# Research Journal of
# Phytochemistry

ISSN 1819-3471

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Phytochemistry 4 (3): 194-200, 2010
ISSN 1819-3471 / DOI: 10.3923/rjphyto.2007.33.39
© 2010 Academic Journals Inc.

# Phytochemical Screnning and Mineral Contents of Leaves of Some Nigerian Woody Plants*

Francis Olawale Abulude
Department of General Studies, Federal College of Agriculture,
Akure 340001, Ondo State, Nigeria

**Abstract:** In this study, leaves of woody plants (2-4 species) obtained in Nigeria between November and December 2001 was evaluated for their phytochemical and mineral contents using standard methods. To determine minerals, 0.5 g of each samples were dry ashed, dissolved in distilled water with few drops of conc. HCl and read on an atomic absorption spectrophotometer. Phytate and phytate P were analyzed by first extracting the samples followed by titrating with $FeCl_3$, the values obtained were multiplied with standard factors (1.95 and 3.56, respectively) and qualitative methods were used for other tests. The study revealed presence of alkaloids, tannins, resins, saponins, flavonoids, glycosides, carbohydrate, sterols and flobatanin in most of the samples. The levels of phytate (mean = 692, SD = 212, CV% = 30.7) and phytate phosphorous (mean = 188, SD = 51, CV% = 27.4) were generally high and all leaves had more than 30% of their total phosphorus linked to phytate. These results compared with literature values. The concentrations of the mineral were found to be high. The result showed that with high phytate contents the bioavailability of minerals might be relatively low.

**Key words:** Phytochemical, phytate, mineral composition, therapeutic compositions, bioavailability

## INTRODUCTION

Woody plants have been of wise use in Nigeria. They have contributed to sustainable development and benefit to many people especially the poor, who depend on these for their livelihoods. There are about 900 different kinds of trees in Nigeria, some are easily recognized but many can ouly be named with certainty when flowers or fruit as well as leaves, are available (Aju and Popoola, 2005). Fruits, barks and leaves, body are appreciated, not ouly for texture and flavor, but also for their chemical and nutritional properties (Abulude *et al*., 2004).

The woody plants are versatile material plants having a wide range of local therapeutic applications. The leaves, roots, barks and seeds are found to be active antipyretic laxative, analgesic, antifungal, antibacterial and anti-inflammatory (Faruq, 2004; Olafimihan *et al*., 2004; Hassan *et al*., 2004; Ogukwe *et al*., 2004). Some of the woody plants have also been reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolamia and cancer (Lexicon, 1983). Fragrant gum resins obtained from some of them are sometimes used as fumigants (Hassan *et al*., 2004). These functional characteristics are maiuly due to the presence of phytochemicals. Despite the extensive use of these woody plants, reports on detailed phytochemical investigation are scanty. Out of many potent phytochemicals, tannin, glycosides, saponin, sterol, resin, flobatannins, flavonoids, alkaloids and phytate were initially chosen for this research.

The aim of this research was to extend knowledge on mineral and phytochemical qnalities of woody plant leaves. It is hoped that the results would add to composition table.

*Originally Published in Research Journal of Phytochemistry, 2007*

## MATERIALS AND METHODS

The different varieties (2-4 species) of wood plant leaves were obtained from the Federal College of Agriculture Campus in Akure, Ondo State, Nigeria between November and December, 2004, identified and labeled (Irvine, 1961). The samples under investigation are shown in Table 1.

### Experimental

One hundred gram of the leaves were washed with distilled water, oven dried at 60°C for 6 h, then finely ground, sieved (2 mm sieve), mixed thoroughly, stored in plastic containers and kept in ambient temperature prior analysis.

### Mineral Analysis

Total phosphorus (P) was analyzed from solutions obtained by first dry-ashing 0.6 g of the samples at 550°C to constant weight and dissolving the ash in volumetric flasks using distilled water with a few drops of concentrated HCl. Phosphovanadomolybdate method was used for the determination (AOAC, 1990). A Perkin Elmer atomic absorption spectrophotometer was used for the determination of Ca, K, Na and Mg.

### Phytate Analysis

Four grams of ground sample was soaked in 100 $cm^3$ of 2% HCl for 3 h and then filtered through two layers of filter paper 25 $cm^3$ of the filtrate was placed in a 250 $cm^3$ conical flask and 5 $cm^3$ of 0.3% $NH_4SCN$ solution was added as an indicator, 53.5 $cm^3$ of distilled water was then added to reach the proper acidity. This mixture was titrated against $FeCl_3$ solution, which contains about 0.00195 g of Fe iron per $cm^3$ of $FeCl_3$ solution. The result was multiphed by factor 1.95 to obtain phytate P. phytate P result was multiphed by factor 3.55 to convent to phytate.

Table 1: Common, scientific, family and vernacular names of the investigated woody plants

| Code | Common name | Scientific name | Family name | Vernacular name |
|---|---|---|---|---|
| WP 1 | Christmas Bush | *Alchornea cordifolia* | Euphorbiaceae | - |
| WP 2 | Gliricidia | *Giliricidia sepium* | Papilionaceae | Agunmaniye |
| WP 3 | Hop bush | *Dodonaea viscosa* | Sapindaceae | - |
| WP 4 | Neem | *Azadirachta indica* | Meliaceae | Dongoyaro |
| WP 5 | Mango | *Mangefera indica* | Anacardiaceae | Mangoro |
| WP 6 | Cashew | *Anacardium occidentale* | Anacardiaceae | Kaju |
| WP 7 | Hog plum | *Spondias monbin* | Anacardiaceae | Iyeye |
| WP 8 | Teak | *Tectona grandis* | Verbenaceae | - |
| WP 9 | Indian almond | *Prunus amygdalus* | Rosaceae | - |
| WP 10 | Arabia coffee | *Coffea arabica* | Rubiaceae | - |
| WP 11 | Wild mango | *Irvingia gaboneusis* | Irvingiaceae | Oro |
| WP 12 | Kolanut | *Cola nitida* | Struculiaceae | Obi |
| WP 13 | Pear | *Persea Americana* | Lauraceae | - |
| WP 14 | Rubber | *Hevea brascileusis* | Euphorbiaceae | - |
| WP 15 | Pawpaw | *Carica papaya* | Caricaceae | Ibepe |
| WP 16 | Grape | *Citrus paradise* | Rutaceae | Osan |
| WP 17 | Abbe walker | *Dracaena fragrans* | Agaraceae | Peregun |
| WP 18 | Fig | *Ficus capensis* | Moraceae | Opoto |
| WP 19 | _ | *Bombax buonoposcence* | Bombacaceae | Poporo |
| WP 20 | African teak | *Chlorophora excelsa* | Moraceae | Iroko |
| WP 21 | Tallow tree | *Detarium microcarpum* | Gaesalpinaceae | - |
| WP 22 | Lemon-Scented gum | *Encalyptus citriodora* | Myrtaceae | - |
| WP 23 | Sand paper | *Ficus asperifoloa* | Moraceae | Epinpin |
| WP 24 | Sour sop | *Aumona muricata* | Annonnaceae | - |
| WP 25 | Alee apple | *Blighia sapoda* | Sapindaceae | - |
| WP 26 | Ringworm shrub | *Cassia alata* | Caesalphinaceae | - |
| WP 27 | White star apple | *Chysophyllum albidum* | Sapotaceae | Agbalumo |
| WP 28 | White butter | *Butyrospermum parkii* | Sapotaceae | Ori |

[A] Vernacular-Yoruba name

**Phytochemical Analysis**

**Extraction**

One hundred and fifty centiliter of water was added to 20 g of ground sample in a conical flask. The mixture was covered and allowed to stand for 3 h with occasional stirring. The mixture was filtered with a whatman No. 2 filter paper. The filtrate was stored in plastic containers and kept in ambient temperature prior to analyses (Abulude, 2001).

**Test for Carbohydrate**

**Fehling's Test**

5 $cm^3$ of mixture of equal volumes of Fehlings A and B was added to 2 $cm^3$ of each extract in a test tube. The resultant mixture was boiled for 2 min. A brick red precipitation of copper oxide was observed.

**Test for Tannins**

Two drops of 5% $FeCl_3$ was added to 1 $cm^3$ of extract. A dirty-green precipitate was observed in each extract.

**Test for Glycosides**

10 $cm^3$ of 50% $H_2SO_4$ was added to 1 $cm^3$ of each extract in a test tube. The mixture was heated in boiling water for 5 min. 10 $cm^3$ of Fehlings solution (5 $cm^3$of each solution A and B) was added and boiled. A brick red precipitate indicating presence of glycosides was observed.

**Tests for Saponins**

**Frothing Test**

2 $cm^3$ of each extract in a test tube was vigorously shaken for 2 min. Frothing indicating presence of saponin was noted.

**Test for Resins**

5 $cm^3$ of copper was added to 5 $cm^3$ of each extract. The resulting solution was shaken vigorously and allowed to separate. A green colored precipitate indicating presence of resin was noticed.

**Test for Phlobatanins**

5 $cm^3$ of distilled water was added to 5 $cm^3$ of each extract and boiled with 5 $cm^3$ of 1% HCl for 2 min. No visible reaction was obtained indicting absence of phlobatanins.

**Test for Flavonoids**

2 $cm^3$ of extract was heated with 10 $cm^3$ of ethyl acetate on a water bath and cooled. The layers were allowed to separate and the color of the $NH_3$ layer noted (red coloration formed).

**Test for Alkaloids**

1 $cm^3$ of 1% HCl was added to 3 $cm^3$ of each extract in a test tube. Each extract was treated with few drop of Meyer's reagent. A creamy white precipitate was observed indicating presence of alkaloids.

## RESULTS

Table 2 shows total P; phytate P, phytate, phytate P expressed as percentage of total P. Phytate content ranged from 391-1108 mg 100 $g^{-1}$ DM. Total P was the highest in neem leaves and lowest in

Table 2: Total phosphorus (P), phytate P, phytate (mg100 $g^{-1}$ DM) and phytate P (as % of total P) in the woody plant leaves examined

| Code | Samples | Total P (mg100 $g^{-1}$) | Phytate P (mg100 $g^{-1}$) | Phytate (mg100 $g^{-1}$) | Phytate P (as % of total P) |
|---|---|---|---|---|---|
| WP 1 | *Alchornea cordifolia* | 250.0 | 110.0 | 391.0 | 44.0 |
| WP 2 | *Gliricidia sepium* | 290.0 | 240.0 | 852.0 | 83.0 |
| WP 3 | *Dodonaea viscose* | 320.0 | 160.0 | 568.0 | 50.0 |
| WP 4 | *Azadirachta indica* | 450.0 | 210.0 | 746.0 | 47.0 |
| WP 5 | *Mangefera indica* | 297.0 | 125.0 | 444.0 | 42.0 |
| WP 6 | *Anacardium occidentale* | 310.0 | 110.0 | 391.0 | 36.0 |
| WP 7 | *Spondias monbin* | 218.0 | 121.0 | 430.0 | 56.0 |
| WP 8 | *Tectona grandis* | 314.0 | 135.0 | 479.0 | 43.0 |
| WP 9 | *Prunus amygdalus* | 291.0 | 114.0 | 405.0 | 39.0 |
| WP 10 | *Coffee arabica* | 315.0 | 215.0 | 763.0 | 68.0 |
| WP 11 | *Irvingia gaboneusis* | 420.0 | 200.0 | 710.0 | 48.0 |
| WP 12 | *Cola nitida* | 410.0 | 270.0 | 959.0 | 66.0 |
| WP 13 | *Persea americana* | 325.0 | 240.0 | 852.0 | 74.0 |
| WP 14 | *Hevea brasiliensis* | 285.0 | 200.0 | 1065.0 | 70.0 |
| WP 15 | *Carica papaya* | 217.0 | 212.0 | 1108.0 | 98.0 |
| WP 16 | *Citrus paradise* | 225.0 | 190.0 | 675.0 | 84.0 |
| WP 17 | *Dracaena fragrans* | 330.0 | 182.0 | 646.0 | 55.0 |
| WP 18 | *Ficus capensis* | 360.0 | 310.0 | 1101.0 | 86.0 |
| WP 19 | *Bombax buonoposcence* | 410.0 | 240.0 | 852.0 | 59.0 |
| WP 20 | *Chlorophora excelsa* | 310.0 | 245.0 | 870.0 | 79.0 |
| WP 21 | *Detarium microcarpum* | 321.0 | 128.0 | 454.0 | 40.0 |
| WP 22 | *Encalyptus citriodora* | 245.0 | 135.0 | 479.0 | 55.0 |
| WP 23 | *Ficus asperifolia* | 336.0 | 164.0 | 582.0 | 49.0 |
| WP 24 | *Annona maricata* | 218.0 | 182.0 | 646.0 | 84.0 |
| WP 25 | *Blighia sapida* | 328.0 | 210.0 | 746.0 | 64.0 |
| WP 26 | *Cassia alata* | 323.0 | 210.0 | 746.0 | 65.0 |
| WP 27 | *Chrysophyllum albidium* | 278.0 | 176.0 | 625.0 | 63.0 |
| WP 28 | *Butyrospermum parkii* | 252.0 | 221.0 | 785.0 | 88.0 |
| | X | 309.0 | 188.0 | 692.0 | 62.0 |
| | ±SD | 61.0 | 51.0 | 212.0 | 17.0 |
| | CV (%) | 19.6 | 27.4 | 30.7 | 27.6 |

Table 3: Phytochemical analysis of the woody plant leaves examined

| Label | Sample | Carbo-hydrate | Tannins | Glyco-sides | Sapon nins | Sterols | Resins | Flobat-anin | Flavo-noids | Alkaloids |
|---|---|---|---|---|---|---|---|---|---|---|
| WP 1 | *Alchornea cordifolia* | + | + | - | + | + | + | - | + | + |
| WP 2 | *Gliricidia sepium* | + | + | + | + | + | + | - | + | + |
| Wp 3 | *Dodonaea viscose* | + | + | + | + | + | + | - | + | + |
| WP 4 | *Azadirachta indica* | + | + | + | + | + | + | - | + | + |
| WP 5 | *Mangefera indica* | + | + | + | + | + | + | - | + | + |
| WP 6 | *Anacardium occidentale* | + | + | + | + | + | + | - | + | + |
| WP 7 | *Spondias monbin* | + | + | + | - | + | + | - | + | + |
| WP 8 | *Tectona grandis* | + | + | + | + | + | + | - | + | + |
| WP 9 | *Prunus amygdalus* | + | + | - | + | + | + | - | + | + |
| WP 10 | *Coffee arabica* | + | + | + | + | + | - | - | + | + |
| WP 11 | *Irvingia gaboneusis* | + | + | + | + | + | + | - | + | + |
| WP 12 | *Cola nitida* | + | + | - | + | + | + | - | + | + |
| WP 13 | *Persea anenricana* | + | + | + | + | + | + | - | + | + |
| WP 14 | *Hevea brasiliensis* | + | + | - | + | + | + | - | + | + |
| WP 15 | *Carica papaya* | + | + | + | + | + | + | - | + | + |
| WP 16 | *Citrus paradisi* | + | + | + | + | + | + | - | + | + |
| WP 17 | *Dracaena fragrans* | + | + | - | + | + | - | - | + | + |
| WP 18 | *Ficus capensis* | + | + | - | + | + | + | - | + | + |
| WP 19 | *Bombax buonoposcence* | + | + | + | - | + | + | - | + | + |
| WP 20 | *Chlorophora excelsa* | + | + | + | + | + | + | - | + | + |
| WP 21 | *Detarium microcarpum* | + | + | + | + | + | + | - | + | + |
| WP 22 | *Encalyptus citriodora* | + | + | + | + | + | + | - | + | + |
| WP 23 | *Ficus asperifolia* | + | + | + | + | + | + | - | + | + |
| WP 24 | *Annona mnricata* | + | + | - | - | + | + | - | + | + |
| WP 25 | *Blighia sapide* | + | + | + | + | + | + | - | + | + |
| WP 26 | *Cassia alata* | + | + | + | + | + | + | - | + | + |
| WP 27 | *Chrysophyllum albidun* | + | + | + | + | + | + | - | + | + |
| WP 28 | *Butyrospermum parkii* | + | + | + | + | + | + | - | + | + |

+ Present, - Absent

Table 4: Mineral composition in leaves investigated (mg100 $g^{-1}$ DM)

| Label | Sample | Ca | Na | K | Mg |
|---|---|---|---|---|---|
| WP 1 | *Alchornea cordifolia* | 600 | 75 | 672 | 199 |
| WP 2 | *Gliricidia sepium* | 420 | 45 | 717 | 74 |
| WP 3 | *Dodonaea viscose* | 513 | 125 | 625 | 92 |
| WP 4 | *Azadirachta indica* | 768 | 183 | 425 | 93 |
| WP 5 | *Mangefera indica* | 460 | 247 | 470 | 82 |
| WP 6 | *Anacardium occidentale* | 815 | 158 | 620 | 120 |
| WP 7 | *Spondias monbin* | 358 | 80 | 525 | 134 |
| WP 8 | *Tectone grandis* | 620 | 112 | 473 | 98 |
| WP 9 | *Prunus amygdalus* | 680 | 118 | 327 | 110 |
| WP 10 | *Coffea arabica* | 490 | 80 | 490 | 120 |
| WP 11 | *Irvingia gaboneusis* | 754 | 95 | 972 | 79 |
| WP 12 | *Cola nitida* | 800 | 76 | 812 | 82 |
| WP 13 | *Persea Americana* | 752 | 221 | 621 | 91 |
| WP 14 | *Itevea brasilieusis* | 727 | 125 | 561 | 94 |
| WP 15 | *Carica papaya* | 681 | 232 | 655 | 191 |
| WP 16 | *Citrus paradisi* | 625 | 242 | 472 | 120 |
| WP 17 | *Dracaena fragrans* | 481 | 252 | 724 | 80 |
| WP 18 | *Ficus capensis* | 567 | 189 | 625 | 140 |
| WP 19 | *Bombax buonoposcence* | 888 | 88 | 754 | 170 |
| WP 20 | *Chlorophora excelsa* | 479 | 70 | 785 | 120 |
| WP 21 | *Detarium microcarpum* | 450 | 68 | 777 | 116 |
| WP 22 | *Encalyptus citriodora* | 410 | 99 | 625 | 118 |
| WP 23 | *Fiscus asperifolia* | 624 | 121 | 872 | 147 |
| WP 24 | *Annona muricata* | 578 | 100 | 612 | 152 |
| WP 25 | *Blighia sapida* | 574 | 97 | 525 | 89 |
| WP 26 | *Cassia alata* | 620 | 135 | 621 | 143 |
| WP 27 | *Chrysophyllum albidum* | 717 | 148 | 348 | 127 |
| WP 28 | *Butyrospermum parkii* | 824 | 193 | 562 | 184 |
| | X | 617 | 746 | 617 | 120 |
| | ±SD | 140 | 78 | 150 | 35 |
| | CV (%) | 23 | 53 | 24 | 29 |

pawpaw leaves. Phytate P expressed as percentage of total P ranged between 36% (*Anacardium occidentale*) and 98% (*Carica papaya*). Coefficient of variation in percent (CV%) of all the results were high among the samples with total P being the least (20%) while phytate (31%) showed the highest variation.

The results in Table 3 showed that carbohydrate, alkaloids, glycosides, sterols, saponins, flavonones, tannin and resin were present in most of the extracts of leaves examined. Phlobatanins was absent.

All the minerals were highly concentrated. Calcium, potassium and sodium were highly concentrated with means (mg 100 $g^{-1}$) of 617 (SD = 140, CV = 23%), 617 (SD = 150, CV = 24%) and 746 (SD = 78, CV = 53%), respectively (Table 4).

## DISCUSSION

The values of total P, phytate P, phytate, phytate P expressed as percentage of total P were higher than those reported for some varieties of mushrooms (Abulude *et al*., 2001) and some foods of major consumption in Nigeria (Adeyeye *et al*., 2000). Levels of phytate were comparable to levels reported for vegetables (Abulude, 2001) and varieties of lupin seeds (Trugo *et al*., 1993). Phytate contents vary considerably depending on the environmental conditions, maturation and processing procedures (Griffiths and Thomas, 1981). Phytate chelates with mineral elements thereby have significant effects on the utilization of the minerals and also interfere with basic residues of proteins. Phytate has been shown to play a role in preventing colorectal carcinoma, hyperchlolesterolaemia and renal calculi (Marounek *et al*., 2000). Phosphorus assists calcinm in many body reactions although it

also has its own independent functions (Fleck, 1976). Calcium in conjunction with phosphorus, magnesium, manganese, vitamins A, C and D, chlorine and proteins are all involved in bone formation. Results of Phytate P expressed as percentage of total P were consistent with earlier results on lesser-known leguminous crops seeds (Balogun and Fetuga, 1989). Coefficients of variation of the parameters were not similarly distributed in all it samples.

Results of the phytochemical analyses compared well with literatures (Hassan *et al*., 2004; Faruq *et al*., 2004; Olafimihan, 2004). The classes of compounds are known to show curative activity against several pathogens and is therefore not surprising that the plant leaves extracts are used traditionally as an analgesic, antimicrobial and soothing herbs (Hassan *et al*., 2004). It is documented that presence of saponins can control human cardiovascular disease and reduce blood cholesterol. Tannins may provide protection against microbial degradation of dietary proteins in the rumen (Aletor, 1993).

The results recorded in this research were in total agreement with results obtained by Abulude *et al*. (2001) for mushrooms. Despite the fact that there is no recommended dietary allowance for potassium and sodium, it is recommended that the intake should be the same to counteract the effect of sodium in raising blood pressure. The leaves may serve as good supplements in the body supply of calcium, magnesium, potassium and sodium. Calcium is important in blood clotting, muscles contraction and in certain enzymes metabolic processes. It is very important that the normal calcium level in the diet should be balanced throughout life. Magnesium is an activator of many enzyme systems and maintains the electrical potential in nerves. Sodium and potassium are required to maintain osmotic balance of the body fluid, the pH of the body, regulate muscle and nerve irritability and control of glucose absorption.

The nutritive values of the leaves were high, since they were rich in mineral elements, efforts to reduce their loss through processing should be ensured. The mineral bioavailability may be low due to high phytate contents. The results obtained for the identified phytochemical compounds showed the therapeutic compositions of the leaves.

## ACKNOWLEDGMENTS

The author is grateful to E. Ogundele and A. Adebisi of Horticulture and Landscape Design Department, Federal College of Agriculture, Akure, Nigeria for the identification of the leaves. Also the technical contributions of M. Oladimeji, M. Gabriel and B. Adeyeye of the above College are acknowledged.

## REFERENCES

Abulude, F.O., 2001. Mineral and phytate contents of 10 vegetables grown in Nigeria and calculation of their phytate: Zn and Ca: Phytate molar ratios Adv. Food Sci., 23: 36-39.

Abulude, F.O., C. Akajagbor and B.H. Dafiehware, 2001. Distribution of trace minerals, phosphorus and phytate in some varieties of mushrooms found in Nigeria. Adv. Food Sci., 23: 113-116.

Abulude, F.O., V.O. Onibon and F. Oluwatoba, 2004. Nutritional and nutritional compositions of some tree barks. Nig. J. Basic Applied Sci., 13: 43-49.

Adeyeye, E.I., L.A. Arogundade, E.T. Akintayo, O.A. Aisida and P.A. Alao, 2000. Calcium, zinc and phytate interrelationships in some foods of major consumption in Nigeria. Food Chem., 71: 435-441.

Aju, P.C. and L. Popoola, 2005. Trees in the traditional farming systems in southeastern Nigeria. A case study of Imo State. J. Environ. Ext., 5: 25-31.

Aletor, V.A., 1993. Allelochemicals in plant food and feedingstuffs: 1. Nutritional, biochemical and physiopathological aspects in animal production. Vet. Hum. Toxicol., 35: 57-67.

Association of Analytical Chemists (AOAC), 1990. Official Methods of Analysis. 15th Edn., Washington DC., USA.

Balogun, A.M. and B.L. Fetuga, 1989. Antinutritional components in some lesser-known leguminous crop seeds in Nigeria. Biol., Wastes, 28: 303-308.

Faruq, U.Z., M. Adul-Malik and Y.U. Dabai, 2004. Antibacterial activity of crude anthraquinone extract of *Senna Italica* leaves. Biosci. Res. Comm., 16: 7-13.

Fleck, H., 1976. Introduction to Nutrition. Macmillan Publishing Co. Inc. New York, USA.

Griffiths, D.W. and T.A. Thomas, 1981. Phytate and total phosphorus content of various field bean (*Vicia faba* L.). J. Sci. Food Agric., 32: 187-192.

Hassan, M.M., A.O. Oyewale, J.O. Amupitan, M.S. Abdullahi and B. Okonkwo, 2004. Preliminary phytochemical and antibacterial investigation of crude extracts of the root bark of *Detarium microcapum*. J. Chem. Soc. Nig., 29: 26-29.

Irvine, F.R., 1961. Woody Plants of Ghana. Oxford University Press Ltd., London, England.

Marounek, M., D. Duskova and D. Brezina, 2000. Occurrence, biological activity and implications of phytic acid in nutrition. Biologicke Listy, 65: 103-111.

Ogukwe, C.E., E.E. Oguzie, C. Unaegbu and B.N. Okolue, 2004. Phytochemical screening on the leaves of *Sansevieria trifasciata*. J. Chem. Soc. Nig., 29: 8-10.

Olafimihan, C.A., 2004. Effects of seasonal variation on the antibacterial activity of aqueous extract of *Azadirachta indica* fresh stem bark. Biosci. Res. Comm., 16: 13-16.

Roempps Chemie Lexicon, 1983. Phytic acid-INN Fytine.

Trugo, L.C., C.M. Donangelo, Y.A. Duarte and C.L. Tavares, 1993. Phytic acid and selected mineral compositions of seeds from wild species and cultivated varieties of lupin. Food Chem., 47: 391-394.