The Natural Forages of Northern Nigeria

I. Nitrogen and Mineral composition of Grasses and Browse from the Northern Guinea Savanna and Standing Hays from the different Savanna Zones

By

M. MOISA KAPU

Department of Biological Sciences

Ahmadu Bello University,

Zaria, Nigeria.

SUMMARY

THE mineral status of nine native grass species and ten browse species from the Northern Guinea Savanna Vegetation was investigated together with the mineral composition of standing hays from Daura and Kano areas of the Sudan Savanna, Bauchi ranch of the sub-Sudan, Samaru (Shika Fadama) of the Northern Guinea Savanna and Jos area of the Plateau vegetation, in Northern Nigeria. All forage types (grasses, browse and standing hays) which were sampled in April of 1975 were analysed for nitrogen (N), Phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), zinc (Zn) and copper (Cu). The grass species included: *Andropogon gayanus*, *A. ascinodis*, *Brachiaria jubata*, *Cynodon dactylon*, *Hyparrhelia dissoluta*, *Panicum phragmitoides*, *Setaria anceps*, *Sporobolus pyramidalis* and *Urelytrum muricatum*, while the browse consisted of *Adenodolichos paniculatus*, *Annogeissus leocarpus*, *Briddelia ferruginea*, *Crossopteryx febrifugus*, *Dichrostachys ceneria* (glomerata), *Khaya senegalensis*, *Mimosa pigra*, *Parinari curatellifolia*, *Psorospermum guineense*, and *Pterocarpus erinaceus*. Both grass and browse species were leafy materials from among those species considered to be highly consumed by cattle. In general, the average values for Na, P, and Zn in the grasses, browse and standing hays were inadequate for the nutritional needs of cattle. One standing hay from all locations contained suboptimum amounts of N, Ca, P, K, Mg, Na and Cu. The Cu content of all three forage types was adequate for cattle nutrition. The grass and browse species contained adequate amounts of N, K, Mg and Cu. The trace elements and Ca and Mg tended to be more concentrated in the browse species than in the grass species. The opposite was true of P. Grasses, browse and standing hays contained equal amounts of Na. Similarly, the grass and browse species contained identical amounts of P. Supplementation of mineral concentrates to include Na, P, K, Ca and Zn was suggested.

INTRODUCTION

THE vast majority of Nigerian cattle are found in the Northern States of Nigeria

(Oyenuga, 1968) and are mostly kept under traditional systems of management. The major fodder resources include grasses, browse, crop residues and the standing hays (Miller and Blair Rains, 1963a; Miller, Blair Rains and Thorpe, 1963b and 1964; Van Raay and de Leeuw, 1974). However, very little is known of the chemical constituents of these fodder resources (Oyenuga, 1968; Loosli, 1974). Any study that provides information on the mineral composition of the indigenous forage species of Northern Nigeria would contribute significantly to the progress of systematic nutritional work in Nigeria and possibly serve as a basis for appropriate formulation of feeds for livestock. This study was undertaken to find out the levels of nitrogen and some important minerals in the local forage species found in Northern Nigeria.

EXPERIMENTAL METHODS

Materials

Nine grass and ten browse species and standing hays were sampled during the month of April of 1975. The grass and browse species were leafy materials native to Northern Nigeria, and were collected from the Samaru area (on the Shika Fadama) of the Northern Guinea Savanna about 11° 11' north of the equator and 07° 38' east of the prime meridian at an

altitude of about 685.8m (2250ft) above sea level. The annual rainfall of the area is 111.40cm (43.86in). The standing hays were whole materials and were collected from Daura and Kano areas of the Sudan Savanna, Samaru in the Northern Guinea Savanna, Bauchi ranch of the sub-Sudan and Jos area of the Plateau vegetation. Daura is about N13° 02' and longitude E08° 13' and Kano is about latitude N12° 03' and longitude E08° 32'. The altitudes of Daura and Kano are 426.72m (1400ft) and 472.14m (1549ft) above sea level, with annual rainfall of 67.56cm (26.6in) and 88.42cm (34.81in), respectively. Bauchi is about latitude N10° 11' and longitude E09° 49' with an altitude of 609.30m (1999ft) above sea level and an annual rainfall of 110.19cm (43.38in). Jos is about Longitude E08° 54' and latitude N09° 52' with an altitude of 1284.73m (4215ft) above sea level and an annual rainfall of 141.02cm (55.52in) (Fig. 1. after Clayton, 1957).

A representative sample of each forage type was collected according to the sampling procedures for field hay, pasture or forage grasses (Jones, Large, Pfeidere,

and Klosky, 1971). All samples were washed several times in distilled water to avoid any contamination from accumulated dust and soil particles. They were air dried under the shade and later in an oven at about 85°C, cooled and then ground in a stainless Microhammer mill. The samples were then stored in plastic jars after oven drying at about 104°C prior to digestion.

Analytical Methods

One gram of the oven-dried sample was wet digested in Kjeldahl flask in duplicate as described by Sandell (1950). The digest was washed with distilled water into 100m volumetric flask and made to mark. The concentrations of K, Ca, Mg, Zn and Cu were determined with a Perkin-Elmer Model 290B atomic absorption spectrophotometer.* P was determined by the Vanadomolybdate colorimetric method (Cavell, 1955). The Standard flame photometric method was used to estimate the concentration of Na, while the micro-Kjeldahl method was used for N determination. All results were expressed on an oven-dry basis.

TABLE 1

Nitrogen and Mineral Composition of Grasses from the Northern Guinea Zone of Nigeria

Species	N %	P %	K %	Ca %	Mg %	Na %	Zn ppm	Cu ppm	Ca to P ratio
<i>Andropogon gayanus</i>	1.78	0.11	1.43	0.30	0.14	0.013	28	17	2.73
<i>Andropogon ascinioidis</i>	2.31	0.19	2.49	0.32	0.25	0.052	42	20	1.68
<i>Brachiaria jubata</i>	2.84	0.28	3.49	0.29	0.32	0.043	40	20	1.04
<i>Cynodon dactylon</i>	2.30	0.32	1.99	0.75	0.20	0.024	43	10	2.34
<i>Hyparrhenia dissoluta</i>	1.50	0.13	1.62	0.28	0.16	0.011	30	12	2.15
<i>Panicum phragmitoides</i>	2.87	0.28	2.53	0.24	0.45	0.024	54	24	0.86
<i>Setaria anceps</i>	2.64	0.21	5.54	0.26	0.15	0.020	42	10	1.24
<i>Sporobolus pyramidalis</i>	3.31	0.22	2.07	0.35	0.26	0.019	77	5	1.59
<i>Urelytrum muricatum</i>	1.92	0.21	1.86	0.25	0.18	0.013	27	12	1.19
Average Values	2.39	0.22	2.56	0.34	0.23	0.02	42.50	14.44	1.55
Standard Deviations	0.59	0.07	1.27	0.16	0.10	0.01	15.56	6.13	

* The Perkin-Elmer Corporation (1971), Norwalk, Connecticut, U.S.A.

TABLE 2

Nitrogen and Mineral Composition of Browse from the Northern Guinea Savanna of Nigeria

Species	N %	P %	K %	Ca %	Mg %	Na %	Zn ppm	Cu ppm	Ca to P ratio
<i>Adenodolichos paniculatus</i>	3.31	0.39	2.49	0.31	0.21	0.018	16	10	0.79
<i>Anogeissus leocarpus</i>	1.86	0.20	1.09	1.34	0.31	0.023	22	14	6.70
<i>Briddelia ferruginea</i>	1.64	0.12	2.33	0.70	0.41	0.028	53	15	5.83
<i>Crossopteryx febrifuga</i>	1.82	0.16	1.40	0.53	0.20	0.017	48	20	3.31
<i>Dichrostachys cinerea</i>	2.61	0.19	1.30	0.79	0.39	0.24	43	16	4.16
<i>Kyaya Senegalensis</i>	1.51	0.15	1.37	0.90	0.27	0.021	31	11	6.00
<i>Mimosa pigra</i>	2.72	0.27	1.50	0.98	0.22	0.026	70	25	3.63
<i>Parinari curatellifolia</i>	1.39	0.12	1.05	0.53	0.19	0.021	19	10	4.42
<i>Psorospermum guineense</i>	1.25	0.18	1.47	0.48	0.18	0.017	49	10	2.67
<i>Pterocarpus erinaceus</i>	3.56	0.30	2.58	0.43	0.45	0.019	63	20	1.43
Average Values	2.17	0.21	1.66	0.70	0.28	0.021	45.90	15.10	3.33
Standard Deviations	0.82	0.09	0.78	0.31	1.10	0.003	17.29	5.20	

TABLE 3

Nitrogen and Mineral Content of Standing Hays from the Savanna Zones of Northern Nigeria

Vegetation Zone	N %	P %	K %	Ca %	Mg %	Na %	Zn ppm	Cu ppm	Ca to P ratio
Sudan									
Daura — Northern Sudan	0.32	0.02	0.65	0.12	0.12	0.015	42	15	6.00
Kano — Southern Sudan	0.45	0.05	0.17	0.31	0.11	0.029	43	10	56.20
Sub-Sudan									
Bauchi — ranch	0.26	0.02	0.45	0.20	0.12	0.016	35	11	10.00
Northern Guinea									
Samaru (Shika-Fadama)	0.29	0.03	0.36	0.23	0.10	0.020	36	10	7.67
Plateau									
Jos	0.22	0.01	0.20	0.22	0.07	0.027	29	13	22.0
Average Values	0.31	0.03	0.37	0.22	0.11	0.02	37.00	11.80	7.33
Standard Deviations	0.09	0.02	0.20	0.07	0.02	0.01	5.70	2.17	

RESULTS AND DISCUSSION

The average values of nitrogen and the seven mineral elements in each forage type are presented in tables 1, 2 and 3. Figures 2, 3, 4, 5 and 6 show the mean protein and mineral values.

In all three forage types, the concentration of N (or protein) was directly pro-

portional to the concentration of Zn ($P < 0.05$), while in the standing hays alone, the K concentration was inversely proportional to the concentrations of Ca and Na ($P < 0.05$). The N concentration in Browse species was directly related to the concentrations of P ($P < 0.05$) and K ($P < 0.01$). Similarly, the concentration of N in the standing hays was directly related to the concentration of P ($P > 0.05$).

NORTHERN NIGERIA VEGETATION

Fig. 1

PROTEIN CONTENT OF NATIVE GRASSES, BROWSE SPECIES AND STANDING HAYS OF NORTHERN NIGERIA

Fig. 2

Major Elements

The crude protein values for each grass and browse species and the standing hays were calculated from the nitrogen figures (Figs. 2 and 3). According to the A.R.C. (1965) recommendations, 8% crude protein which is equivalent to 1.28% nitrogen was adequate for milk production. On this basis all the grass and browse species provided adequate amounts of nitrogen. The standing hays from all locations contained inadequate amounts of nitrogen. The mean crude protein values of temperate zone pastures (Wienmann, 1955) and Uganda grasses (Long, Thornton and Marshall, 1969a) were 20% and 6.24 respectively, compared with $14.91 \pm 3.66\%$ for grasses, $13.55 \pm 5.15\%$ for browse and $1.93 \pm 0.54\%$ for standing hays obtained in this study. There was no significant difference between the average protein (or nitrogen) contents of the grass and browse species. The average protein content of the standing hays was significantly lower ($P < 0.01$) than those of the grass or browse species.

All forage types sampled contained low concentrations of Na, with equal values of 0.02% (Fig. 4), which were lower than the A.R.C. (1965) recommendations of 0.13% or good United Kingdom pastures which normally contained 0.167% Na (Orr, 1929). Long, Ndyababo, Marshall and Thornton (1969b) obtained a higher Na value of 0.044% for grasses in Uganda while lower values of 0.015% were obtained by Howard, Burdin and Lampkin (1962) for Kenya highland pastures.

Since the requirements of beef cattle are reported to be lower than dairy cattle, the amounts of Na found in the present study may be barely adequate for beef grazing but definitely deficient for dairy production.

The average K values were 2.56 ± 1.27 , 1.66 ± 0.78 and $0.37 \pm 0.20\%$ for grasses,

browse and the standing hays respectively. K intended to be more concentrated in the grasses than in the browse or the field hays ($P < 0.01$) (Figure 5). K contents of grass and browse species were within the range of 1 to 4% reported for temperate grasses. The field hays from all locations were deficient in K. The differences between forage and types may be due to differences in age at sampling, since K concentration drops with increasing maturity (Widdowson Penny and Williams '1965).

The average P levels of the grasses and browse were about identical and were significantly higher ($P < 0.01$) than that of the field hays (Fig. 4). In general, the P levels of all forage types were below the ARC (1965) recommendations of 0.36% necessary for dairy cattle. It is interesting to note that the grass species *Cynodon dactylon* contained a very high amount of P (table 1). This is in agreement with the finding of Long *et al* (1969) for the same grass found in Uganda. The browse species *Adenodolichos paniculatus* (table 2) contained 0.39% of P which was higher than the ARC (1965) recommended requirements. It is concluded that P is deficient in all forage types.

The Ca level tended to be more concentrated in the browse than in the grass or standing hays ($P < 0.01$) and more in the grass ($P \pm 0.01$) than in the hays Fig. 4). The Ca concentration of most of the browse exceeded the A.R.C. (1965) suggested value of 0.43% for dairy cattle (table 2), while the Ca values for all hays and grasses with the notable exception of *Cynodon dactylon* were well below the A.R.C. (1965) stipulations (table 1).

The average Mg values in the grasses, browse and field hays were 0.23 ± 0.10 , 0.28 ± 0.10 and 0.11 ± 0.02 , respectively. The A.R.C. (1965) has recommended a Mg requirement of 0.18%. On this basis,

Fig. 3

Fig. 4

Fig. 5

Fig. 6

the grass and browse species contained adequate amounts of Mg while the hays were deficient. There was no significant difference between the average Mg contents of grasses and browse. The average Mg level in the field hays was significantly lower ($P < 0.01$) than in the grasses or the standing hays (Fig. 4). Calcium: Phosphorus ratio.

Hignett and Hignett (1951 and 1953) and Hignett (1959) have suggested that the Ca:P ratio was a factor influencing animal fertility. They proposed an optimal ratio of between 1 and 2.1 which was later disputed by Little John and Lewis (1960). Long *et al* (1969) obtained a ratio between 1:1 and 2:1 for grasses in Uganda. The Ca: P ratios obtained in this study are presented in tables 1, 2 and 3. The Ca: P ratio for grasses varied between 1:1 and 2:1.

Trace elements

Cu levels were about within the range of 12 to 18 ppm reported by Oyenuga and Olubajo (1974) for forages grown at Ibadan (tables 1, 2 and 3). The grass species *Sporobolus pyramidalis* had the lowest Cu level (table 1). Lower average Cu levels of $6.0 \pm 3.6\%$ have been reported for Dairy farms in Uganda (Long, Marshall, Ndyababo and Thornton, 1972). There were no significant differences in average Cu level between the different forage types (Fig. 6). It is suggested that all three natural forage types provided adequate amounts of Cu for cattle production. According to Kapu (1975) Native Northern Nigerian Zebus had normal serum Cu status which were above Cu levels of Zebus in Senegal or temperate breeds of cattle.

The average Zn levels in all three forage types were below the A.R.C. (1965) recommendations of 50 ppm, but were with-

in the range of 36 to 52 ppm reported by Oyenuga and Olubajo (1974) for forages grown at Ibadan (tables 1, 2 and 3). There were no significant differences in Zn levels of the three forage types. Both Cu and Zn tended to be more concentrated in the browse species than in the grasses or hays (Fig. 6).

Mineral supplementation containing Na, cl, P, K, Ca and Zn is suggested. Cu is unlikely to be deficient and should not be included.

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