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Mineral Content and Chemical Composition of Napier *(Pennisetum purpureum)* Grass

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Original Research Article

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Abstract: Napier grass is a popular tropical grass, employed by farmers in livestock nutrition. In this work, the matrices of matured shoots of *P. purpureum* (schumach) commonly called Napier grass, were subjected to proximate analysis, mineral content determination and phytochemical screening. The proximate profile includes moisture (91.00%), total ash (22.20% DW), crude protein (20.11% DW), crude fat (14.00% DW), total carbohydrate (27.24% DW) and the total metabolizable energy value (315.40 kcal/100g DW) was obtained. The mineral content determination revealed the presence of Calcium (1.479 mg/100g), Cadmium (0.001 mg/100g), Copper (0.017 mg/100g), Iron (0.200 mg/100g), Manganese (0.043 mg/100g), Potassium (10.715 mg/100g), Sodium (0.495 mg/100g), and Zinc (0.045 mg/100g). The presence of alkaloids, flavonoids, glycosides, oils, saponins, steroids, tannins, terpenoids and absence of acidic compounds and resins were determined from the phytochemical screening carried out. This result suggests that Napier grass possesses several bioactivities of which antimicrobial activity is likely the significant activity. Also, the proximate composition and mineral content underlines its importance as a health food suitable for weight loss management of obese individuals, due to the high fibre content and low calorie value.
Keywords: Matrices, P. purpureum, phytochemical screening.

INTRODUCTION

Investigations into the contributions of plant nutrition in the management of disease conditions have occupied research focus lately. The cereal grasses such as alfalfa, oats, barley and wheat have acquired the status of super foods owing to their high nutritive values exceeding the nutritional value of most dark green vegetables [1, 2].

The nutritional components of these "super-grasses" can only be digested and available to the human body if juiced or pulverized [3]. The folkloric uses of these cereal grasses includes; as an antidote for heartburn, inflammation and for blood detoxification [4]. Less emphasis has been paid to the "grass group of plants," i.e. the *Poaceae* family with regards to their nutritional potentials and health benefits. This is because grasses have historically found use mainly as nutrition in ruminants and not humans.

Napier grass, (*Pennisetum purpureum*) popularly referred to as "elephant grass" is native to African countries such as Kenya, Ethiopia, Cameroon, Cote D'Ivoire, Ghana, Guinea, Liberia, Nigeria, Sierra Leone, Angola, Malawi, Mozambique, Tanzania, Togo, Uganda, Zambia and Zimbabwe. The ethno pharmacological uses of Napier grass include as a laxative in Gambia; tranquillizer in Tanganyika, diuretic and analgesic in Nigeria, and as a mouth wash for buccal infections, gingivitis and thrush in Congo [5]. *P. purpureum* is a robust perennial with an extensive root system reaching a depth of 4.5m. The plant belongs to the *Poaceae* (alt *Gramineae*) family and has been used extensively in livestock nutrition and has a huge potential as a feedstock for bio fuel processing. In Kenya, more than 70% of livestock farmers grow Napier grass [6]. The grass yield is highest in dry matter and is better than most tropical grasses. In terms of human nutrition, the matrices of the matured shoots are sliced and used in the preparation of a special delicacy called "Achara soup" by the Ngwa and Umuahia people of Abia state in South Eastern Nigeria [7].

The cultivation of Napier grass is easy as it follows conventional farming practices. The plant is a high yielding plant that could be harvested up to four times in a year. Napier grass checkmates the growth of weeds, and rarely requires any supplementary nutrients. Thus; has a very low establishment and maintenance cost [8].

In view of scanty studies into the nutritional value of Napier grass with no mention of the mineral content analysis of the matrices of the matured shoots consumed by humans, this study on the proximate chemical analysis and mineral content determination of Napier grass was undertaken to evaluate the nutritional composition and thus the potential health benefits of the plant.

MATERIALS AND METHODS

Materials

Plant

The fresh young shoots of *P. Purpureum* were obtained from Aba, Abia state in the South Eastern part of Nigeria in the month of August during the peak of the rainy season. The specimen was identified at the University of Port Harcourt Herbarium, Choba, Rivers state, Nigeria.

Reagents

0.128M H_2SO_4, 0.223M KOH, antifoaming agent, 40% NaOH, Boric acid indicator, Kjeldahl catalyst mixture, 0.01M HCl, Picric acid solution, Wagner's reagent, Dragendroff's reagent and Mayer's reagent.

Solvents

Acetone, Chloroform and N-Hexane (Sigma-Aldrich, Europe), Ethyl acetate (Sigma-Aldrich, France) and Methanol (Sigma-Aldrich, Germany)

Equipments

Electronic weighing balance (JD 300-3), water bath (TECHMEL and TECHMEL, USA), Soxhlet extractor, Rotary evaporator, Kjeldahl apparatus, Atomic Absorption Spectrophotometer (GBC Avanta ver. 2.02)

Methods

Preparation of Plant Material

After collection the shoots were washed and the outer, hard and fibrous parts removed to obtain the inner fresh, tender and edible part which was required for the experiments. The inner part was divided into two portions; the first portion was used immediately for the proximate analysis, while the second portion was oven dried to a constant weight at 40°C and retained for extraction and phytochemical screening.

Preparation of Extract

200g of the dried pulverized sample was extracted with 600 ml of Methanol. The resultant Methanol extract was concentrated using rotary evaporator and evaporated to dryness.

The Methods Employed in the Experiments

The proximate chemical analysis was carried out by AOAC [20, 16] official methods [16]. The plant was analysed for moisture content, Total ash, Crude protein, Crude lipid and Crude fibre. The metabolizable energy value was calculated using factors 4, 4 and 9 for protein, carbohydrates and fats respectively.

Moisture content determination

The Moisture content was calculated as follows;

$$Moisture\ (\%) = \frac{\text{Weight of the dried sample X 100}}{\text{Fresh weight used (2g)}}$$

Ash Content determination

The Ash was calculated as follows;

$$Ash\ (\%) = \frac{\text{Weight of ash X 100}}{\text{Weight of sample (2g)}}$$

Crude fat Content

The Crude fat Content was calculated as follows;

$$\%\ \text{fat} = \frac{C - A}{B} X \frac{100}{1}$$

Where A= weight of empty flask

B= weight of the sample

C= weight of flask + oil after drying

Crude fibre determination
The crude fibre content was determined as follows;

$$\% \text{ crude fibre} = \frac{W2 - W3}{W1} X \frac{100}{1}$$

Where W1= original weight of sample
W2= weight after drying
W3= weight after ignition

Crude Protein determination
The crude protein content was determined as follows;

$$\% \text{ crude protein} = \frac{Vol.HCl\ X\ 314.01\ X\ 0.01\ X\ 100\ X\ 6.25}{1000\ X\ Weight\ of\ sample}$$

Carbohydrate content determination
The carbohydrate content was determined as follows;

%Carbohydrate= 100-(%moisture+%ash+%crude protein+%crude fibre+%crude fat)

The Phytochemical screening in this study was done according to the methods described by Harbone [19]; Evans, [17, 18]. The plant was tested for Alkaloids, Flavonoids, Glycosides, Saponins, Steroids, Tannins, Terpenes, Reducing sugars, Resins and Acidic compounds. The mineral content determination was by the methods of Pearson [21], using an Atomic Absorption Spectrophotometer (GBC Avanta ver. 2.02).The determination of the following eight minerals was carried out: Cadmium, Calcium, Copper, Iron, Manganese, Potassium, Sodium and Zinc.

RESULTS AND DISCUSSIONS

The results of the proximate composition of *P. purpureum* contained in Table 1, indicates that the plant has a high moisture content of 91.00%, which is higher than that (89%) reported by Okaraonye *et al*. [7], and 75.27 % from whole stem reported by Mohammed *et al*. [8] in which no season of collection was specified. The high moisture content of the plant indicates that Napier grass would have a very short shelf-life, susceptible to fast degradation and would require dehydration if preservation is desired. This high moisture content also suggests that in cases of animal and human dehydration, this plant could prove useful in rapid re-hydration.

Table-1: Proximate Composition of *P. purpureum*

Parameter	Dry Weight
Moisture (%)	-
Total ash (%)	22.20±2.31
Crude Protein (%)	20.11±1.44
Crude Lipid (%)	14.00±1.09
Crude Fibre (%)	27.24±1.87
Total Carbohydrate (%)	16.45±0.54
Total metabolizable energy (Kcal/100g)	315.40

Each value represents the mean ± SD of three determinations on dry weight (DW) basis.

Further analysis of the results of Table 1, demonstrated that Napier grass is low in carbohydrates and fat. This finding implies that the plant would be beneficial in weight loss management, as foods high in carbohydrates and fat supports weight gain and obesity. The protein content of the plant constituted 20.11% of the analysed portion of the plant. The protein requirement for adults is stipulated as 0.8g/kg of body weight, which Napier grass could contribute significantly towards. The crude protein content of the whole stem was found to be 61.8 g/kg from another study. The referenced study noted that the leaves of Napier grass had 122.2 g/kg of crude protein, which was twice that of the stem [9]. This plant might be helpful as a source of protein for vegetarians.

The crude fibre content is higher than all other parameters evaluated. This is a further pointer to the potential benefit of the plant in weight loss management. The total ash content constituted 22.2% of the analysed stem, which is

comparable to the total ash contents obtained for the dry hay of Bermuda grass (*Cynodon dactylon*) as 29.5% [11] and 36.7% [12] for Guinea grass (*Megathyrsus maximus*).

Table-2: Summary of the Mineral Content of *P. purpureum*

Component	Value (mg/100g)	Recommended Daily Amount in mg [10].
Calcium	1.479±0.020	
Cadmium	0.001±0.000	
Copper	0.017±0.004	2
Iron	0.200±0.003	18
Manganese	0.043±0.006	2
Potassium	10.715±0.350	3500
Sodium	0.495±0.004	
Zinc	0.045±0.002	15

Values are means ± SD calculated as milligram per 100 gram dry weight (DW) for *Pennisetum purpureum* analyzed individually in triplicate.

The result presented in Table 2 is the summary of the mineral content of P. purpureum. The table indicates the presence of eight minerals of which Potassium had the highest concentration of 10.715mg/100g. In comparison, to the required daily intake values of this mineral, the amount contained in Napier grass is far below the required daily intake. An earlier study by Mohammed, et al., 2015, obtained the Calcium content as 4.34% and the sodium content as 0.27% respectively for the whole stem analysis. Their result is in close agreement with the findings of this present research. The calcium and sodium content of Bermuda and Guinea grasses have been determined from studies to be 4.2 and 4.6 mg/kg for calcium and 0.2 and 3.1mg/kg for sodium respectively from studies [11,12]. It has been observed that grasses in the tropics have a deficiency of sodium mineral [13]. This result implies that the plant is not a recommended source for dietary minerals. Again, this result underscores the non-toxic nature of the plant.

Table-3: Result of Phytochemical Tests on Methanol Extract of *P. purpureum*

Phytochemical Constituent	Result
Alkaloids	++
Flavonoids	++
Glycosides	++
Oils	++
Reducing sugars	+
Resins	-
Saponins	++
Steroids	+++
Tannins	+++
Terpenes	+++
Acidic compounds	-

Key: - Absent, + slightly present, ++ moderately present, +++ highly present

The results of the phytochemical screening of *P. purpureum* displayed in Table 3, demonstrated that the plant is rich in steroids, tannins and Terpenes. A number of tannins have shown potentials as anti-carcinogenic and anti-mutagenic agents due to their anti-oxidants properties [14]. The high levels of tannins present in Napier grass may be linked to the antimicrobial activities observed about the plant in its use as a mouth wash for buccal infections, gingivitis and thrush in Congo [5]. Moderate levels of alkaloids, flavonoids, glycosides, saponins and oils were recorded. The presence of alkaloids, flavonoids and saponins in Napier grass implies that the plant may possess some pharmacological activities [*15]*.

CONCLUSION

The study on the Mineral content and Proximate chemical composition of Napier *(Pennisetum purpureum*) grass has being carried out. The results of the study revealed that the plant has low levels of carbohydrate and sugar. Also, the plant could contribute significantly to the RDA of protein intake in humans. The mineral contents of Napier grass are inadequate in meeting the RDA for human, but the phytochemical profile of the plant suggests that the plant may possess some pharmacological activities.

Thus, the consumption of Napier grass is beneficial to a healthy lifestyle and could be exploited in weight loss management.

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