PROXIMATE COMPOSITION, NUTRITIVE VALUES AND PHYTOCHEMICAL EVALUATION OF *Deinbollia pinnata* (SCHUM AND THONN) SAPINDACEAE

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Abstract: Leaves of *Deinbollia pinnata* were investigated for proximate contents, phytochemical compositions and nutritive values. Preliminary phytochemical screening of the *n*-hexane, ethyl acetate (EtOAc) and methanol (MeOH) extracts of *D. pinnata* revealed terpenoids, steroids, phenols, anthraquinones, flavonoids, saponnins, cardiac glycosides and alkaloids. Quantitative estimation of phytoconstituents in the leaves of *D. pinnata* based on dry weight ranges between 0.001 ± 0.04 - 0.85 ± 0.01 %. Proximate compositions in the leaves of *D. pinnata* revealed crude fibre (16.1%), crude protein (13.9%), carbohydrates (43.7 %), dry matter (84.3 %), fats (1.9 %), moisture (15.2 %) and total ash (6.89 %). Nutritive values with respect to bioinorganic mineral constituents (mg/kg) in the dried leaves of *D. pinnata* are Fe (37.35 ± 0.40), Ca (30.20 ± 0.091), K (47.6 ± 0.35), Zn (38.45 ± 0.40), Na (33.44 ±0.18), P (22.10 ± 0.20) and Mg (6.50 ± 0.01). Level of phytoconstituents in the leaves of *D. pinnata* gave scientific support to its trado-medical applications in treating ailments. The leaves of *D. pinnata* serve as a potential source for macro and micro nutrients.

Keywords: *Deinbollia pinnata*, phytochemical composition, nutritive values, proximate composition

Introduction

Medicinal plants are gaining popularity among urban dwellers as a result of inability of orthodox medicine to unravel cure for some intractable diseases like HIV AIDS, diabetes, sickle cell anemiaand host of other deadly diseases. Medicinal plants have produced therapeutic drugs in pharmacy. Besides, indigenous medicinal plants are used as spices and food by man; some are added as food supplements for pregnant and nursing mother's medication (Joy *et al*., 2001; Ladeji *et al*., 2004).

Sapindaceae (soapberry family) is a family of flowering plants with about 136 genera and 2000 species occurring from temperate to tropical regions throughout the world (Burkhill, 2000). Plants in Sapindaceae are widely reported for pharmacological, antioxidant, antidiabetic, anti-inflammatory activities (Sofidiya *et al*., 2007; Simpson *et al*., 2010). Ethnobotanical reports indicated that plants in Sapindaceae are used for treating ulcer, boils, pain, dermatological problems, wound healing, diarrhea and dysentery (Burkhill, 2000; Sofidiya *et al*., 2007; Agboola *et al*., 2012).

The genus *Deinbollia* consists of 59 species, including *D. accuminata, D. angustifolia, D. borbonica, D. boinensis, D. calaophylla, D. crassipes D. cuneifolia, D. dasybotrys, D. overadii, D. fanshawei, D. fulvotomentella, D. gossweileri, D. grandifolia, D. hierniana, D, insignis, D. laurenti, D. pinnata, D. laurifolia, D. longiacumainata, D. macarantha, D. macrocarpa, D. macroura, D. mexima* (Temitope and Oluwatoyin, 2012).

Ethnobotanical information revealed that the roots and leaves of *D. pinnata* are used as remedy for febrifuge, analgesic, bronchiasis intercostal, intestinal pains, jaundice, cough, asthma, aphrodisiac infections (Margret *et al.*, 2011; Agboola *et al.*, 2012). In addition, reports abound in literature on accumulation of micro and macro elements in various morphological parts of flowering plants, reported for various active medicinal therapies (Baker and Brooks, 1989).

Despite numerous folkloric utility of *D. pinnata* in traditional medicine, there are no known scientific studies on its phytochemical constituents, proximate and nutritional compositions.

In the course of our on-going research for useful phytochemicals from Nigerian forest, we encountered the leaves of *D. pinnata*, used in the indigenous medical practice for intestinal pains, jaundice, cough and asthma. We herein report, for the first time, concentration of phytoconstituents, proximate assay and nutritive values of the leaves of *D. pinnata*. To our knowledge, reports on phytoconstituents and nutritive values of *D. pinnata* are rare in literature.

Experimental

General

Solvents and reagents used in the study were procured from Sigma Aldrich, England and are of analytical grade. Extracts obtained are preserved in refrigerator prior to use. Plant materials are collected in less polluted sites. All determinations were carried out in triplicates and results expressed as mean values.

Materials and Methods

Plant collection and authentication

Leaves of *D. pinnata* used in this study were collected at Mosunse-Idiaka village, Odeda Local Government, Abeokuta, Ogun State, Nigeria in March, 2013. Plant material was authenticated at the Forest Research Institute of Nigeria (FRIN), Jericho, Ibadan, Oyo State, Nigeria by comparing it with voucher specimen under the accession number FHI 12345. Mr. Michael, a taxonomist in the herbarium section of FRIN identified and authenticated the plant material.

Preparation of plant material

Fresh leaves of *D. pinnata* was air-dried for four weeks and pulverized by means of an automated grinding machine (KV 1500, England) to allow easy extraction and percolation of the solvents. Powdered leaves (100 kg) of *D. pinnata* was successively and exhaustively extracted separately with n-hexane (66-68^{o}C) for 48 h by means of soxhlet extractor. Extracts obtained were concentrated by vacuum distillation, using rotary evaporator, dried, weighed and stored at 4^{o}C, to yield yellow oil (40 g). The residue (marc) was re-extracted with EtOAc (61^{o}C) and distilled to yield red solid (18 g). The remaining marc was extracted with MeOH (65^{o}C) to afford reddish-brown solid

(50.2 g). Each extract was stored in refrigerator prior to analysis.

Another 100 g of powdered leaves of *D. pinnata* was stored in clean dry container and used later for the proximate and nutritive assay.

Phytochemical screening of extracts of D. pinnata

Extracts of *D. pinnata* were subjected to preliminary phytochemical screening to evaluate the phytochemicals present. The procedure of Harbone (1984) was adopted to test for phytochemicals in the extracts. The concentrations of the phytoconstituents in the dried leaves of *D. pinnata*were determined according to the method of Obadoni and Ochuko (2001); Trease and Evans (1989) and Bao *et al.* (2005).

Proximate analysis

The proximate compositions such as moisture content, total ash, crude fibre, crude protein, fat and total carbohydrate, dry matter and total ash were determined according to method of AOAC (2000).

Analysis of bio-inorganic mineral elements in the dry leaf of D. pinnata

Acid digestion method was employed for releasing into analytical sample, the mineral constituent in the leaves of *D. pinnata*. Ground dried leaves of *D. pinnata* (2 g) was weighed and transferred into a micro-Kjeldahl digestion flask to which 12 mL of concentrated HNO_3 was added and left overnight for 12 h at room temperature. Perchloric acid ($HClO_4$, 4 mL) was added to the mixture and kept in the fume cupboard for 30 min at 300^oC. The flask content was heated on a heating block and digested to a clear solution with white precipitate. It was cooled and the content was transferred to 100 mL volumetric flask, and made up to 100 mL with distilled water (AOAC, 2000). The digested sample was stored in glass bottle for analysis, using the atomic absorption spectrophotometer (AAS – BUCK, 210 VGP) and flame photometer (Corrings, 410 digital). Fe, Zn, Cu and Pb were determined with Atomic Absorption Spectrophotometer while Ca, Na, K, Mg were determined using flame photometer. Phosphorus was determined colorimetrically. Concentration of mineral elements are recorded in ppm and converted to mg of the mineral element, by multiplying the ppm value with dilution factor and dividing by 1000 as follows: MW= absorbance (ppm) x dry weight x dilution factor/weight of sample x 1000. Extracts from digest were aspirated and the equipment calibrated for each element at different specified wavelengths. Results were recorded as mg L^{-1} of solution and were converted to mg kg^{-1}.

Statistical analysis

Each experiment was carried out in triplicate. The results were subjected to statistical analysis of ANOVA to deduce the standard deviation, mean and statistical error using Microsoft Excel 2007 and SPSS software.Data are expressed as mean ± standard error mean (SEM, $P \leq 0.05$).

Results and Discussion

Results obtained in this study are presented in Tables 1-4. Table 1 gives the result of preliminary phytochemical screening of the phytoconstituents in the plant material analysed. Quantitative estimation of the level of phytoconstituents in the extracts of *D. pinnata* is exhibited in Table 2. The result of proximate analysis is shown in Table 3, while concentration of bioinorganic mineral elements accumulated in dried leaves of *D. pinnata* are outlined in Table 4.

Table 1: Preliminary phytochemical screening of the leaves n-hexane, ethyl acetate (EtOAc) and methanol (MeOH) extracts of *D. pinnata*

Phytochemicals	Reagent used (Test performed)	Results of screening		
		n-hexane extract	EtOAc extract	MeOH extract
Alkaloids	Dragendorff's Reagents	-	-	+
	Mayer's Reagents	+	+	+
	Wagner's Reagents	-	+	+
	Hager's Reagents	-	-	+
Saponnins	Froth	-	-	+
	Haemolysis	-	-	+
Tannins	Gelatins	+	+	+
Phlobatannins		-	+	-
Anthraquinones	Borntrager's	+	+	-
	Combined Anthraquinone test	+	+	-
Cardiac glycosides	Legal test	+	+	+
	Kedde test	+	+	+
Terpenoids/Steroids	Lieberman's test	+	+	-
	Salwoski's test	+	+	-
Flavonoids	Shinoda test	++	++	+ + +
	Lead acetate test	++	++	+ +
	Free Flavonoids	++	++	+ +
Phenol	Ferric chloride test	+	+	+ +
Reducing Sugar	Fehling's solution	+	+	-

+++ = Highly positive, + + = Mildly positive, + positive; – = negative

Analysis of phytochemicals in the extracts revealed presence of saponnins, tannins, alkaloids, flavonoids, phlobatannins, glycosides, phenol, terpenoids, reducing sugars and steroidsin extracts of *D. pinnata* (Table 1). Glycosides (0.850±0.007 %) is of the highest concentration followed by alkaloids (0.627±0.002 %), the least is steroids (0.017± 0.001 %) in the *n*-hexane extract (Table 2). In ethyl acetate extract, glycosides (0.720 ± 0.014 %) are present in higher concentration, followed by alkaloids (0.534 ± 0.003 %), while the least is tannins (0.013 ± 0.001 %) and terpenoids (0.013 ± 0.004%). Methanol extract exhibited highest concentration of alkaloids (0.714 ± 0.002 %) and the least concentrate is glycosides (0.112 ± 0.000 %). Detection of various

metabolites at differing level of concentration in the leave extracts of *D. pinnata* confirmedvarious pharmacological activities associated with *D. pinnata* in traditional medicine (Margret *et al*., 2011; Agboola *et al.*, 2012). Secondary metabolites have been implicated forantiviral, antibacterial, anthelmintic, antinflammatory, antidiabetic, antimalarial and host of other diseases in pharmaceutical preparations (Chin-chang *et al*., 2016; Florentine *et al*., 2016, Lasisi *et al*., 2016; Lasisi and Adesomoju, 2015; Zubair *et al*., 2013, Lasisi *et al*., 2011 and Simpson *et al*, 2010. Thus, our study in this report provides scientific justification to the folkloric uses of *D. pinnata*in traditional medicine.

Table 2: Phytochemical screening and concentrations of phytoconstituents in the leaves of *D. pinnata*

Phytochemicals	*N*-hexane extract (%)	Ethyl acetate extract (%)	Methanol extract (%)
Saponnins	0.153 ± 0.004	0.136 ± 0.014	0.194 ± 0.001
Tannins	0.016 ± 0.001	0.013 ± 0.001	0.018 ± 0.001
Alkaloids	0.627 ± 0.002	0.534 ± 0.003	0.714 ± 0.002
Flavonoids	0.031 ± 0.001	0.023 ± 0.001	0.017 ± 0.001
Glycosides	0.850 ± 0.007	0.720 ± 0.014	0.112 ± 0.000
Phenol	0.035 ± 0.001	0.026 ± 0.000	0.043 ± 0.001
Terpenoids	0.023 ± 0.001	0.013 ± 0.004	0.036 ± 0.002
Steroids	0.017 ± 0.001	0.022 ± 0.001	0.030 ± 0.002

Values are mean± standard deviation of triplicate determination

The result of the proximate analysis is shown in Table 3. Moisture content, total ash, crude fibres, crude protein, carbohydrate, dry matter and fats are significant ($P<0.05$) in varying concentrations in the leaves of *D. pinnata*. The moisture content of the sample is low, suggesting that it is less vulnerable to microbial attack in the course of storage. High level of carbohydrate (43.7 ± 0.04 mg/kg) in the sample analysed suggested high calorific values and the suitability of compounding the leaves in animal feed (Abighor *etal*., 1997). The crude fibre in the sample is significantly high and compare favourably with recommended daily intake (RDI) values for fibre in children and lactating mother (Hegarly, 1988; RDI, 2009). The crude protein content in the dried leaves of *D. pinnata* (13.90 ± 0.26%) is considerably lower compared to one reported for some conventional seeds (Arogba *etal*., 1994; Esuoso and Bayer, 1998). However, the crude protein obtained in this study indicates that the leaves of *D.pinnata* could also serve as supplement for animal feed stuffs. Recommended daily intake (RDI) of protein ranges from 14 - 65 g (RDI, 2009).

Table 3: Proximate composition (%) of the dry leaves of *D. pinatta*

Parameters	Values (%)
Crude fibre	16.1 ± 0.41
Crude protein	13.9 ± 0.26
Carbohydrate	43.7 ± 0.04
Dry matter	84.3 ± 0.23
Fat	1.9 ± 0.04
Moisture	15.2 ± 0.27
Total ash	6.89 ± 0.11

Values are mean± standard deviation of triplicate determination

Table 4: Concentration of mineral elements in the dried leaves of *D. pinnata*

Mineral elements	Concentration (mg/kg)
Ca	30.20 ± 0.09
Cu	ND
Fe	37.35 ± 0.40
K	47.6 ± 0.35
Pb	ND
Zn	38.45 ± 0.40
Na	33.44 ± 0.18
P	22.10 ± 0.20
Mg	6.50 ±0.01

Values are mean ± standard deviation of triplicate determination; ND = not detected

Dried leaves of *D. pinnata* contained essential elements like calcium (30.20 ±0.09 mg/kg), potassium (47.6 ±0.35 mg/kg), sodium (33. 44 ± 0.18 mg/kg) and Magnesium (6. 50 ± 0.01 mg/kg). Others include iron (37. 35 ± 0.40 mg/kg), phosphorus (22.10 ± 0.20 mg/kg) and zinc (38. 45 ± 0.40 mg/kg). Lead and copper were not detected in the leaves of *D. pinnata.* High amount of potassium in the body has been reported to increase iron utilization (Adeyeye and Omotayo, 2011) and beneficial to people taking diuretics to control hypertension and suffer from excessive excretion of potassium, through body fluid (Arinathan *et al.*, 2003). Sodium is an important source of electrolytes within the body. The recommended daily allowance of sodium is 500 mg/kg for adult (Islam, *et al.*, 2002). Calcium and phosphorous containing substances are required by children, pregnant and lactating woman for bones and teeth development. Recommended daily intake allowance of 800 mg/kg per day is recommended for adults and children. The concentration phosphorous obtained in this study is less than the daily allowance. The concentration of iron in *D. pinnata* is 37.35 mg/kg. Iron is required for the formation of hemoglobin and its deficiency leads to anaemia, the value was higher than 28.97±0.04 mg/kg reported for *Astragalina* leaves (Gafar *et al.*, 2011). Presence of essential nutrients and minerals elements in considerable concentrations suggests that the dried leaves of *D. pinnata* can serve as supplements in food, in addition to phytochemical compounds. In this respect, it can provide nutrient required by the body.

Conclusion

Results obtained in this study suggest that the leaves of *D. pinnata* contain enormous phytoconstituents that can serve as therapy for pharmacological, antioxidant, antidiabetic and anti-inflammatory activities. Concentration of micro and macro nutrients in *D. pinnata*suggests that the dried leaves of *D. pinnata* can serve as supplements in food

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