"Pasture mineral nutrition in Uganda"

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Pasture Mineral Nutrition in Uganda[1]

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The general picture of pasture minerals in Uganda indicates that some of the essential minerals are either marginal or deficient and supplementation is necessary. Under present conditions of low production, the marginal or deficient mineral levels do not seem to pose a very serious threat of mineral deficiency in livestock. However, with improved management of high-yielding stock and disease control, these shortages are likely to assume more importance and other deficiencies may be revealed.

Research work carried out in Uganda to investigate mineral levels in pasture herbage has revealed that mineral contents of grasses and legumes differ markedly in different herbage species and different agro-ecological areas.

Table 1 shows the average and range figure of mineral contents in different areas of Uganda together with recommended levels of each mineral for milking cows.

It is noteworth that the mineral survey from which these data were obtained was intended to give a broad general idea on minerals found in various areas and on different farms in Uganda.

Sodium and Potassium

Sodium and potassium play a similar role in the animal body, that is acid-base balance and osmotic regulation of the body fluids; sodium being the chief cation of blood plasma and other extra cellular fluids of the body. Average sodium levels in herbage collected from all areas of the country are invariably very low and even at poor levels of production, supplementation of the diet with sodium chloride is likely to be beneficial.

The danger of gross cation imbalance may arise due to the very low sodium and normal potassium levels of the pasture (Bredon, 1964). Little information is available on the dietary requirements of cattle for potassium, but the ARC (1965) recommended a level of 0.80 percent dry matter. At this level, average potassium level in all areas of Uganda are adequate and it is unlikely that the ruminant would become deficient in this element.

Magnesium

The magnesium level suggested by Allcroft (1954) of 0.096 percent magnesium in the diet as adequate for milking cows is lower than averages of 0.15, 0.22, 0.20 and 0.17 percent, respectively, for the Western, Lakeshore, Eastern and Northern areas. The ARC (1965) have proposed a higher requirement of 0.18 percent of dry matter, but all the grasses examined in Uganda pastures except one species (Cynoden Dacylon with mean magnesium 0.17 percent) attained this level and the position at present is entirely satisfactory. One factor which might reduce magnesium uptake by the plant would be the excessive use of potassic fertilizers leading to potassium-magnesium antagonism. Present findings suggest that potassium levels are not high and would not be expected to exert any significant inhibitory influence on the uptake of magnesium.

Calcium and Phosphorus

Very few minerals can be considered in isolation; calcium and phosphorus utilisation is affected by their ratio and by other factors such as Vitamin D and the nutritional history. The ARC (1965) recommendation for a standard cow of 500 kg body weight producing 10 kg of milk daily and with a dry matter intake of 8.8 kg is 0.52 percent calcium. The average levels of calcium in all areas except the Eastern area fall short of the requirements for this mineral. The upper levels of the range figures for the East-

Table 1. *Average and range of mineral content of pasture herbage in four areas of Uganda together with recommended nutrient levels for livestock*

	COMPOSITION OF SPECIES SAMPLED								RECOM-MENDED % LEVEL FOR ANIMALS
	Percent content on dry matter basis								
	Western area*		Lakeshore area**		Eastern area***		Northern area***		
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	
Sodium	0.03-0.09	0.04	0.01-0.04	0.03	0.04-0.06	0.06	0.03-0.06	0.05	0.13
Potassium	0.49-2.15	1.06	1.31-3.34	2.41	1.13-2.09	1.68	1.14-3.10	2.11	0.80
Magnesium	0.09-0.23	0.15	0.17-0.29	0.22	0.15-0.25	0.20	0.11-0.22	0.17	0.18-0.20
Calcium	0.21-0.56	0.36	0.32-0.47	0.39	0.32-1.41	0.68	0.21-1.20	0.4	0.39-0.48
Phosphorus	0.11-0.39	0.21	0.32-0.50	0.43	0.23-0.31	0.27	0.17-0.30	0.26	0.30-0.35
Nitrogen	0.18-3.57	0.99	1.90-3.80	2.51	1.78-3.94	2.59	1.71-3.10	2.10	2.24
Sulphur	-	-	0.12-0.27	0.16	0.14-0.25	0.19	0.12-0.27	0.17	0.10-0,20
	p.p.m. on dry matter basis								
Selenium	0.01-0.40	-	0.01-0.20	-	0.03-0.74	-	0.03-0.50	-	0.10
Manganese	-	-	41.00-362.00	135.00	55.10-113.50	72.70	32.50-51.80	40.10	40.00
Copper	-	-	5.20-12.70	10.70	4.40-9.10	6.00	4.10-8.80	5.80	10.00
Zinc	-	-	7.90-34.80	25.90	15.90-26.40	20.90	16.03-27.00	22.00	40.00
Cobalt	-	-	0.01-0.21	0.09	0.10-0.40	0.19	0.11-0.38	0.15	0.05-0.10
Molybdenum	-	-	0.07-0.38	0.30	0.60-5.79	1.40	0.62-3.78	1.42	not known

* 22 common grasses, ** all grasses collected, *** grasses and legumes, p.p.m.= parts per million

ern and Northern areas are due to legumes which grow abundantly in these areas.

With the exception of the Lakeshore area all areas of Uganda surveyed are below the recommended levels for phosphorus. However as is to be expected, plasma minerals of cows investigated during the survey were within normal limits.

In the Lakeshore area, 23 percent of cattle gave blood-calcium results which were below 8.5 mgs per 100 ml the usually accepted lowest normal level. In the Eastern area, only 3 percent were below the normal lowest level and in the Northern area 5.4 percent of cattle showed these sub-normal levels. The general opinion is that these differences in blood-calcium levels were due, in addition to abundant legumes in the Eastern and Northern areas, to somewhat lower milk production per cow in these areas.

A small number of plasma samples gave inorganic phosphorus temporarily below 3 mgs per 100 ml. These were not significant. These findings would suggest that cattle diet supplementation with calcium and phosphorus would be beneficial.

Sulphur, Molybdenum and Copper

The three mineral elements, sulphur, copper and molybdenum are closely inter-related in animal nutrition. Where sulphur intake is low, molybdenum and copper retention by the animal is increased. Conversely, where sulphur and molybdenum are high, molybdenum tends to accumulate in the tissues to the detriment of copper (Long et al., 1970).

The ARC (1965) have not made recommendations for sulphur, but Whitehead (1966) quoted a minimum level of 0.1 percent and Cullison (1982) quoted a level of around 0.1–0.2 percent of dry material ration. Based on these recommendations, the general average of 0.16 percent found in all areas would appear to be adequate for the grazing animal.

Exact needs of livestock for molybdenum are not known although the level is considered to be very small. The range in Ugandan pastures is between 0.07 and 5.79 p.p.m.(parts per million) and is probably within acceptable normal limits.

The complex relationship between copper, molybdenum and sulphur makes it difficult to assess the true copper status of pastures. On the basis of the ARC (1965) recommendations of 10 p.p.m. only the Lakeshore area is just adequate while the Northern and Eastern areas appear to be deficient in this element. It is likely that copper levels are at least adequate in all areas due to the comparatively low levels of molybdenum and sulphur.

Manganese

Studies of the effect of manganese on growth, milk yield and blood haemoglobin have indicated that this element should be present in the diet at a level 40 mg/kg dry matter (ARC, 1965). The upper limit for manganese intake has not been established though 70 p.p.m. in mineral supplemented hay-maize silage-mixed grain diet was reported as non-toxic by Bentley and Phillips (1951). These workers recommended 20 p.p.m. as the safe margin meeting all normal cattle requirements, but that extra mineral should be fed below this level.

In some of the areas surveyed individual pasture quantities examined were as high as 600 p.p.m. in grassas like Cynodon dactylon. Although the general average manganese for the Lakeshore area was 135 p.p.m. the likelihood of manganese posing a nutritional problem in the pastures investigated would appear to be slight.

Zinc

Dairy cattle requirements for zinc are inconclusive. The ARC (1965), on comparatively little critical evidence has proposed 50 p.p.m. as an adequate dietary intake. American proposals (Technical Services, 1970) have placed the intake for dairy cattle

at between 45 and 72 p.p.m. with 60 p.p.m. as the practical operating level. The recommended intake for calves and heifers is between 8.6 and 46 p.p.m. with a practical operating level of 50 p.p.m. The intake for beef cattle has been recommended to be between 83.5 and 100 p.p.m. with a practical operating level of 90 p.p.m.

On the basis of these suggested levels, it would appear that all areas of Uganda for which zinc results are available must be considered as somewhat deficient. This situation is complicated by the fact that available proprietary mineral supplements do not contain zinc. On the other hand, there have not been reports of deficiency symptoms in livestock from any of the surveyed areas.

Cobalt

The ARC (1965) recommended a minimal level of 0.1 p.p.m. in the dry matter intake. On this basis the average levels in all surveyed areas would appear to be adequate. However, the larger part of pastures sampled were deficient in this element though variation between different grasses and farms was high. Brachiaria ruziziensis was particularly rich in cobalt but very few samples were used. One of the grasses containing adequate cobalt was Pennisetum purpureum (0.13 p.p.m.) and in one of the survey areas only five individual samples out of 15 farms contained less than 0.1 p.p.m. and two of these samples were not markedly deficient. Comparatively high values of 0.24 and 0.27 p.p.m. were obtained from two farms. At the other extreme, cobalt levels in some samples of Brachiaria platynota (K.schum) Robyns, Penicium maximum and Setaria sphacelata were below the level of detection by the method used.

Selenium

Pasture samples collected from all areas of Uganda and examined for selenium content have shown that 20 percent of them contained less than 0.05 p.p.m. selenium and about half contained less than 0.1 p.p.m. This observation suggests that this element is likely to be sporadically deficient in some places.

Of the sites investigated; in the Western area 38 out of 48 sites simultaneously gave levels which were deficient; in the Lakeshore area, 10 of 22 sites were deficient. In the Eastern and Northern areas, 4 of 13 sites and 12 of 23 sites respectively, had deficient selenium levels.

The ARC (1965) considered severe selenium deficiency to be below 0.05 p.p.m., marginal deficiency below 0.01 p.p.m. and toxic level to be 5.0 p.p.m. Although to date no occurrences of "White muscle disease" have been reported in Uganda, the disease might occur undetected by the veterinary staff who are preoccupied with the prevention of major endemic diseases. In addition, the low selenium levels in pastures may be one of the factors behind the frequent reports of cattle infertility in the country.

Iodine

Iodine has been reported as being deficient in many parts of Africa (Follis and Connor, 1966) which is not surprising in view of the large distances of most of the continent from the sea. The Uganda Medical Department (Kajubi and Okel, 1970) have also found evidence of iodine deficiency in humans, i. e. goitre especially in southwestern Uganda. Whilst no direct determinations of iodine in grasses have been attempted, protein-bound iodine in serum, usually considered as giving a reliable guide to the iodine status of the animal, has been found to average 3.99 ug/100 ml, varying from 1.7 to 8.0 ug/100 ml although there is some dispute about these levels.

Assuming these levels are normal, then some of the animals were below satisfactory levels and the whole country must be regarded as marginally deficient. The picture of low blood-iodine levels persisted even when proprietary mineral licks, of which Iodine is a constituent, were available to animals.

Conclusion

Cattle in Uganda being dependent wholly upon pasture for feed are most likely to suffer from the limitations imposed on pasture growth by rainfall and temperature. Most mineral levels are satisfactory with the exception of sodium, phosphorus, zinc, cobalt and iodine which can readily be corrected. Calcium requires further investigation which is at hand and selenium which is sometimes deficient in some locations can also be fairly readily rectified.

Note

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References

Agricultural Research Council (ARC) 1965, *The Nutrient Requirements of Farm Livestock. No. 2 Ruminants.* London: H.M.S.O.

Allcroft, R. 1954, "Hypomagnesaemia in Cattle", *Vet. Res.*, 66:517–522.

Bentley, O.G. and P. H. Phllips 1951, "The Effects of Low Manganese Rations Upon Dairy Cattle, *J. Dairy Sci.*, 34:396–403.

Bredon, R. M. 1964, "The Influence of Animal Management and Nutrition on the Infertility of Cattle", *Agric. Vet. Chem. Agric. Eng. A.V.C.*, May–June: 6–8.

Cullison, A. E. 1982, *Feeds and Feeding.* 3rd edn. Reston Virginia.

Follis, R. H. and D. H. Connor 1966, "Some Patterns of Urinary Iodine Excretion in Uganda", *East Afr. Med. J.*, 43:114–118.

Kajubi, S. K. and R. M. Okel 1970, "Possible Existence of Iodine Deficiency in Uganda", *East Afr. Med. J.*, 47:453–456.

Long M. I. E. *et al.* 1970, "The Mineral Status of Dairy Farms in the Parts of Buganda and Busoga Bordering Lake Victoria, Uganda. II—Nitrogen and mineral content of pastures", *Trop. Agriculture* (Trinidad), 47:37–50.

Technical Services, Animal Health and Nutrition Division 1970, *Trace Elements in Animal Nutrition.* Skokie, Illinois: International Minerals and Chemical Corporation.

Whitehead, D. D. 1966, *Data on the Mineral Composition of Grassland.* Tech Rep. No. 4, Hurley Grassland Research Institute.

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