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# Mineral profile of some fodder crops and their residues in the Nigerian subhumid zone.

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## Summary

*The three fodder cereals examined (*Zea mays, Pennisetum typhoïdes, Sorghum vulgare) crops were generally low in protein and mineral contents and were found to be lower in nutritive value than the legume Arachis hypogea analysed. Fodder quality was higher during the wet season.
Crude protein, phosphorus and micro-nutrients (Zn and Cu) contents were generally below the recommended critical levels for livestock production in the tropics. However, K, Mg and Ca contents were generally adequate, especially in the wet season. Species, season and location were important factors in quality and mineral composition. Provision of salt licks containing micro-nutrients is recommended in this zone.

## Résumé

*L'analyse chimique du* Zea mays, Pennisetum typhoïdes, Sorghum vulgare *et* Arachis hypogea *comme fourrage a montré des taux faibles en protéines et en minéraux chez les graminées dont la valeur nutritive est inférieure à celle de la légumineuse examinée. La qualité du fourrage était meilleure en saison des pluies.*
*Les teneurs en protéines brutes, en phosphore, en zinc et en cuivre étaient sous les valeurs critiques recommandées pour l'élevage tropical. Les taux en potassium, magnésium et calcium étaient convenables, surtout en saison des pluies. L'espèce, la saison et la localisation ont une grande importance dans la qualité de la composition minérale. L'utilisation de compléments minéraux est donc indispensable.*


## Introduction

The Subhumid Zone of Nigeria (SHZ) occupies about 50% (455,000 km²) of Nigeria's land mass (3) or approximately consists of a third of West Africa's land mass (7). The growing season within this zone varies between 180-270 days and transforms from the derived savanna in the North to forest vegetation zones in the South (9).
By International Livestock Centre for Africa's extrapolation, there are 9.3 million cattle in Nigeria out of which the SHZ has about 4.5 million (2). Sheep and goats populations are put at 8.8 and 2.4 millions respectively in Nigeria (4). The Subhumid Zone accounts for a sizeable proportion of the total livestock population in Nigeria.

During the wet season (May-September) animals graze mainly natural pastures but depend mostly on crop residues (over 50% of grazing time) in the dry season (October-April). The critical period in livestock production in this zone is the dry season and the major problem is poor forage quality as well as quantity. The resident cattle of the zone at this period tend to lose about 15-20 percent of their body weight each dry season inspite of available forage (11). Under the conditions, milk yields are low, calf mortality is high and owing to nutritional anoestrus, cow fecundity also is low (8).
The objective of this study was to evaluate the quality and mineral composition of four common fodder crops of this zone as they relate to ruminants' requirements.

## Material and Methods

Three common cereal fodder crops (*Zea mays, Pennisetum typhoides* and *Sorghum vulgare*) and one legume (*Arachis hypogea*) were obtained at two growth stages: Vegetative (pre-flowering) in August, 1989 (representing the peak of the wet season) and at maturity (after harvesting) in February, 1990 during the dry season around Funafuna about 50 km to Kontagora in the lower part of the Northern Guinea savanna and Shika-Zaria; Lat. 10°51'; Long. 7°35'E (Upper Northern Guinea savanna).
These were brought to the laboratory in polythene bags. For materials harvested in August, 1989 only the young and mature leaves along with tender stems were used for the analysis. Crop residues of maize stover (*Zea mays*) millet (*Pennisetum typhoides*) and Sorghum (*Sorghum vulgare*) (Stalks and leaves) and groundnut (*Arachis hypogea*) (leaves and stems) were sampled from Funafuna and Shika. Thirty samples of each fodder per location per time of sampling were used. The samples were dried at 60°C for 48 hours and subsamples were milled using a portable hammer mill with a 1 mm screen for analysis. Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) contents were determined according to (1). Nitrogen content was determined by Kjeldahl digestion and protein content calculated by multiplying by 6.25. The concentrations of P, Mg, Ca, Cu and Zn were measured by atomic absorption spectrophotometry while K was determined using flame photometry after nitric-

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***TABLE 1***

**Chemical composition of some selected fodder crops of Funafuna-Kontagora in the wet season (August, 1989).**

| Fodder | (Dry Matter) ADF | NDF | CP | P | K | Mg | Ca | Zn | Cu | GE |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | ppm | | Kcal/g |
| *Arachis hypogea* | 32.18 | 34.40 | 12.56 | 0.26 | 1.41 | 0.44 | 0.71 | 1.68 | 9.96 | 3.14 |
| *Zea mays* | 36.27 | 65.29 | 4.25 | 0.10 | 0.64 | 0.64 | 0.45 | 2.47 | 8.00 | 3.54 |
| *Pennisetum typhoides* | 37.36 | 54.82 | 4.50 | 0.12 | 0.69 | 0.69 | 0.47 | 3.18 | 11.06 | 3.57 |
| *Sorghum vulgare* | 38.61 | 56.31 | 2.56 | 0.14 | 0.72 | 0.72 | 0.48 | 4.00 | 10.98 | 2.66 |

***TABLE 2***

**Chemical composition of crop residues of some fodder in Funafuna-Kontagora in the dry season (February, 1990).**

| Fodder | (Dry Matter) ADF | NDF | CP | P | K | Mg | Ca | Zn | Cu | GE |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | ppm | | Kcal/g |
| *Arachis hypogea* (hay) | 36.18 | 37.50 | 9.50 | 0.22 | 0.98 | 0.53 | 0.62 | 1.22 | 3.00 | 3.12 |
| *Zea mays* (Stover) | 38.72 | 75.20 | 2.94 | 0.06 | 0.52 | 0.40 | 0.41 | 0.30 | 1.68 | 3.08 |
| *Pennisetum typhoides* | 39.63 | 68.00 | 3.94 | 0.10 | 0.59 | 0.30 | 0.43 | 0.42 | 3.42 | 3.19 |
| *Sorghum Vulgare* | 40.16 | 70.23 | 2.00 | 0.11 | 0.64 | 0.32 | 0.46 | 0.46 | 3.40 | 2.34 |

***TABLE 3***

**Chemical composition of some selected fodder crops of Shika-Zaria in the wet season (August, 1989).**

| Fodder | (Dry Matter) ADF | NDF | CP | P | K | Mg | Ca | Zn | Cu | GE |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | ppm | | Kcal/g |
| *Arachis hypogea* | 29.0 | 35.19 | 11.24 | 0.25 | 0.98 | 0.53 | 0.63 | 2.14 | 8.16 | 3.10 |
| Zea mays | 33.60 | 68.22 | 3.85 | 0.08 | 0.52 | 0.40 | 0.41 | 3.22 | 7.31 | 3.48 |
| Pennisetum typhoides | 31.00 | 57.00 | 4.64 | 0.13 | 0.59 | 0.30 | 0.45 | 4.08 | 10.36 | 3.36 |
| *Sorghum vulgare* | 36.00 | 58.13 | 2.37 | 0.12 | 0.64 | 0.32 | 0.49 | 5.64 | 8.17 | 2.19 |

***TABLE 4***

**Chemical composition of crop residues of some fodder in Shika-Zaria in the dry season (February, 1990).**

| Fodder | (Dry Matter) ADF | NDF | CP | P | K | Mg | Ca | Zn | Cu | GE |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | ppm | | Kcal/g |
| *A. hypogea* (hay) | 30.17 | 37.64 | 8.49 | 0.21 | 0.83 | 0.30 | 0.57 | 1.41 | 8.00 | 2.81 |
| *Z. mays* (hay) | 34.00 | 76.79 | 2.01 | 0.06 | 0.46 | 0.14 | 0.40 | 3.00 | 7.13 | 2.99 |
| *P. typhoides* (hay) | 35.18 | 68.92 | 3.46 | 0.10 | 0.49 | 0.20 | 0.42 | 3.09 | 9.23 | 3.03 |
| *S. vulgare* (hay) | 36.16 | 71.42 | 1.96 | 0.10 | 0.60 | 0.22 | 0.41 | 3.45 | 7.08 | 2.16 |

perchloric acids digestion procedure. Gross energy (GE) of the fodder crops was also estimated.

## Results and Discussions

The mineral and quality of the fodder crops analysed is presented in Tables 1 to 4.

**Crude protein:** Crude protein levels in the fodder crops were between 2.56 and 12.56% in the wet season and was found to be lower in the dry season at Funafuna (Tables 1 and 2); for all fodder analysed. Dry season values were between 2.0 and 9.5% for Funafuna areas; while in Shika it was between 2.37 and 11.34% in the wet season, and ranged from 1.96 to 8.49% in the dry season.

Based on the critical level of 10.88% (1.74% N) for ruminants (11), only groundnut fodder met the requirements for beef cow production in the wet season. However, in the dry season, protein level in the fodder did not meet animal requirements at both locations. Generally, protein contents of the fodder cereal crops were quite low.

Crude protein of the evaluated fodder and crop residues were higher in Funafuna situated in the wetter lower norther Guinea savanna of the zone than Shika (Tables 3 and 4), which is located in the drier fringes of the Northern Guinea savanna.

**Phosphorus:** Phosphorus content ranged from 0.10 to 0.26% (Table 1) and from 0.09 to 0.22% (Table 2) in Funafuna in the wet — and dry — season respectively. The range in Shika (Tables 3 and 4) was between 0.08 and 0.25%, and from 0.06 to 0.21% in the wet — and dry — season respectively. At both locations, P contents were found to decrease in the dry season for all fodder and residues analysed. Based on the critical value of 0.25% for cattle (3); 0.6% and 0.5% for sheep and goat (6.5-11 kg) respectively only groundnut fodder meet the P requirements of ruminants. However, based on (6) recommendation of 0.12%, millet and sorghum fodders were marginally adequate. But in the dry season, P requirements fell appreciably below the critical levels suggested by (2) and (6). Thus, dry season P supply to animals in this zone of these fodder crops are quite low and the need to supplement livestock diets with this element is imperative.

**Potassium:** The critical K requirements of beef cattle has been reported to be between 0.60 to 0.80% (11). K was found to be generally adequate in the fodder and crop residues to meet the requirements of beef cattle, lactating dairy cows, growing sheep and lactating dairy goats. K levels were found to decline with season in all materials and at both locations (Tables 1 to 4).

**Magnesium:** With respect to the critical level of 0.18% (11), Mg content was adequate in all the plant materials analysed. Groundnut fodder generally had the highest level of Mg, while other fodders had different levels at both locations and in the two seasons. Mg content was found to be lower in the dry season for all the fodder crops and residues.

**Calcium:** The critical level of Ca has been put at 0.30% (11). Calcium content was between 0.45 and 0.71% (wet season), and 0.41 and 0.62% in the dry season at Funafuna; while the range was between 0.41 to 0.63% (wet season) and 0.41 to 0.57% in the dry season at Shika. These ranges are adequate for beef cattle production in the tropics.

**Copper and Zinc:** Cu and Zn contents were very inadequate in the plants. The critical levels of Cu and Zn are 10 and 30 ppm respectively. Millet and sorghum were marginally adequate in Cu at Funafuna in the wet season (Table

1) and only millet was again marginally sufficient in Cu in the wet season (Table 3) at Shika. The need therefore to give salt licks containing these nutrients and other micro-nutrients cannot be overlooked in this zone.

**ADF and NDF:** NDF contents were higher than ADF levels in all the fodder crops. NDF content was lowest in groundnut fodder when compared to the cereals. NDF contents were lower in the wet — than dry — season, suggesting a higher digestibility value in the wet season. ADF contents were noted to be low; indicating low cell-wall contents, in the fodder, particularly in the wet season (Tables 2 and 4).

**GE:** Energy values of the fodder were between 2.66 kcal/g in sorghum fodder to 3.57 kcal/g in millet in the wet season at Funafuna-Kontagora while the range was between 2.34 and 3.19 kcal/g in the dry season at the same location. At Shika-Zaria, the GE was between 2.19 and 3.48 kcal/g in the wet season while it ranged from 2.16 to 3.03 kcal/g in the dry season.

## Conclusion

Crude protein and mineral compositions of the evaluated fodder and crop residues were noted to be generally below the critical levels necessary for ruminant livestock production in the tropics. Under these circumstances, the productivity of ruminants in the Nigeria Subhumid Zone (SHZ) is low as already indicated by Otchere (13); especially under traditional management.

The low dietary quality of fodder in the dry season indicates that maintenance requirements of livestock is not even met but at best only marginal levels may be supplied of these essential elements. Thus, the need to improve dry season nutrition of livestock in this zone becomes imperative. Dry season feed supplementation with concentrates or legumes such as *Stylosanthes spp* will improve the productivity of these animals. Besides, adequate feed conservation procedures during the wet season when there is usually abundant pastures of relative high quality against the dry season should be adopted. The provision of salt licks containing both macro-and-trace elements to grazing animals is quite invaluable in the agro-pastoral system of this zone.

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