

## THE CHEMICAL COMPOSITION OF THE GRASSES OF KENYA—III

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(Received for publication on 7th September 1964)

In this third paper of a series which began in 1958, the chemical composition of 32 indigenous grasses of Kenya is given together with descriptive notes and remarks on their nutritive value. The grasses grown in the nursery of the National Agricultural Research Station (formerly the Grassland Research Station), Kitale, are represented by 15 species. Eight of these were sampled early in the season, in April, and this early harvest is reflected in chemical composition, and especially in the crude protein content of the dry matter which is much higher than would normally be expected at the same stage of development, usually the early flowering stage, later in the season. Samples of 17 other grasses were collected in their natural habitats, viz. seasonally wet grassland on poor lateritic soil near Nairobi (1 species); seasonally water-logged black clays on the Athi Plains (3 species); grassland with *Commiphora* bush in the Tsavo National Park (East) near Voi (2 species); grassland with scattered or grouped trees in the Mara area of Masailand (2 species); alluvial flats with scattered *Acacia tortilis* at Marigat, near Lake Baringo (9 species, all annual). These nine annuals were collected on rich alluvial soil. They show a relatively high content of crude protein and, what is particularly characteristic, a high content of total ash, silica-free ash and of calcium. Two species of *Aristida* and especially *A. mutabilis* are exceptions in that they are a poor source of calcium and are not particularly rich in protein.

In the Table of chemical composition, details of silica and silica-free ash have been added in order to show more clearly the mineral status of each plant.

As in the two previous investigations in this series the chemical analysis of the plants was undertaken by H. W. Dougall, while the descriptions and botanical characteristics were made by A. V. Bogdan. These are given hereunder:

### *Acroceras macrum* Stapf. Nile grass

A stoloniferous or rhizomatous perennial up to 2 ft. in height which forms colonies in swamps and on stream banks. The variety

grown in the nursery and used for our analysis came from swampy ground near Turbo in western Kenya; it is a stoloniferous type forming dense leafy cover that is well grazed by cattle.

Although the grass is leafy at the early flowering stage it is not particularly rich in protein (8.7 per cent) and it is poor in P (0.10 per cent). It is not an aromatic grass and it is therefore surprising that its ether extractives constitute nearly 6 per cent of the dry matter.

### *Brachiaria nigropedata* (Munro) Stapf

A tufted perennial with long, hairy leaves. It occurs on red soil in relatively dry areas where it is well liked by all stock.

This grass was analysed at the full flowering stage, and the crude protein content of our sample constitutes only 8.4 per cent of the dry matter.

### *Echinochloa pyramidalis* (Lam.) Hitchc. et Chase. Antelope grass

Tall perennial mostly 6-8 ft. high but reaching occasionally a height of 12-15 ft. It is fairly common in swamps and on river banks mostly at high altitudes. It is well grazed when young and several unsuccessful attempts have been made to introduce it into cultivation.

Our sample, taken at the full flowering stage, was relatively low in crude protein although it was not unduly fibrous.

### *Eleusine floccifolia* (Forsk.) Spreng.

A perennial forming strong, broad, low tufts, with tough, narrow, flexible leaves which are provided with characteristic tufts of hairs. This grass has been found only in Nairobi and has possibly been accidentally introduced from Ethiopia where it is common in the highlands. It is a grass of low palatability and in Ethiopia it is eaten only when no other grazing is available.

Analysed at the early flowering stage in April it contained over 17 per cent of crude protein in its dry matter, but it was somewhat fibrous.

*Eragrostis racemosa* (Thunb.) Steud.

A small short-lived tufted perennial 4 in. to 2 ft. in height common in highland grassland where it is usually found between tufts of larger grasses. Although it does not produce a large bulk of herbage *E. racemosa* provides useful grazing and is well liked by all stock.

Our sample was collected at the early flowering stage in April. It was relatively rich in protein and phosphorus though fibrous.

*Eulalia polyneura* (Pilger) Stapf

A perennial which forms strong broad low tufts with its flowering heads rarely exceeding 3 ft. in height. It occurs in somewhat water-logged highland grassland and it is also a dominant grass on water-logged flat ground in the grouped-tree grassland in southern Nyanza.

*E. polyneura* is a poor source of minerals especially phosphorus, and of protein and it is very fibrous at the early flowering stage of growth.

*Exothea abyssinica* (Hochst. ex A. Rich.) Anderss.

A tufted perennial 2-4 (occasionally 5) ft. in height; common at altitudes above 5,500 ft. in grassland, often on seasonally wet ground. It has tough leaves and is grazed only when young.

Our sample was collected at the early flowering stage very early in the season. It was rich in protein though rather fibrous. Total ash was very low, and constituted less than 6 per cent of the dry matter. Ca was low (0.26 per cent) though P was reasonably high (0.19 per cent).

*Latipes senegalensis* Kunth. Hook grass

A small short-lived tufted perennial 6-18 in. in height, with hardly any basal leaves but with numerous short leaves on the stems; common and often abundant in semi-arid areas in bush, on eroded slopes, in thin grassland, etc. This grass is well grazed and is reputed to be palatable even in the dry season, though its productivity is low.

Our analysis shows that this grass is very fibrous and of medium protein content at the early flowering stage.

*Loudetia phragmitoides* (Peter) C.E. Hubbard

A robust tufted perennial 4-10 ft. in height which occurs in western Kenya although it is

more common in Uganda. It forms colonies on swampy ground and on lake shores and is almost unpalatable to cattle.

Analysis of the herbage at the early flowering stage shows that this grass is extremely fibrous, and that it is not a good source of protein or of Ca and P.

*Paspalidium desertorum* (A. Rich.) Stapf

A perennial with trailing stems and long narrow succulent leaves which occurs in arid areas of northern Kenya where it is a well grazed and valuable grass.

Our analysis of plants originally brought from the Isiolo District and sampled at the full flowering stage shows *P. desertorum* to be relatively rich in protein and not unduly fibrous. This grass is also a very useful source of Ca and P.

*Pennisetum polystachyon* (L.) Schult.

A tufted perennial from 1-7 ft. high common in the Nyanza Region and at the Coast where it is locally very abundant. It also occurs in other semi-arid parts of Kenya in thin bush and on roadside verges. This grass is usually considered to be of only medium grazing value as it often becomes stemmy and fibrous at relatively early stages of growth.

Our analysis of herbage taken early in the season, in April, at the early flowering stage shows that *P. polystachyon* can be of high nutritive value early in the season. It contained over 17 per cent of crude protein in its dry matter and 0.22 per cent P.

*Pennisetum setaceum* (Forsk.) Chiov.

A densely tufted perennial up to 2, rarely 3 ft. in height which occurs only very occasionally in Kenya. Our material originates from the West Pokot District. It has harsh fibrous leaves and is hardly suitable for grazing.

A sample of herbage collected at the early flowering stage very early in the season contained almost 16 per cent of crude protein in its dry matter.

*Rottboellia exaltata* L.f. Buffalo Bean grass

A tall annual 5-12 ft. in height; common at the Coast and in the Nyanza Region; it occurs also in other areas below 6,000 ft. altitudes under a rainfall over 30 in. annually. It is often found on swampy ground but is more

common as a weed of cultivated land, and as a roadside grass. It has been reported that *R. exaltata* can make good silage. At later stages of growth this tall grass is usually unpalatable to cattle and only young growth is normally grazed.

A sample of tall herbage collected early in the season at the early flowering stage contained an adequate amount of protein although the material was rather fibrous. Ca and P values were relatively low.

*Sehima nervosum* (Rottb. ex Willd.) Stapf

A tufted perennial with harsh, fragile leaves; the tufts split easily at the base. This species is common and locally numerous on lava rocks and on black, seasonally water-logged clays. Its palatability is low.

Chemical analysis shows that this grass has a high fibre and a low protein content. As is usual for plants growing in black clay soils, its calcium content is relatively high.

*Sporobolus marginatus* Hochst. ex A. Rich.

A low growing stoloniferous perennial which forms slowly spreading, dense leafy colonies on soils rich in soda. This grass provides grazing of excellent quality though it is not productive.

A nursery sample of herbage collected early in the season in April at the early flowering stage contained 23.29 per cent of crude protein and 0.25 per cent P in its dry matter and its crude fibre content was low.

*Aristida adscensionis* L. Common needle grass

An annual grass up to 2½ ft. in height with narrow leaves and sharp seeds which make it almost unpalatable from the full flowering stage until well after seed ripening when the sharp seeds are shed.

A sample of herbage growing on alluvial soil at Marigat and collected at the early flowering stage contained slightly less than 9 per cent of crude protein and 0.30 per cent P in its dry matter. It was very fibrous, containing some 37 per cent crude fibre at a stage when it could still be grazed by stock.

*Aristida mutabilis* Trin. et Rupr. Fine needle grass

A small annual up to 18 in. high with the leaves softer, and the sharp seeds finer, than those of *A. adscensionis*. It occurs under drier

conditions than *A. adscensionis* and is one of the first pioneer grasses to colonize bare ground in semi-arid and arid areas of Kenya.

Our analysis of herbage growing on alluvial soil at Marigat and sampled at the early flowering stage of growth was similar to that of *A. adscensionis* from the viewpoint of crude protein and crude fibre but its Ca and P content respectively was much inferior.

*Brachiaria deflexa* (Schumach.) C. E. Hubbard

An annual 6 in. to 2 ft. in height with broad, bright-green leaves. It is fairly common in semi-arid parts of Kenya below 5,000 ft. altitude in grassland, bush, and on rocky ground.

A sample of herbage collected by D. L. W. Sheldrick in the Tsavo Royal National Park (East) at the early flowering stage contained an adequate amount of crude protein (12.49 per cent of the dry matter) and of calcium (0.49 per cent) and it was not unduly fibrous—thus indicating the good nutritive value of this grass. *B. deflexa* was recorded as being eaten by elephant.

*Brachiaria leersioides* (Hochst.) Stapf. Blue signal grass

An annual 6 in. to 2 ft. in height with narrow bluish leaves; widespread in semi-arid areas of Kenya in grassland, bush and on rocky ground; it only seldom forms colonies but usually occurs scattered between other grasses and herbs. Two samples of herbage were collected by D. L. W. Sheldrick in the Tsavo Royal National Park (East), near Voi: one at the early flowering stage during the "short" rains and the other, at the full flowering stage in the dry season.

The first sample was of useful nutritive value, containing just under 12 per cent of crude protein in its dry matter. As could be expected the second sample was much more fibrous and it contained less crude protein in its dry matter. *B. leersioides* was being grazed by elephant at this stage of growth.

*Chloris virgata* Sw. Black seed grass

An erect, and usually leafy annual 6 in. to 3 ft. high which occurs at altitudes below 6,000 ft. in bush, on rocky ground, at roadsides, etc., and can be locally abundant.

A sample of herbage collected at Marigat at the full flowering stage was of high nutritive value. It contained almost 13 per cent of crude

protein and the average expected amount of crude fibre. Both total and silica-free ash values were high and the sample was reasonably rich in calcium.

*Ctenium concinnum* Nees. Pigtail grass

A perennial forming dense broad tufts. The leaves are narrow and hard and the single spikes or racemes which terminate the fertile stems twist spirally at maturity, hence its common name. It occurs in grassland, mostly seasonably wet, at the Coast and occasionally also in other parts of Kenya.

A sample of stemmy herbage collected in the Mara area of Masailand by L. Wateridge was somewhat fibrous (33.81 per cent) although its protein content was reasonably high (9.18 per cent). The silica-free ash content of this grass is relatively low but the calcium content is relatively high.

*Dactyloctenium aegyptium* (L.) Beauv. Crow foot grass

An annual up to 2½ ft. high with soft, slightly succulent leaves; widespread below 6,500 ft. altitude on denuded ground in semi-arid areas and common in many areas as a weed of arable land.

Our recent analysis of the herbage collected at Marigat at the full flowering stage agrees well with the values obtained in 1959 (Dougall and Bogdan, 1960) for the Kitale material. The only substantial difference is that the Marigat material was much richer in ash—both total and silica-free; this might be expected because the Marigat soil is itself richer in minerals.

*Dinebra retroflexa* (Vahl) Panzer

An annual 6 in. to 2½ ft. high; common on black clay soils of seasonably water-logged plains where it occupies the gaps which occur occasionally in the perennial grass cover; it is also a common weed of arable land on the same type of soil.

A sample of herbage growing on the black soil of a stream bank near Athi River was collected at the early flowering stage of growth. Although somewhat fibrous, it was rich in protein, Ca and P.

*Drake-Brockmania somalensis* Stapf

An annual with prostrate and ascending stems freely rooting from nodes. It occurs occasionally on heavy black clays, in better-drained situations or on patches of somewhat

saline soil on the Athi Plains although it is more common in northern Kenya under similar soil conditions. *D.-B. somalensis* is well liked by all ruminants.

Our analysis of a sample of herbage growing on alluvial soil near Athi River Station was collected at the early flowering stage. It contained over 20 per cent of crude protein in its dry matter and was rich in Ca and P. The stems of this plant are wiry and hard and this accounts for its somewhat high content of crude fibre.

*Eragrostis cilianensis* (All.) Lutati. Grey lovegrass

An annual 6-18 and occasionally to 30 in. high, rather stemmy with numerous relatively soft stems. The whole plant is usually pale-greyish-green. It is common at altitudes below 7,000 ft. in partially denuded grassland, on bare ground, at roadsides and as a weed of arable land. *E. cilianensis* is one of the first pioneer grasses to appear on denuded land in semi-arid areas.

A sample of herbage at the full flowering-early seeding stage was collected on alluvial soil at Marigat. Our analysis reveals the high nutritive value of *E. cilianensis*. The herbage contained over 15 per cent of crude protein in its dry matter and this high value can be partially ascribed to the presence of numerous seeds in the large panicles. This grass is also rich in calcium, which forms 0.7 per cent of the dry matter.

*Eriochloa nubica* (Steud.) Hack. et Stapf ex Thell.

An annual 6-30 in. in height which occurs on alluvial soil in dry areas and also on stream-banks, roadsides and as a weed of arable land. It usually produces a reasonable bulk of leafy herbage that is well liked by stock.

Our analysis of a sample collected at the full flowering stage at Marigat shows a very high content of total ash (16.18 per cent), and of silica-free ash (12.40 per cent).

*Hyparrhenia cymbaria* (L.) Stapf. Coloured hood grass

A tufted perennial which varies in size and can reach a height of over 9 ft. It is common in bush, at forest edges and sometimes also in open grassland in areas with a rainfall of 35-40 in. annually.

A sample of herbage collected at the flowering stage by L. Wateridge in the Mara contained 7.32 per cent of crude protein in its dry matter. Its percentage content of total ash was high, but that of silica-free ash was very low—being only 3.90 per cent of the dry matter. Impala were grazing this grass at the time of sampling.

*Panicum poaeoides* Stapf

A small tufted perennial 6 in. to 2½ ft. high with soft hairy leaves and small panicles. It is fairly common in seasonally wet grasslands in the Nairobi area.

A sample of herbage growing on poor, lateritic soil at Langata near Nairobi, was collected at the early flowering stage. It contained 9 per cent of crude protein in its dry matter and its Ca content (0.32 per cent) was low. *P. poaeoides* may be regarded as a grass of relatively low nutritive value.

*Sorghum verticilliflorum* (Steud.) Stapf Wild  
Sudan grass

A tall annual 4-10 ft. in height with large loose panicles. It occurs on roadside verges and other places with disturbed soil; it also occurs on black clay soils of plains that are subjected to seasonally water-logged conditions.

A sample of tall herbage at the early flowering stage was collected near Athi River Station. It contained just over 8 per cent of crude protein in its dry matter and almost 35 per cent crude fibre, thus indicating its relatively low nutritive value. Characteristically for plants growing on or originating from black clay soils, the calcium content of this grass was relatively high although its total content of minerals, including P, was low.

*Tetrapogon spathaceus* (Hochst. ex A. Steud.)  
Hack. ex Dur. et Schinz. Hairy herringbone grass

A small annual under 12 in. in height which occurs below 5,000 ft. altitude in semi-arid

and arid areas on red soil, often on denuded land where it can be very numerous. It is one of the first pioneer grasses to appear on denuded pastoral land although its life span is very short.

A sample of herbage growing on alluvial soil at Marigat was collected at the full flowering stage of growth. Its protein content (12.60 per cent) was relatively high and its Ca and P content respectively reached 0.5 per cent and 0.2 per cent of the dry matter.

*Tetrapogon tenellus* (Roxb.) Chiov. Smooth herringbone grass

An annual 6-18 in. in height, varying in leafiness. It occurs below 5,000 ft. altitude in semi-arid and occasionally also in arid areas on red soil or on rocky ground.

Our analysis of a sample of herbage collected at the full flowering stage at Marigat shows that *T. tenellus* is of reasonably good nutritive value, containing 11.58 per cent of crude protein, 0.56 per cent Ca and 0.26 per cent P in its dry matter.

*Urochloa panicoides* Beauv.

An annual 6-24 in. in height with broad leaves and semi-prostrate stems which form spreading growth. It occurs at altitudes below 6,000 ft. on roadside verges, alluvial soil and as a weed in cultivations.

Analysis of herbage collected at the late flowering-early seeding stage on alluvial soil at Marigat shows the high nutritive value of *U. panicoides*. This grass contained almost 15 per cent of crude protein in its dry matter and a proportionate amount of crude fibre. Total ash and silica-free ash constituted 14.87 per cent and 10.83 per cent respectively of the dry matter and P, 0.25 per cent of the dry matter.

REFERENCES

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(per cent of dry matter)

Botanical name	Date harvested	Ash	Crude protein	Ether extract	Crude fibre	N-free extractives	Silica	Silica-free ash	Ca	P
KITALE NURSERY SAMPLES										
<i>Acroceras macrum</i>	20-6-62	9.88	8.70	5.94	30.77	44.71	3.41	6.47	.45	.11
<i>Brachiaria nigropedata</i>	20-6-62	9.01	8.48	1.55	30.68	50.28	4.03	4.98	.41	.23
<i>Echinochloa pyramidalis</i>	20-6-62	8.55	7.03	1.14	31.35	51.93	2.97	5.58	.34	.13
<i>Eleusine floccifolia</i>	28-4-61	10.03	17.02	2.86	32.00	38.09	3.75	6.28	.39	.21
<i>Eragrostis racemosa</i>	28-4-61	10.61	13.98	2.39	31.85	41.17	5.44	5.17	.28	.25
<i>Eulalia polyneura</i>	20-6-62	4.88	5.35	1.17	37.91	50.69	1.37	3.51	.30	.09
<i>Exothea abyssinica</i>	13-4-61	5.77	13.61	2.39	33.10	45.13	1.84	3.93	.26	.19
<i>Latipes senegalensis</i>	20-6-62	7.46	9.28	1.34	38.91	43.01	3.33	4.13	.41	.15
<i>Loudetia phragmitoides</i>	20-6-62	6.08	7.60	1.26	40.28	44.78	2.43	3.65	.28	.13
<i>Paspalidium desertorum</i>	20-6-62	13.01	13.78	1.20	29.42	42.59	4.77	8.24	.97	.18
<i>Pennisetum polystachyon</i>	28-4-62	11.87	17.59	2.67	27.11	40.76	5.28	6.59	.31	.22
<i>Pennisetum setaceum</i>	28-4-62	10.97	15.93	2.25	31.29	39.56	4.43	6.54	.33	.17
<i>Rottboellia exaltata</i>	14-4-62	10.88	11.06	2.34	32.88	42.84	5.19	5.69	.30	.15
<i>Seluma nervosum</i>	20-6-62	8.79	7.01	1.34	38.71	44.15	4.37	4.42	.66	.12
<i>Sporobolus marginatus</i>	28-4-61	9.28	23.29	3.10	25.68	38.65	3.04	6.24	.51	.25
SAMPLES FROM NATURAL HABITATS										
<i>Aristida adscensionis</i>	29-8-61	11.44	8.90	1.73	36.84	41.09	6.58	4.86	.33	.30
<i>Aristida mutabilis</i>	29-8-61	11.30	8.71	1.19	35.47	43.33	8.20	3.10	.15	.10
<i>Brachiaria deflexa</i>	5-12-61	12.62	12.49	2.13	29.96	42.80	4.82	7.80	.49	.19
<i>Brachiaria leersioides</i>	10-12-61	13.47	11.78	1.91	31.47	41.37	5.38	8.09	.44	.16
<i>Brachiaria leersioides</i>	1-4-62	14.67	7.88	2.04	35.46	39.95	8.33	6.34	.34	.22
<i>Chloris virgata</i>	29-8-61	13.80	12.86	1.80	31.09	40.45	3.24	10.56	.55	.19
<i>Ctenium concinnum</i>	24-10-62	9.97	9.18	2.52	33.81	44.52	5.79	4.18	.50	.12
<i>Dactyloctenium aegyptium</i>	29-8-61	13.65	15.62	1.51	27.91	41.31	1.58	12.07	.73	.30
<i>Dinebra retroflexa</i>	2-5-62	13.44	16.97	2.30	32.97	34.32	5.98	7.46	.63	.33
<i>Drake-Brockmania somalensis</i>	2-5-62	13.96	20.15	2.86	28.87	34.16	4.98	8.98	.69	.28
<i>Eragrostis cilianensis</i>	29-8-61	10.65	15.30	2.35	28.98	42.72	3.10	7.55	.70	.20
<i>Eriochloa nubica</i>	29-8-61	16.18	10.15	1.45	33.49	38.73	3.78	12.40	.51	.30
<i>Hyparrhenia cymbaria</i>	6-12-62	15.09	7.32	2.65	30.33	44.61	11.19	3.90	.39	.18
<i>Panicum poaeoides</i>	2-5-62	10.00	9.04	1.80	30.97	48.19	4.65	5.35	.32	.16
<i>Sorghum verticilliflorum</i>	2-5-62	10.96	8.29	1.49	34.95	44.31	5.34	5.62	.56	.14
<i>Tetrapogon spathaceus</i>	29-8-61	8.66	12.60	1.67	34.60	42.47	2.72	5.94	.50	.20
<i>Tetrapogon tenellus</i>	29-8-61	12.63	11.58	1.96	32.93	40.90	5.06	7.57	.56	.26
<i>Urochloa panicoides</i>	29-8-61	14.87	14.70	1.74	29.92	38.77	4.04	10.83	.48	.25