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Comparative Phytochemical, Proximate, Vitamins and Mineral Nutrient Composition of Leaf, Stem, and Root of *Ipomea involucrata* and *Milletia aboensis* from Southern Nigeria

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Original Research Article

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Abstract: This study was designed for comparative evaluation of phytochemical, proximate, vitamins and mineral nutrient composition of leaf, stem, and root of two medicinal plants- *Ipomea involucrata* (IP) and *Milletia aboensis* (MA) - used for the treatment of mental illness in Southern Nigeria. Result of phytochemical screening reveals the presence of alkaloids, saponins, cardiac glycosides, deoxy sugars and resins in all parts of both plants while flavonoids, anthraquinones tannins, terpenes and steroids were unevenly distributed. Organic matter content of all parts of IP and MA fell within a narrow range or 90-99 %. Crude fat was significantly higher ($p < 0.05$) in both stem and roots than leaves of IP, whereas in MA it was significantly higher ($p < 0.05$) in leaves than stem and root. Crude protein content of stem and root of IP were similar and about double (and significantly higher ($p < 0.05$)) than that of the leaves whereas for MA, similar value for leaves was significantly higher than those for stem and root. Vitamins A and E, Fe, Mg, P, Na, K, and Ca, were found in appreciable amounts in all parts of IP and MA. The result of this study has provided both phytochemical and nutritional evidence for the pharmacological roles assigned for the plants and a guide for effective combination of respective plant parts in treatment. It recommends the use of the whole plant of IP for maximum benefit.

Keywords: Phytochemical, Proximate, Vitamins, Mineral nutrients, *Ipomea involucrate*, *Milletia aboensis*

INTRODUCTION

The place of medicinal plants in the Healthcare delivery system of many countries of the world especially the poor economies cannot be compromised. In a report [1] even the World Health Organization, WHO is said to have encouraged the use of all available herbal resources for primary healthcare, and incorporation of proven traditional remedies into national drug policy and regulation.

Accordingly, many ethnobotanical surveys and reviews [2–5] have brought to the lame light herbal remedies in various cultures, traditions, and geographical regions of the world. It is a common knowledge that prominent drugs used in orthodox medicine today were birthed from researches that sought to give scientific backing to the claims from traditional knowledge base [6]. In Akwa Ibom State and other Southern parts of Nigeria, the roots of *Ipomea involucrata* and leaves of *Milletia aboensis* are reportedly used for the treatment of mental illness [5]. In addition to reviewing ethnobotanical use of *Ipomea involucrata* to include treatment for fever, oedema, filarial infection, jaundice, dysmenorrhea, headache, certain workers [1] confirmed its haematopoietic effects. Antinociceptive and anti-inflammatory activities of crude extracts of *Ipomoea involucrata* leaves in mice and rats has also been reported [7]. Acute, sub acute and chronic toxicity of ethanol leaf extract of *Milletia Aboensis* has also been investigated [8].

Production and use of nutraceuticals and functional foods as dietary supplements has become a fast growing multibillion business globally [9]. In recognition of this fact, it is needful to have a complete profile on all plant parts (leaves, stem, and roots) of every medicinal plant identified in ethnopharmacological studies. Apart from helping in the understanding of mechanisms of actions of the phytochemicals, this may open more doors of investigation into efficient utilization of the plant-drug superstore divinely provided by nature. This study was therefore designed to go beyond phytochemistry into the evaluation of proximate, vitamins and mineral nutrient composition of leaf, stem, and root of *Ipomea involucrata* and *Milletia aboensis.*

MATERIALS AND METHODS

All the reagents used for this work were of analytical grade, obtained from Chemical stores.

Collection and treatment of Plant Samples

The leaves, stems and roots of *Ipomoea involucrata* and *Milletia aboensis* were collected during farming season respectively, from Mbierebe Obia, Calabar/Itu Road in Itu Local Government Area and Itak Ikot Akap, Ikono Local Government Area of Akwa Ibom State. The plants were authenticated by a taxonomist in the Department of Botany, University of Uyo, Akwa Ibom State, Nigeria.

For Phytochemical Screening: The leaves, stems and roots of the plants were separately washed and air-dried under shade. They were then pulverized with mortar and blender unto fine powder. Each ground sample was soaked in 90% ethanol for 48hrs (leaves) or 72hrs (stems and roots). The extract was then decanted, filtered and concentrated to dryness in a water bath at 40°C till the solvent was completely evaporated. Each evaporated extract was then labeled and refrigerated until when needed for analysis.

For Proximate composition analysis, the washed and air dried fresh samples were cut into uniform sizes. For the respective parameters, portions of each sample were treated as required.

Phytochemical Screening

Phytochemical Screening was performed for alkaloids, saponin, flavonoids, tanins, phlobataninins, anthraquinones, terpenes, steroids, cardiacglycosides, deoxy-sugar resins using standard methods [10,11].

Proximate composition

For proximate composition, analyses for moisture, ash, fiber, organic matter, lipid, crude protein, carbohydrate, and caloric value we performed using the methods of AOAC [12].

Determination of vitamins and mineral nutrients

Vitamins A and C were determined using the method of AOAC [12] while mineral elements were determined after wet digestion with a mixture of nitric, sulphuric and hydrochloric acid using Atomic Absorption Spectrophotometer (AAS model UNICAM Solar 969).

STATISTICAL ANALYSIS

Results obtained were expressed as mean ± S.E.M. The data was analyzed using One-way ANOVA followed by Dunnett's post hoc test (SPSS 11.0 for Windows; SPSS Inc., Chicago IL, USA). $P<0.05$ was considered as significant.

RESULTS

Phytochemical constituents

The result of phytochemical screening of plant parts (leaves, stems, and roots) of *Ipomea involucrata* (IP) and *Milletia aboensis* (MA) as shown below (Table 1) reveals the presence at varying levels, of alkaloids, saponins, cardiac glycosides, deoxy sugars and resins in all parts of both plants. Whereas flavonoids and anthraquinones were found in all parts of IP, they were not detected in MA. Tannins and terpenes were equally found in all parts of IP but tannins were detected only in leaves, while terpenes were present in both and stem and roots of MA. Steroids were found only in the leaves of MA while both IP and MA lacked phlobatanins in all their parts.

Table-1: Qualitative phytochemical composition of leaves, stem and root samples of *ipomoea involucrata* and *m. Aboensis*

Phytochemicals	*Ipomoea involucrata*			*Milletia aboensis*		
	Leaves	Stem	Root	Leaves	Stem	Root
Alkaloids	+++	+++	++	+	+	+++
Saponin	++	+	++	+	+	+
Flavonoids	+++	+++	+++	-	-	-
Tanins	++	++	+	+	-	-
Phlobatanins	-	-	-	-	-	-
Anthraquinones	+++	+++	+	-	-	-
Terpenes	+	+++	++	-	+++	++
Steroids	-	-	-	++	-	-
Cardiac glycosides	+	+++	++	++	+++	++
Deoxy-Sugar	+	+++	++	+++	+++	+++
Resins	+	+	+	+	+	+

KEY: + - Trace Presence; ++ - Moderate Presence; +++ - Heavy Presence; - - Not Detected

Proximate composition

Moisture content of IP leaves was significantly higher ($p < 0.05$) than those of stem and roots (Table 2). The reverse was the case in MA where the leaves recorded the least moisture content compared to stem and roots. In both IP and MA ash content was significantly higher ($p < 0.05$) in the leaves than stem and roots. In both plants organic matter content was highest in root, being significantly higher ($p < 0.05$) than in leaves. Organic matter content of all parts of IP and MA fell within a narrow range or 90-99 %. Crude fat was significantly higher ($p < 0.05$) in both stem and roots than leaves of IP, whereas in MA it was significantly higher ($p < 0.05$) in leaves than stem and root. Crude protein content of stem and root of IP were similar and about double (and significantly higher ($p < 0.05$) than) that of the leaves while for MA, similar value for leaves was significantly higher than those for stem and root. Carbohydrate content of IP leaves was found to be significantly higher than in stem and root samples whereas in MA both stem and root recorded significantly higher ($p < 0.05$) values than the leaves. Energy content of stem and root of IP were significantly higher than that of the leaves, while in MA, leaves was significantly higher ($p < 0.05$) than stem and root in energy content. Except for IP leaves (374Kcal/100mg), all other plant parts under study had caloric value of > 400Kcal/100g.

Table-2: Proximate Composition of leaves, stem and roots of *I. involucrata and M. aboensis*

	I. involucrata			***M. aboensis***		
	Leaf	**Stem**	**Root**	**Leaf**	**Stem**	**Root**
Moisture (%)	75.94	65.25	61.97	14.05	34.89	43.96
	±3.24	±1.56*	±6.44*	±2.27	±2.45*	±2.90*, a
Ash (%)	9.94	5.23	1.11	4.87	1.17	2.09
	±0.39	±0.38*	±0.46*, a	±0.10	±0.15*	±0.16*, a
Fibre (%)	6.62	3.48	7.38	3.24	0.78	1.39
	±0.24	±0.42*	±0.43a	±0.16	±0.17*	±0.26*, a
Organic matter	90.06	94.77	98.89	95.13	98.83	97.91
(%)	±0.07	±2.49	±1.10*, a	±2.02	±1.67	±0.65*
Fat (%)	8.05	16.40	15.38	12.42	2.80	5.99
	±0.19	±1.02*	±0.97*	±0.88	±0.17*	±0.68*, a
Crude protein	16.80	32.38	32.38	28.00	15.75	18.39
mg/100g	±0.73	±0.36*	±0.15*	±0.09	±0.75*	±0.71*, a
Carbohydrate	58.59	42.51	43.75	51.47	72.15	79.50
(%)	±0.67	±0.67*	±1.25*	±0.67	±1.90*	±0.61*, a
Caloric value	374.01	447.16	442.92	429.66	406.20	416.03
Kcal/100g	±1.52	±0.69*	±0.16*, a	±0.65	±1.71*	±0.89*, a

Values are expressed as mean ±SEM, n = 3
* = significantly different from Leaf at p<0.05
a = significantly different from Stem at p<0.05

Vitamins and mineral elements

From the results shown on Table 3, Vitamins A and E were found in a significantly higher ($p < 0.05$) concentrations in the leaves of IP and MA than in their stems and roots. The root of IP and leaves of MA had significantly higher ($p < 0.05$) content of Phosphorous than other parts of the respective plants. Iron was found to be significantly richer ($p < 0.05$) in IP roots, MA stem and roots than other parts. A similar trend was observed for Magnesium. For IP, the highest content of Calcium was found in the root (significantly higher ($p < 0.05$) than leaves and stem) while in MA, Ca was significantly higher in the stem than leaves and roots. However, all parts of both plants had mean calcium content of > 30mg/100g. The highest content of K was found in IP root; it was significantly higher than leaves and stem. MA leaves on the other hand had significantly higher K than stem and roots. A similar trend was also found for Sodium.

Table-3: Vitamins and Minerals contents of the different plant parts of *I. involucrata and M. aboensis*

	I. involucrata			***M. aboensis***		
	Leaf	**Stem**	**Root**	**Leaf**	**Stem**	**Root**
Vitamin A	94.62	18.22	13.48	68.13	40.22	31.94
(mg/100g)	±0.66	±1.30*	±0.78*, a	±0.82	±0.42	±0.45*, a
Vitamin E	445.16	53.87	18.87	295.16	16.45	21.26
(mg/100g)	±5.92	±0.79*	±0.61*, a	±0.32	±0.75*	±0.62*, a
Phosphorus	2.61	3.72	3.72	4.60	2.42	1.73
(mg/100g)	±0.56	±0.37	±0.28*	±0.44	±0.17*	±0.09*, a
Iron	6.28	5.11	11.78	3.53	20.42	20.42
(mg/100g)	±0.54	±0.06	±0.42*, a	±0.44	±0.33*	±0.33*
Calcium	33.25	33.21	36.05	30.05	39.07	33.09
(mg/100g)	±0.47	±0.48	±0.31*, a	±0.42	±0.40*	±0.40*, a
Magnesium	23.59	22.20	30.11	21.24	33.33	33.35
(mg/100g)	±0.54	±0.37*	±0.19*, a	±0.46	±0.65*	±0.40*
Potassium	450.00	348.00	671.94	438.00	114.00	96.00
(mg/100g)	±0.90	±1.80*	±0.05*, a	±1.29	±1.17*	±0.16*, a
Sodium	151.20	140.40	189.80	150.80	123.00	117.00
(mg/100g)	±0.36	±0.99*	±1.40*, a	±0.31	±1.13*	±0.25*, a

Values are expressed as mean ±SEM, n = 3
* = significantly different from Leaf at p<0.05
a = significantly different from Stem at p<0.05

DISCUSSION

Secondary metabolites found in plants are not known to have energy roles but account for pharmacologic potentials that make them invaluable in tackling several diseases. In this study, the phytochemical profiles of leaves, stem, and roots of IP were similar in alkaloids, saponin, flavonoids, tannins, anthraquinones, terpenes, cardiac glycosides, deoxy-sugar and resins. This suggests that all the plant parts are capable of effecting same pharmacological roles. The same could be said of MA regarding alkaloids, saponins, flavonoids, cardiac glycosides, deoxy-sugar and resins only. In other phytochemicals (tannins, terpenes, and steroids) the leaves, roots and stem of MA differed considerably in their profiles. Saponins are reported to have among others, cholesterol lowering, anti-inflammatory, and anti-convulsant properties [13,14] while others like flavonoids and tannins are known for their anti-oxidant potentials [15].

The proximate composition of the various plant parts of IP and MA coupled with their excellent vitamins and mineral nutrient profile as reported in this study make them very nutritionally valuable. This is in agreement with the reports of other studies [5,16].

The rich content of Vitamins A and E, Phosphorous, Fe, Mg, Ca, K, and Na in IP justifies it's ethnopharmacological application in the treatment and correction of anemia and other hemorrhagic diseases [1], mental illness [5] as well as anti-sickling [17], anti-inflamatory and antinociceptive properties [18] reported for it. Although the traditional therapeutic effects of MA against acute and chronic inflammation, mental illness, venereal diseases and constipation has been reported [5, 8, 19], the results of this study provides phytochemical and nutritional justification for those claims. Fe is a requirement for haemoglobin synthesis [3, 20, 21]; Mg, Na, K, and Ca metabolism are implicated in the mechanism of epilepsy [22–24]. Vitamins A and E are antioxidants and are known to play effective roles in various disease prevention and management [25–27].

CONCLUSION

The result of this study has provided both phytochemical and nutritional evidence for the pharmacological roles assigned for the plants and a guide for effective combination of respective plant parts in treatment. This study recommends and supports the use of IP whole plant in pharmacological applications for maximum utilization of its medicinal endowments as its morphological disposition as an herbaceous twining climbing plant makes this possible. However, the different parts of MA can be used singly or in combinations as guided by the scientific information hereby provided.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests whatsoever in regards to this article.

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