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# SURVEY OF NUTRITIONALLY IMPORTANT MINERALS IN SOME WILD UNDERUTILIZED TROPICAL PLANT SEEDS

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## ABSTRACT

Potassium, Na, Mg, P, Ca, Zn, Fe, Mn and Cu contents of 17 wild underutilized plant seeds, which included 11 leguminosae and 6 miscellaneous seed groups are reported. *Prosopis africana*, *Daniellia ogea*, *Enterolobium cyclocarpium*, *Sesbania pachycarpa* and *Albizia zygia* had relatively high concentrations of essential minerals investigated. *P. africana* contained high concentrations of Mg (489 mg/100g) and P (659 mg/100g) while seeds of *Cupressus lustinica* and *Millettia thonningii* are high in Ca (1548 and 862 mg/100g respectively). When compared to the reference foods, cowpea, soybean and maize, several of the wild crop seeds had higher mineral concentrations and therefore would easily meet animal requirements.


**KEY WORDS**: nutrition, minerals, wild, underutilized, tropical, plant seeds

## INTRODUCTION

The tropical and sub-tropical regions of the world are richly endowed with plant genetic resources, housing an amazing wide genetic diversity. These plant resources, including especially the forests, provide a home for wild relatives of crops, some with useful characters (Ezeagu and Ologhobo 1995, Vietmeyer and Janick 1996, Nordeide *et al.* 1996). The shortages of and high price paid for conventional edible sources have stimulated nutritional and economic feasibility studies of these minor crops. Species of seed crops, which had formed, to a certain extent, part of the human food chain in ancient times are presently attracting research attention. Many of such crops have been identified but data on their chemical and nutrient composition are scarcely available which limits their possible utilization in food or feed. Availability of data on the biochemical characteristics of such wild and unfamiliar plants could make way for their use in at least animal feed and thus spare more of the conventional food articles for human consumption. This is especially more important in the sub-Saharan Africa where serious food shortages due to population growth have been widely reported (FAO 2002).

The dietary sources of micronutrients such as meat, liver and cereals are becoming expensive and out of the reach of the poorest in the society. It is therefore necessary to identify less expensive food sources of plant origin that have high micronutrients value for promotion and research attention (Ogunsanya and Ezeagu, 2004). Quite some data already exists on the protein and energy contents of many underutilized crops and not much on the inorganic elements appears to be available. Therefore, as part of the continuing search for new food resources, this study seeks to evaluate the content of micro and macro minerals in some uncultivated and wild gathered tropical plant seeds previously described (Ezeagu *et al.* 2002; Petzke *et al.* 1997)

## MATERIALS AND METHODS

About 2 kg of the matured fruits of the following crops, *Afzelia bella*, *Albizia zygia*, *Prosopis africana*, *Enterolobium cyclocarpum*, *Gliricidia sepium*, *Millettia thonningii*, *Lonchocarpus sericeus*, *Pterocarpus osun*, *Daniellia ogea*, *Leucaena leucocephala*, *Sesbania pachycarpa*, *Diospyros mespiliformis* and *Etandraphragma angolense* were harvested from the ICRAF-IITA Arboretum, International Institute of Tropical Agriculture, Ibadan, Nigeria, and the seeds were manually separated from the pods. *Cochlospermum vitifolium*, *Khaya senegalensis*, *Cupressus lindleyi* and *Cupressus lustinica* seeds were collected from the Forestry Research Institute of Nigeria, Ibadan. The seeds were ground to flour using a Wiley Mill with the 1 mm mesh sieve and stored in plastic bags at -4° C until analysis. Micro- and macro-minerals were determined by standard wet digestion method (AOAC, 1990) using an atomic absorption spectrophotometer (Perkin Elmer Model 305B). Phosphorus was determined colorimetrically by the phosphovanado-molybdate method (AOAC, 1990). All analysis was done in duplicate and results compared with common staples.

## RESULTS AND DISCUSSION

Table 1 summarizes the micro- and macro mineral contents of the plant seeds expressed in mg/100g dry matter. Wide variation in mineral contents was found to occur. The most abundant macro mineral is K (375-1875 mg/100g). *A. digitata*, *P. Africana*, *D. mespiliformis*, *E. cyclocarpium*, *G. sepium* and *P. osun* are particularly high in K (922.7-1429.0 mg/100g) and indicates them as potential good sources of this mineral. Intake of these seeds especially the legumes could provide sufficient potassium to meet the needs of man and farm animals. Magnesium, Ca and P also occur in appreciably high amounts in *A. zygia*, *A. bella*, *M. thonningii* and *S. pachycarpa*. Levels of micro minerals, as expected, were low especially Fe, Zn, Cu and Mn. Calcium contents ranged from 89.0 in *E. cyclocarpium* to 862.0 mg/100g in *M. thonningii*. Phosphorus varied between 244.6 in *M. thonningii* and 659.0mg/100g in *P. Africana*. Among the legumes the general averages for Na, K, Ca, Mg and P are 190.74, 902,53, 406.10, 224.11 and 408.92 mg/100g respectively. Except for the low Ca level in *E. cyclocarpium* (89.0 mg/100g), the macro mineral element contents in these uncultivated seeds are generally higher than their respective levels in soybean and other common staples (Udoessien and Aremu 1991). Maize is reported to contain 280.0, 200.0, 130.0, 270.0 and 10.0 mg/100g of K, Ca, Mg, P and Na respectively, while soybean contains 192.0, 260.0, 320.0, 750.0 and 10.0 mg/100g respectively of same elements (FAO 1982). Sodium levels among the legumes varied between 103.0 in *M. thonningii* and 252.6 mg/100g in *S. pachycarpa* with a mean value of 190.74 mg/100g. The low levels of sodium were in accordance with the observation of Chamberlain (1965), that tropical crops carry subnormal concentration of sodium.

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Table 1. Mineral contents of wild gathered seed crops (mg/100gDM)[1]

| Species | Na | K | Ca | Mg | P | Fe | Zn | Cu | Mn |
|---|---|---|---|---|---|---|---|---|---|
| Leguminosae: | | | | | | | | | |
| ***Albizia zygia*** | 195.00 | 1109.00 | 560.00 | 232.00 | 255.0 | 12.23 | 4.84 | 0.87 | 3.27 |
| ***Afzelia bella*** | 175.30 | 733.94 | 307.06 | 223.78 | 368.00 | 9.40 | 2.56 | 0.92 | 1.10 |
| ***Daniellia ogea*** | 133.90 | 565.50 | 342.52 | 150.05 | 297.50 | 12.69 | 1.77 | 0.49 | 1.17 |
| ***Enterolobium cyclocarpium*** | 220.80 | 1036.30 | 89.00 | 158.60 | 542.80 | 4.68 | 3.00 | 0.80 | 2.37 |
| ***Gliricidia sepium*** | 201.00 | 987.00 | 421.00 | 145.00 | 584.71 | 14.28 | 1.90 | 0.95 | 2.50 |
| ***Leucaena leucocephala*** | 250.00 | 1000.00 | 125.00 | 150.00 | 125.00 | 32.00 | 5.80 | 0.00 | ND |
| ***Lonchocarpus sericeus*** | 132.00 | 800.00 | 455.00 | 175.00 | 309.50 | 11.16 | 6.61 | 1.32 | 5.30 |
| ***Millettia thonningii*** | 103.00 | 406.00 | 862.00 | 202.00 | 244.66 | 24.58 | 3.59 | 1.12 | 2.17 |
| ***Pterocarpus osun*** | 224.53 | 922.70 | 537.10 | 299.30 | 483.60 | 8.94 | 4.49 | 4.00 | 8.82 |
| ***Prosopis africana*** | 210.00 | 1275.00 | 336.00 | 489.00 | 659.00 | 6.72 | 10.16 | 3.10 | 20.17 |
| ***Sesbania pachycarpa*** | 252.64 | 1092.37 | 432.40 | 240.50 | 628.30 | 11.74 | 5.67 | 1.76 | 4.57 |
| Mean±SD | **190.74 ± 49.50** | **902.53 ±255.23** | **406.10 212.21** | **224.11 ±100.29** | **408.92 ±178.98** | **13.49 ±7.99** | **4.58 ±2.46** | **1.39 ±1.17** | **5.14 ±5.76** |
| [2]Non-leguminosaea: | | | | | | | | | |
| ***Cochlospermum vitifolium*** *(Cochlospermaceae)* | 63.00 | 1875.00 | 125.00 | 244.00 | 225.00 | 76.00 | 11.75 | 12.70 | ND |
| ***Cupressus lindleyi*** *(Cupressaceae)* | 250.00 | 375.00 | 125.00 | 65.00 | 310.00 | 9.80 | 19.50 | 8.25 | ND |
| ***Cupressus lustinica*** *(Cupressaceae)* | 188.00 | 500.00 | 1548.00 | 112.00 | 480.00 | 17.00 | 18.00 | 7.25 | ND |
| ***Etandraphragma angolense*** *(Meliaceae)* | 113.00 | 596.00 | 662.00 | 273.00 | 321.90 | 7.46 | 5.04 | 1.20 | 0.82 |
| ***Diospyros mespiliformis*** *(Ebenaceae)* | 250.30 | 1197.10 | 174.00 | 195.30 | 420.50 | 10.26 | 2.94 | 0.37 | 2.21 |
| ***Khaya senegalensis*** *(Meliaceae)* | 563.00 | 1000.00 | 125.00 | 200.00 | 198.00 | 33.00 | 4.50 | 11.25 | ND |
| ***Cowpea**** | 20 | 96 | 130 | NA | 430 | NA | NA | NA | NA |
| ***Soybean**** | 10 | 192.0 | 260.0 | 320.0 | 750.0 | NA | NA | NA | NA |
| ***Maize**** | 0.00 | 280 | 200 | 130 | 270 | NA | NA | NA | NA |

[1]Means of two independent determinations, [2]Words in parenthesis indicates family names
ND: Not Determined, NA: Not Available, *FAO (1982)

Madubuike *et al.* (1994) reported Ca contents of 500.0mg/100g for *Afzelia africana* seeds, which is higher than 307.06mg/100g obtained for the *Afzelia* spp in this study, but compares well to Ca levels recorded for *L. sericeus, M. thonningii, P. osun* and *E. angolensis* in this study. Gokhu seeds are reported to contain as much as 911 mg/100g of P, 417 of Ca, 643 mg/100g of Mg, 1591.4 mg/100g of K and 647.2mg/100g Na (Udayasekhara Rao, 1994; Al-Wandawi, 1983), which are in good agreement with levels obtained for most of the plant seeds in this study. Several other literature reports seem to indicate that uncultivated wild plants contain higher levels of mineral than most agricultural crops (Badifu, 1993; Badifu and Ogunsua, 1991). For example, Oyenuga (1968) reported 75.0 mg/100g Ca and 380 mg/100g P for groundnut, and 90.0mg/100g Ca and 451 mg/100g P for cowpea, which are lower than values recorded in this study. Bressani and Elias (1974) also reported that edible legumes contain 10.0mg/100g and 300 mg/100g of Ca and P respectively. Generally many plant materials are not good sources of Ca and P (Mba *et al.*, 1974), though the values reported for soybean (260 and 750 mg/100g respectively) are close to levels observed *in A. digitata, P. africana and A. bella* seeds. This clearly indicates that the uncultivated plant seeds in this study, with high levels of Ca (89.0 –862 mg/100g) and P (244.6-659.0 mg/100g), could be good sources of these minerals and will easily satisfy animal needs assuming they occur in readily available forms.

Magnesium contents, which ranged from 145.0 in *G. sepium* to 489.0 mg/100g in *P. africana*, are comparable to values ranging between 260.0 and 364.0 mg/100g reported for similar uncultivated plant seeds of *A. pavonina, Parkia biglobosa, Tetrapleura tetraptera, Cassia siebberiana, Acacia leucocephela, Colocynthis citrullus and Citrullus vulgaris* (Balogun and Fetuga, 1986; Vijayakumari *et al.*, 1994; Badifu, 1993). Eromosele *et al.* (1994) however, recorded higher range of values (3,160 - 11,720 mg/100g) for several other uncultivated plant seeds. These reports again seem to indicate that many wild plants could be very rich in minerals.

Zinc contents varied between 1.77 in *D. ogea* and 19.50mg/100g in *C. lindleyi*. Equally low levels 5.78-13.7 and 1.1-7.8 mg/100g reported respectively for okra seeds and some less familiar oil seeds are comparable to the range of Zn values in this study (Savello, 1980; Udayasekhara Rao, 1994). Zinc level in *P. africana* (10.16mg/100g) is similar to the value of 9.00mg/00g reported by Balogun and Fetuga (1986) but their value for *P. osun* (10.0mg/100g) differed from 4.50 mg/1100g obtained in this study for the same specie. Manganese contents, ranging from 0.82 in *E. angolense* to 20.17 mg/100g in *P. africana*, are comparable to levels reported for other plant protein sources. With the exception of *P. africana*, all the plant seeds contain less than 10.0mg/100g of Mn. Levels lower than 10mg/100g are generally reported for most plant seeds (Savello, 1980; Badifu and Ogunsua, 1991; Badifu, 1993). Iron varied between 6.72 in *P. africana* and 25.58mg/100g in *M. thonningii*, with the mean for the legumes as 13.49mg/100g. Iron contents are all higher than the range of 2.0-7.0mg/100g reported for groundnut, soybean, cowpea and maize and some less known pulses (3.40-3.60mg/100g), but compares fairly well to levels reported for okra seeds (7.30-9.80 mg/100g) (Oyenuga, 1968; Al-Wandawi, 1983; Mohan and Janardhanan, 1994). Higher Fe levels (27.0-81.0 mg/100g) were reported for some seeds of under-exploited plants by Balogun and Fetuga (1986). Copper contents in the seeds are low and ranged between 0.00mg/100g in *L. leucocephala* and 4.0mg/100g in *P. osun*. Copper is usually not detected in most seeds (Eromosele et al., 1994; Ezeagu and Ologhobo, 1995) but results obtained in this study are similar to levels reported for *Bauhizia malabarica* (5.19mg/100g), pulses 0.4-0.6 mg/100g) and some less familiar oil seeds (0.5-5.7mg/100g) (Vijayakumari *et al.* 1993; Udayasekhara Rao, 1994; Mohan and Janardhanan, 1994).

These underutilized plant seeds appear to be good sources of essential minerals and will easily satisfy animal needs without any need for inorganic supplementation, which is in close agreement with the observations and conclusions of Pant and Bishnoi (1984) and Smith *et al.* (1996) on mineral values of uncultivated plants. Zinc, Ca, Fe and Mg levels reported in this study are higher than the requirement for various classes of animals (Miller *et al.* 1962). However, it is worthy to note that the availability of divalent minerals and phosphorus have been shown to be affected by the presence in seeds of metal binding constituents such as tannin, phytate and oxalic acid. These antinutrients are known to chelate elements and make them unavailable (Rackis and Anderson, 1977, Pawar and Ingle, 1988). Therefore further study may be required to ascertain the level of antinutrients and mineral availability before recommendations.

## CONCLUSIONS

These underutilized plant seeds in this study appears to be good sources of essential minerals and will make good supplements in animal feed or food. When compared to the reference foods, cowpea, soybean and maize, several of the wild crop seeds have higher mineral concentrations and therefore would easily meet animal requirements.

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