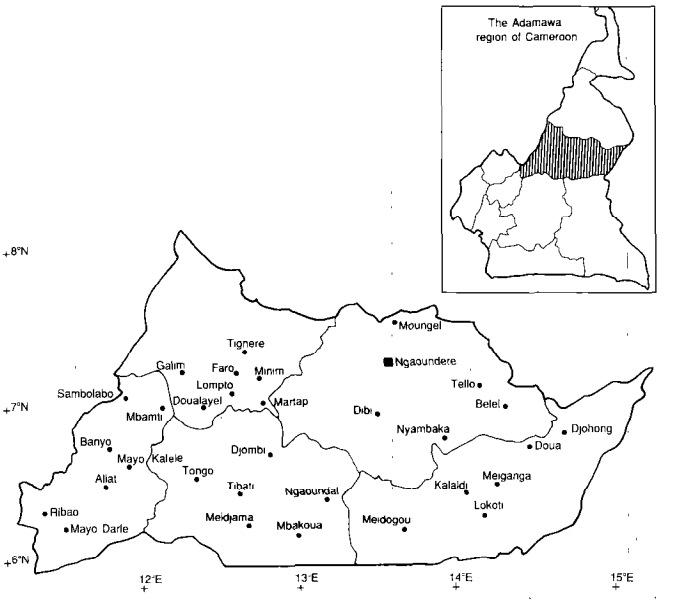
Une étude préliminaire a été menée sur les carences en minéraux des fourrages naturels de l'Adamawa dans le Nord du Cameroun. Les échantillons collectés dans différentes localités ont été analysés pour déterminer leur teneur en Ca, P, Mg, Fe, Cu, Zn et Mn. Les résultats indiquent soit des carences, soit des apports faibles en Ca, P, Cu et Zn. En ce qui concerne le magnésium, la réponse est plus nuancée car les quantités trouvées sont à la limite des besoins recommandés. Il est nécessaire de poursuivre les travaux afin de préciser les risques de carences et rechercher d'éventuelles solutions. *Mots clés* : Pâturage naturel - Carence en éléments minéraux - Cameroun.

INTRODUCTION

Malnutrition is one of the major factors responsible for low productivity of livestock in the tropics and sub-saharian Africa in particular. While energy and protein malnutrition have received a great attention, relatively few investigations on mineral elements have been performed in this region. Several studies (6, 9, 11) carried out in Africa, Central and South America have revealed that mineral deficiencies can significantly contribute to poor growth, high mortality and poor reproductive performance in farm livestock (1, 8). The present study is part of a preliminary survey on low mineral levels or mineral deficiencies in natural pastures in the Adamawa region of Cameroon with the ultimate objective of eventually suggesting practical solutions of these problems.

MATERIALS AND METHODS

The Adamawa region of Cameroon is shown in map 1 and table I. Composite samples of grass species were collected from pastures in the five administrative divisions of the Adamawa Plateau of Cameroon. Eigth samples were collected from eight different sites in each division (table II) during the wet season (September to October, 1983) and the dry season (February to March, 1984).



Map 1 : Sampling sites in the Adamawa Region of Cameroon.

At each sampling site, predominant grass species (*Hyparrhenia* spp, *Sporobolus* spp, *Setaria sphacelata* and *Andropogon gayanus*) within the grazing area were harvested and combined to constitute a single composite sample that was subsequently analysed. The composition of a composite grass sample during the wet and dry season is shown in table III. Grass samples collected during the dry season were not obtained exactly from the same site or the same plant sampled during the previous wet season. Grass samples collected during the dry season were young nutritive regrowths of pasture that had been burnt by herdsmen to renew the vegetative cover of pastures with two main goals : cattle feeding during the dry season and clearing for soil surface cover for the next rainy season.

The grass was cut with a knife at a height of 15 cm from the ground and freed soil and dust particles by washing with distilled water. Five-hundred grams of the wet composite grass sample were placed in a

1. Department of Animal Science, INADER, Dschang, University Centre, BP 222, Dschang, Cameroon.

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TABLE I Physical features of the Adamawa Region of Cameroon.

Feature	Vina	Faro-Deo	Mayo-Banyo	Djerem	Mbere
Geology (13)	Ancient granites and volcanic material (mainly recent basalt)	Ancient granites and volcanic material associated with undifferentiated gneiss and migmatites of lower Precambrian era	Dominantly metamorphic rocks especially migmatites of lower Precambrian era in association with ancient gneiss	Dominantly ancient gneiss with associated migmatites	Dominantly ancient granites and schist associated with quartzite and migmatites
Soils (5)	Orthic and rhodic ferralsols associated with orthic acrisols	Orthic and rhodic ferralsols associated with gleyic luvisols and ferric luvisols	Orthic and rhodic ferralsols associated with orthic acrisols	Associations of ferralsols, lithosols and nitosols	Associations of ferralsols and dystric nitosols
Altitude	1 000-1 400 m	1 000-1 800 m	700-1 400 m	900-1 400 m	800-1 200 m
Climate (14)	Sudano-Guinean climate moderated by altitude. Annual rainfall of 1 500-2 000 mm and above. A dry season of about 5 months and a rainy season of about 7 months between April and October. Precipitation of 1 500 mm between July and October. Average annual temperature of 23 °C with an absolute maximum of 34 °C in March and an absolute minimum of 10 °C in January.				
Vegetation (2)	Open prairie at altitude above 1 800 m dominated by *Sporobolus* spp. At 1 500-1 800 m *Setaria sphacelata* is more abundant. At lower altitudes woody savanna is dominated by *Hyparrhenia* spp. and *Andropogon gayanus. Loudetia phragmitoides* may be found on swampy alluvial plains while *Pennisetum purpureum* in lowlands along streams. Common woody species include *Daniella oliveri, Piliostigma thonningii, Hymenocardia acida* and *Lophira lanceolata.*				
Livestock production system	During the rainy season cattle are sedentary on pastures on the plateau. In the dry season most cattle are sent on transhumance to the alluvial plains. A few are left around homesteads to supply milk and meat for the family. Pastures are burnt in the dry season.				

TABLE II Sampling sites in the Adamawa plateau.

Administrative division	Sampling sites
Vina	Ngaoundere, Belel, Dan, Moungel, Tello, Nyambaka, Dibi
Mbere	Meiganga, Madougou, Lokoti, Kalaldi, Doua, Badogo, Ngaoundal II, Ngaoundal III
Faro-Deo	Tignere, Faro, Doualayel, Galim, Lompto, Minim, Martap, Gadjiwa
Mayo-Banyo	Banyo, Allat, Sambo-Labo, Mayo Kalele, Ribao, Mayo Darle, Mbamti, Mba

TABLE III Proximate composition of representative composite grass samples.

	Wet season (mature grass)	Dry season (regrowths)
Dry matter (%)	25.1	18.5
Ash	8.5	14.0
Organic matter	91.5	86.0
Crude protein	7.9	12.5
Crude fibre	32.1	27.1
Ether extract	2.2	1.8
Nitrogen free extract	49.3	44.6

Figures in the table represent dry matter percentages.

plastic bag and transferred to the laboratory where they were dried at 70 °C for 48 hours. The dried grass was chopped with a pair of scissors, pounded in a porcelain mortar to pass through a lmm sieve and kept in a plastic bag for analysis.

A gram of grass was digested in a Kjeldahl flask containing 25 ml of a digestion solution (5 % perchloric acid, 20 % concentrated nitric acid, 50 % concentrated sulphuric acid). After digestion, the digest was diluted to volume and appropriate aliquots were taken for analysis of calcium, magnesium, iron, copper, zinc and manganese using the atomic absorption spectrophotometer according to procedures of PINTA (14). Phosphorus was determined using the molybdo-vanadate method.

The concentration of various mineral elements in grass samples was compared with adequacy limits developed from mineral investigations in Malawi (12),

South and Central America (9, 10, 11) which are presently used for several investigations in these regions of the tropics.

RESULTS

Results of analysis of composite forage samples for various macro- and micro-elements are shown in tables IV and V respectiveley. Grasses were considered as inadequate if the concentrations of calcium, phosphorus, potassium and magnesium were less than 0.30, 0.25, 0.80 and 0.16 % of dry matter, respectively, and from iron, copper, zinc and manganese if the level was below 50, 10, 40 and 40 ppm, respectively, according to McDOWELL *et al.*, (11) and HILLMAN (7).

Calcium contents of the forages ranged from 0.18 to 0.36 and from 0.19 to 0.78 % during the wet and dry season, respectively. It was observed that 72 % of all samples investigated in the wet season were inadequate in calcium. The deficiency of this element was particularly acute in forages of Mbere, Faro Deo and Mayo Banyo where 7 out of 8 samples collected in the division were deficient. With the dry season forage regrowth, 52 % of the samples were deficient, the majority being from Mbere, Djerem and Mayo Banyo. Phosphorus content of grasses ranged from 0.08 to 0.23 and from 0.07 to 0.34 % during the wet and dry seasons, respectively. More than 96 % of grasses analysed during both seasons of the year were low in phosphorus. Potassium was generally adequate irrespective of the season of the year, or growth stage of the grasses. Magnesium was within the recommended level (0.16 %) in forages sampled during the two seasons.

All forage samples investigated were adequate in iron during the wet and dry seasons. Although not too severe, copper deficiency was evident in forages from several locations of the Adamawa region during the wet and dry seasons. It was observed that 40 and 32 % of forages collected during the two seasons were deficient in copper. Zinc deficiency was common in forages collected during the wet season. About 60 % of them were inadequate especially all forage samples from Mayo Banyo, Faro Deo and Mbere, but all regrowths of the dry season were adequate. Manganese level of forages in the wet and dry seasons were adequate.

DISCUSSION

Calcium deficiency in grasses of the Adamawa region was observed in this investigation. Similar calcium deficiencies have been reported in tropical countries like Uganda, Senegal, Brazil, Panama and Guyana (11). Forage regrowths sampled after burning pasture at the beginning of the dry season had higher levels of

TABLE IV Mineral content of composite forage samples of natural pastures in the Adamawa Region of Cameroon (percentage of dry matter macroelements).

Administrative division	Calcium		Phosphorus		Potassium		Magnesium	
	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season
Vina	0.29 ± 0.01 (0.24-0.36)	0.39 ± 0.06 (0.19-0.70)	0.15 ± 0.01 (0.09-0.23)	0.19 ± 0.02 (0.15-0.33)	1.66 ± 0.21 (1.12-2.72)	1.26 ± 0.10 (0.89-1.78)	0.14 ± 0.1 (0.07-0.18)	0.24 ± 0.04 (0.11-0.50)
Mbere	0.28 ± 0.01 (0.25-0.35)	0.30 ± 0.08 (0.07-0.78)	0.16 ± 0.01 (0.13-0.19)	0.13 ± 0.03 (0.08-0.30)	0.60 ± 0.14 (1.28-2.24)	0.89 ± 0.18 (50.80-1.39)	0.22 ± 0.02 (0.17-0.29)	0.16 ± 0.01 (0.10-0.22)
Djerem	0.31 ± 0.01 (0.23-0.35)	0.28 ± 0.04 (0.19-0.44)	0.18 ± 0.01 (0.13-0.21)	0.17 ± 0.02 (0.07-0.24)	1.67 ± 0.20 (0.64-2.20)	1.34 ± 0.06 (1.15-1.63)	0.21 ± 0.01 (0.17-0.26)	0.20 ± 0.03 (0.11-0.33)
Faro-Deo	0.22 ± 0.02 (0.18-0.32)	0.26 ± 0.03 (0.12-0.38)	0.12 ± 0.01 (0.08-0.16)	0.14 ± 0.01 (0.09-0.17)	1.32 ± 0.13 (0.99-0.17)	1.32 ± 0.05 (1.17-1.52)	0.18 ± 0.02 (0.10-0.29)	0.16 ± 0.01 (0.10-0.23)
Mayo-Banyo	0.26 ± 0.02 (0.20-0.36)	0.27 ± 0.04 (0.10-0.44)	0.15 ± 0.01 (0.11-0.22)	0.16 ± 0.03 (0.07-0.34)	1.38 ± 0.10 (1.10-1.80)	1.26 ± 0.17 (0.74-2.03)	0.17 ± 0.01 (0.12-0.24)	0.17 ± 0.02 (0.09-0.30)
Mean	0.27	0.30	0.15	0.16	1.33	1.21	0.18	0.19
Observations below recommended level (%)	72	52	100	92	0	5	27	37

Recommended levels (McDowell et al., *1984) (in percentage of dry matter) : Ca = 0.30 % ; P = 0.25 % ; K = 0.80 % ; Mg = 0.16 % [Hillman (7)].*

TABLE V Mineral content of composite forage samples of natural pastures in the Adamawa Region of Cameroon (ppm micro-elements).

Administrative division	Iron		Copper		Zinc		Manganese	
	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season
Vina	314 ± 9 (150-560)	536 ± 57 (350-710)	12 ± 1 (8-17)	10 ± 1 (5-15)	51 ± 5 (29-71)	86 ± 15 (30-175)	288 ± 9 (100-185)	140 ± 57 (185-670)
Mbere	390 ± 12 (190-1050)	686 ± 25 (140-1040)	10 ± 2 (6-15)	11 ± 2 (5-15)	46 ± 10 (23-95)	73 ± 10 (35-125)	188 ± 12 (75-175)	133 ± 25 (70-310)
Djerem	251 ± 18 (110-500)	670 ± 25 (150-1130)	10 ± 1 (7-11)	13 ± 5 (5-30)	32 ± 5 (19-46)	65 ± 10 (40-115)	184 ± 18 (140-265)	195 ± 25 (100-345)
Faro-Deo	245 ± 25 (200-500)	472 ± 39 (295-925)	10 ± 1 (6-13)	13 ± 2 (5-25)	34 ± 3 (21-50)	73 ± 16 (30-160)	152 ± 25 (100-285)	180 ± 34 (160-425)
Mayo-Banyo	209 ± 17 (150-270)	584 ± 34 (315-760)	9 ± 1 (6-11)	9 ± 1 (5-15)	26 ± 1 (18-29)	51 ± 5 (40-70)	269 ± 17 (105-225)	150 ± 34 (160-425)
Mean	282	590	10	11	38	70	216	160
Observations below recommended level (%)	0	0	40	33	63	8	0	0

Critical level (McDowell et al., 1984) : Fe = 50 ppm ; Cu = 10 ppm ; Zn = 40 ppm ; Mn = 40 ppm.

calcium than mature forage of the wet season. This may be attributed to differences in the stage of maturity.

Phosphorus shortage in grasses was severe during both seasons of the year. These results agree with reports showing that phosphorus level is low in soils and plants in most livestock grazing areas in the tropics (11). Phosphorus deficiency has also been reported during the wet and dry seasons in Guatemala (17).

The deficiency of P in the tropics is accentuated by high amounts of iron, aluminium in tropical soils which chelate the element forming insoluble phosphates thus rendering the element unvailable to plants (11). Extreme P deficiency has a detrimental effect on the reproductive performance of grazing animals (11). Increase in live weight gain and pregnancy rate have been reported after P supplementation in the Peruvian tropical lowlands (1).

The generally adequate potassium level in forages during the wet and dry season has also been observed in Guatemala (8). NRC (13) recommends a minimum of 0.80 % potassium in ration dry matter. A recent report of HILLMAN (7) suggests that 1.05 % is preferable, particularly under conditions of heat stress because of large potassium losses in perspiration.

Based on 0.20 % of Mg level in dry matter recommended by HILLMAN (7) as adequate for lactating dairy cattle (500 kg) producing 17-23 kg milk, the amount of Mg in forages of the Adamawa plateau appears to be deficient during both seasons of the year. However, it may be adequate to meet the maintenance requirement of pregnant dairy cows, dry and mature cows, growing heifers and bulls, whose requirements are 0.16 % of dry matter (7). However, some authors recommend a level of 0.04 to 0.1 % Mg in beef cattle diets (11).

The adequacy of Fe in forages during the wet and dry seasons agrees with reports from Ethiopia (4). Primary iron deficiency has not been demonstrated unequivocally with grazing ruminants (18). However, high infestation by helminths or blood parasites have been reported to cause severe cases of anaemia thus diminishing the amount of iron in the blood.

The deficiency of copper observed in this study agrees with reports in Ethiopia (4). With the exception of P, Cu deficiency has been reported to be the most severe mineral limitation to grazing livestock in the tropics (11). Copper deficiency may occur as a single deficiency arising from low soil content and consequently low herbage content. Such natural deficiency is conditioned by the presence of dietary factors e.g sulphur and molybdenum in herbage in affected areas, that interfer with the absorption and utilization of copper by the animal (18). Copper deficiency occurs when the forage molybdenum content exceeds 3 ppm and the level of copper is below 5 ppm (3).

Zinc deficiency in Adamawa confirms similar observa-

tions in Guatemala (8) and Ethiopia (4), but the level of forages in Adamawa is superior to those of the two former countries. The adequacy of Mn in forages agrees with similar investigations in Ethiopia (4).

CONCLUSION

The results of this investigation show deficiencies of Ca, P, Cu and Zn and a low to minimum level of Mg in pasture grasses in the Adamawa region of Cameroon ; but the incidence of these deficiencies on the productivity of cattle in the region has to be determined.

Furthermore, despite shortcomings such as uncertainty of samples representing what livestock consume, difficulty of estimating forage intake and possibility of soil contamination of forage samples, forage element analysis remains a better indicator of mineral status for grazing ruminants than soil analysis.

As a whole, the Adamawa region appears to be relatively well balanced in macro- and micro-elements except during the wet season when Zn deficiency is highly probable and throughout the year when the probability of Ca, P, Cu deficiency may be high. Nevertheless, a more comprehensive approach is needed for a better management of land and cattle to ensure sustainability of the ruminant production in the Adamawa region of Cameroun.

NJWE (R.M.), ISSA (J.L.) Mineral status of natural pastures in the Adamawa region of Cameroon. *Revue Élev. Méd. vét. Pays trop.*, 1990, **43** (3) : 375-380

A preliminary survey was carried out on mineral deficiencies in natural pastures in the Adamawa Region of Cameroon. Forage samples were collected from various locations and analysed for Ca, P, Mg, Fe, Cu, Zn and Mn. Deficiencies or low levels of Ca, P, Cu and Zn were observed. As for magnesium, the amount observed was close to the recommended needs. Further studies should be made to determine the risks of mineral deficiencies and search for methods of prevention.
Key words : Natural pasture - Mineral deficiency - Cameroon.

NJWE (R.M.), ISSA (J.L.). Balance mineral de los pastos naturales de la región de Adamaua, Camerún. *Revue Élev. Méd. vét. Pays trop.*, 1990, **43** (3) : 375-380

Se efectuó un estudio preliminar sobre las carencias de minerales de los forrajes naturales de Adamaua, en el norte de Camerún. Se analizaron las muestras recogidas en diferentes lugares para determinar la cantidad de Ca, P, Mg, Fe, Cu, Zn y Mn. Los resultados indican sea carencias, sea proporciones reducidas de Ca, P, Cu y Zn. Concerniendo al magnesio, la cantidad observada está cerca de las dosis recomendadas. Se necesita proseguir los trabajos para determinar los riesgos de carencias y buscar soluciones posibles.
Palabras claves : Pasto natural - Carencia de minerales - Camerún.

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