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Full Length Research Paper

Phytochemical and ethnobotanical study of some selected medicinal plants from Nigeria

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This study involves the phytochemical screening and ethnomedicinal survey of twenty-three medicinal plants belonging to thirteen families commonly found in Nigeria. Semi-structured interviews and discussions with selected informants were adapted to collect ethnobotanical information on the plants. It was discovered that all of them possess alkaloids, tannins and saponin. Steroid is present in only twelve of the plant species, only five have phlobatannin; terpene is present in twenty of the plants, flavonoid is present in nineteen of the plants, while cardiac glycoside is present in sixteen of the species. *Leea guineensis* and *Uvaria chamae* were the only plants among the 23 plant samples that contain all the eight phytochemicals tested. The phytochemical present in the samples were juxtaposed with their ethnomedicinal significance, and from this, several suggestions were deduced on the secondary metabolites responsible for the pharmacological actions of the plants. Conclusively, it could be said that the ethnomedicinal significance of the selected plants for this study corresponds to the pharmacological actions of the secondary metabolites they contain.

Key words: Phytochemical, ethnomedicinal, medicinal plants, bioprospecting.

INTRODUCTION

Medicinal plants are defined as any plants which contain substances that can be used for the therapeutic purposes in one or more of its organ or substances which are precursors for the synthesis of useful drugs (Sofowora, 1982). Furthermore, Elujoba (1997) noted that a plant become a medicinal plant only when its biological activity has been ethnobotanically reported or scientifically established.

Plants are a great source of medicines, especially in traditional medicine, which are useful in the treatment of various diseases (Bako et al., 2005). According to the World Health Organization (WHO 2001), 80% of the world population use medicinal plants in the treatment of diseases and in African countries, this rate is much higher. It has been estimated that up to 90% of the population in developing countries rely on the use of medicinal plants to help meet their primary health care needs (WHO, 2002). The use of traditional medicine is not restricted to the developing countries (Jimoh, 2006). FAO (2000) reported that at least 25% of drugs used in modern pharmacopoeia are derived from plants, while many others are synthetic analogues built on prototype compounds isolated from plants. Over 50% of all modern clinical drugs are of natural product origin (Stuffness and Douros, 1982) and natural products play an important role in drug development programs of the pharmaceutical industry (Baker et al., 1995).

Medicinal plants have demonstrated their contribution to the treatment of diseases such as HIV/AIDS, malaria, diabetes, sickle-cell anaemia, mental disorders (Elujoba et al., 2005) and microbial infections (Okigbo et al., 2005). Iwu et al. (1999) reported that the primary benefits of using plant derived medicines are that they are relatively safer than synthetic alternatives, offering profound therapeutic benefits and more affordable treatment. Furthermore, the increasing reliance on the use of medicinal plants in the industrialized societies has been traced to the extraction and development of several drugs and chemotherapeutics from these plants as well as from traditionally used rural remedies (UNESCO, 1998). Investigations into the chemical and biological

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activities of plants during the past two centuries have yielded compounds for the development of modern synthetic organic chemistry and the emergence of medicinal chemistry as a major route for the discovery of novel and more effective therapeutic agents (Roja and Rao, 2000). Medicinal uses of plants range from the administration of the roots, barks, stems, leaves and seeds to the use of extracts and decoctions from the plants (Ogbulie et al., 2004).

The term ethnobotany was first coined by an American botanist John Harshburger in 1896, in an attempt to study the plants used by the primitive and aboriginal people. Since then, it has been defined as the traditional knowledge of indigenous communities, about surrounding plant diversity and how various peoples make use of indigenous plants found in their localities. Therefore, ethnobotany involves the study of how communities of a particular region make use of indigenous plants in the region for food, clothing and medicine. Historically, plants not only provided man with food but also with means of healing (Aiyeloja and Bello, 2006). Ethnobotany and ethno-medical studies are today, recognised as the most viable methods of identifying new medicinal plants or refocusing on those earlier reported for bioactive constituents (Adjanahoun et al., 1991). It has become very necessary to recover the ancient traditional use of plants from the older and rapidly-declining generation so as to maintain and preserve the uses of the plants and to form a basis for scientific research into the relevant phytochemical principles with the view of designing pharmaceutical research and production, and to make the information available to the populace, especially in the tropics, 90% of which depends on medicinal plants for their primary health care.

The therapeutic value of plants used in trado-medicine derives from the presence of phytochemical principles (Ayodele, 2003), which are found in parts of the plants. Medicinal plants contain biologically active chemical substances such as saponins, tannins, essential oils, flavonoids, alkaloids and other chemical compounds which have curative properties (Sofowora, 1993). These complex chemical substances of different compositions are found as secondary plant metabolites in these plants. In modern medicine, plants are used as sources of direct therapeutic agents, as models for new synthetic compounds, and as a taxonomic marker for discovery of new compounds. They serve as a raw material base for the elaboration of more complex semisynthetic chemical compounds (Akerele, 1992). Phytochemicals are by-products of primary metabolic functions of the plant, otherwise called the secondary metabolites (Richter, 1978). They are produced and used by the plants for protection and repair processes within the natural environment (Bako et al., 2005). According to Heldt (2005), most of these phytochemicals are produced through biosynthesis in the metabolic pathways.

Secondary metabolites have both a defensive role against herbivory, pathogen attack and inter-plant competition and an attractant role towards beneficial organisms such as pollinators or symbionts (Kaufmann et al., 1999). Plant secondary products also have protective actions in relation to abiotic stress such as those associated with changes in temperature, water status, light levels, UV exposure and mineral nutrients (Kaufmann et al., 1999). Furthermore, recent work has indicated potential roles of secondary products at the cellular levels of plant growth regulators, modulators of gene expression and in signal transduction (Kaufmann et al., 1999). Recent research has shown a pivotal role of these chemicals in the ecophysiology of plants (Briskin, 2000).

The primary metabolites are of major importance to plants, while the secondary metabolites are of medicinal value to man (Trease and Evans, 1989) and these can equally be obtained from various anatomical structures of plants (Fahn, 1974). Man has benefited from the presence of these chemicals by exploiting the plant products as sources of sustenance in a variety of ways. For example, many drugs today are of plant origin. Pharmacological history is replete with examples such as quinine, aspirin, picrotoxin, reserpine etc., while many of the synthetic drugs are fashioned after natural plant products (Sofowora, 1982).

Plants which are observed to be efficacious and frequently prescribed may contain compounds that are potential drug candidates and could rightly be recommended for further examination. Scientific investigations of medicinal plants have been initiated in many countries because of their contributions to health care. The active principles differ from plant to plant due to their biodiversity and they produce a definite physiological action on the human body (Edeoga et al., 2006).

In addition, these chemical principles vary in distribution within the plant parts, as well as their occurrence within plant species (Bako et al., 2005). These are influenced mainly by cultivation period, season of collection and plant-to-plant variability in the medicinal content (Nalawade and Tsay, 2003), that is why phytochemical screening of plants must be done constantly, even on the ones whose secondary metabolites are already known. Due to expanding focus on the use of traditional medicine, it has become necessary to document the trado-medicinal uses, as well as expand our knowledge of the possible active principles involved in the acclaimed efficacies of plants used in this system.

This work, therefore, is aimed at screening the leaves of the selected plants for the presence of secondary metabolites in them with the view of bioprospecting of medicinal plants. The choice of leaves for this study is based on the study carried out by Addo et al. (2008) where it was reported that the leaf is the plant organ most widely used in phytomedicine and herbal therapy.

MATERIALS AND METHODS

Collection of information and plant samples

Semi-structured interviews and discussions with selected informants were adapted according to Martin (1995). Participatory rural appraisal (PRA) method was used to ascertain the information provided (Balick and Cox, 1996). Additional ethnomedicinal information about the plants were collected from literature studies. Two methods or techniques namely a modified Whitetaker Nested-Quadrant method (Stohlgren et al., 1994) and normal field techniques for plant collections and herbarium development were used for vegetation sampling and plant collections for this study.

The plants used for the study are *Bombax buonopozenseAlchornea laxiflora, Flueggea virosa, Acalypha wilkesiana, Calopogonium mucunoides, Milletia thonningii, Mucuna pruirens, Vigna racemosa, Sida urens, Hibiscus lunariifolius, Mansonia altissima, Waltheria americana, Corchorus aestuans, Corchorus olitorus, Glyphaea braevis, Triumfetta cordifolia*, *Uvaria chamae, Markhamia tomentosa, Ehretia cymosa, Crateva adansonii, Platostoma africanum, Leea guineensis* and *Tapinanthus globiferus.*

The fresh leaves of the plant materials used in the work were simultaneously collected from forest, abandoned farms, cultivated farms and the open field in Southern part of the country in March, 2009. The plants were identified in their fresh state, and authenticated by Mr. Omotayo, the second author, who also is the curate of Herbarium of the Department of Plant Science, University of Ado-Ekiti. Samples of the specimens have been domiciled and registered at the Herbarium of the Department of Plant Science (UHAE), University of Ado-Ekiti, Ekiti State.

Phytochemical screening

The leaves of all the selected plants for this study were then cut into bits, and air dried for two weeks, after which they were pulverized into powder, using Thomas Wiley mechanical blender before being subjected to phytochemical screening. The grinded/powdered leaves were examined for the presence of the following phytochemicals: alkaloids, tannins, saponin, steroid, terpenes, flavonoids, phlobatannin and cardiac glycosides.

Alkaloids

Drangendoff's reagent was used and the method described by Harborne (1973) was adopted. Grinded and powdered leaves (0.2 g) were extracted with 95% ethanol in a Soxhlet extractor for six hours and the ethanolic extract evaporated to dryness using a vacuum evaporator at 45℃. The residue was redissolve d in 5 ml of 1% HCl and 5 drops of Drangendoff's reagent were added. Colour changes were observed to draw inference.

Saponin

The persistent frothing test for saponin described by Odebiyi and Sofowora (1978) was used. To 1 g of the powdered leaf sample, 30 ml of tap water was added. The mixture was vigorously shaken and heated. The sample was observed for the formation of froth to draw inference.

Phlobatannin

The powdered leaf sample (0.2 g) was dissolved in 10 ml of distilled water and filtered. The filterate was boiled with 2% HCl solution. The sample was observed for the formation and colour of precipitate to draw inference.

Tannins

The method of Trease and Evans (1989) was adopted. 0.5 g powdered leaf sample was dissolved in 5 ml of distilled water, then boiled gently and cooled. 1 ml of this solution was put in a test tube and 3 drops of ferric chloride solution was added. The colour of the sample was observed to draw inference.

Terpenes/ terpenoids

The Salkowski test was used. 5 ml of the powdered leaf sample was mixed in 2 ml of chloroform, and 3 ml concentrated sulphuric acid (H_2SO_4) was carefully added to form a layer. Colour changes were observed to draw inference.

Steroids

2 ml of acetic anhydride was added to 0.5 g powdered leaf of each plant sample, followed by 2 ml of sulphuric acid. Colour changes were observed to draw inference.

Cardiac glycosides

The Keller-Killani test was used. 5 ml of the powdered leaf sample of all the plants studied was treated with 2 ml of glacial acetic acid, containing one drop of ferric chloride solution. This was underlayed with 1 ml of concentrated sulphuric acid. Colour changes were observed to draw inference.

Flavonoids

5 ml of diluted ammonia solution was added to a portion of the aqueous filtrate of each plant extract, followed by addition of concentrated sulphuric acid. Colour changes were observed to draw inference.

RESULTS

Table 1 reveals the ethnomedicinal values of the leaves of the plants used for this particular study. Table 2 presents the distribution of the secondary metabolites in the selected twenty-three plants used for this study. Table 3 describes the indicators for the screening of the eight secondary metabolites and a summary of all the plants where they are present.

DISCUSSION

From Table 1, it could be observed that the plants selected for this study are used in significantly large number of ways in the treatment of various human diseases. The plants provide therapeutic effects for about 32 human diseases, such as gastro-intestinal problems (10 plants), body pains (7 plants), respiratory

Table 1. Table showing the ethnomedicinal values of the 23 selected plants.

S/N	Plant material	Family	Ethnomedicinal uses	References
1	*Bombax buonopozense* P. Beauv. (Y - ponpola, H - gurjiya, I – Akpu)	Bombacaceae	Leaves' decoction used for the treatment of microbial skin infections, fevers and as an emollient. It is also used in treating oedema, convulsions and insanity.	(Arbonnier, 2004)
2	*Alchornea laxiflora* (Benth.) Pax & K. Hoeffm (Y – ijan, I – ubobo)	Euphorbiaceae	Decoction of the leaves is used in the treatment of inflammatory diseases as well as an important component of herbal antimalarial formulations; leaf decoction taken orally to stop post-partum pain.	(Adewole pers. Comm. 1993; Focho et al., 2009)
3	*Acalypha wilkesiana* Mull. Arg. (Y – aworoso)	Euphorbiaceae	The leaf is used for the treatment of malaria, healing of wounds and dermatological as well as gastrointestinal disorders. The leaves are eaten as vegetable to treat hypertension and also used in treating skin infections in children	(Akinde and Odeyemi, 1987; Ikewuchi et al., 2008; Alade and Irobi, 1993)
4	*Flueggea virosa* (Willd) Voight (Y – iranuje)	Euphorbiaceae	A root decoction or root powder taken in water or as a bath is used to treat liver, kidney, urinary and venereal diseases, and also to treat testicular inflammation, frigidity, heavy menstruation, rheumatism and arthritis. Preparations of the leaf twigs are also widely taken as a tonic, as an aphrodisiac or to treat impotence. Leaves and leafy twigs in decoction or infusion are commonly taken to treat malaria, jaundice, measles, oedema, vertigo, sickle cell anaemia, convulsions, vomiting, stomach-ache, intestinal worms, constipation, dysentery and difficult delivery. Leaf sap is used topically against conjunctivitis and earache, and as nose drops to treat headache and migraine. It is rubbed on the joints and limbs to treat feverish stiffness and pain.	(Tabuti, 2007)
5	*Calopogonium mucunoides* Desv.	Fabaceae	Leaves' decoction used for strengthening the system and as an anti-scorbutic. Leaf applied in treating diarrhea.	(Idu and Oniye, 2007)
6	*Millettia thonningii* (Schum & Thonn) Bak (Y – ito, I - okeokpa)	Fabaceae	A spoonful of the aqueous leaf decoction is mixed with 3 spoons of palm oil is applied against measles and chicken pox. Leaves are crushed and mixed with wood ash are used to treat dysentery. The bark is used as palm wine flavour producing a tonic effect, while it is also used as laxative. Bark maceration is given as purgative for young children. In the event of dystocic, the root bark is chewed and one swallows the sap. Leaves in herb tea or crushed and mixed with wood ash are used to treat dysentery. The root is macerated 3 days after which the aqueous maceration is used for 5 days in baths, then as drink and in form of carbonized powder to consume in gravy in the treatment of tuberculoid leprosy. Barks and roots are crushed together and boiled until a thick scum is formed, after cooling the resulting liquid is drunk by the women for the disorders of the menstruations and to purify the blood. It is also anti-helminthic. Leaves and roots are used to treat bronchitis and mouth infections. The seed has molluscicide activity.	(Banzouzi et al., 2008a; Perrett et al., 1995)

Table 1. Contd.

7	*Mucuna pruirens* (L.) DC (Y – werepe, I – agbala)	Fabaceae	The seeds are anti-diabetic; leaves used as aphrodisiac, anti-neoplastic, anti-epileptic, antimicrobial, antivenom and antihelminthic	(Dhawan et al., 1980; Sathiyanarayanan and Arulmozhi, 2007; Rajendran et al., 1997; Jalalpure et al., 2007)
8	*Vigna racemosa* (G. Don) Hutch (Y – gbomogungi/esinsin)	Fabaceae	Leaves' decoction used for the treatment of skin infections	----------
9	*Sida urens* L.	Malvaceae	Leaves' decoction used for treatment of skin infections	----------
10	*Hibiscus linariifolius* Willd	Malvaceae	Leaves' decoction used for treatment of typhoid fever	----------
11	*Mansonia altissima* (A. Chev.) A. Chev.	Sterculiaceae	Leaf used in the treatment of leprosy, as well as an aphrodisiac in man; a bark extract is drunk or an infusion of the root is taken as an aphrodisiac. Root decoction is given as enema against leprosy; decoction of the twig bark is applied as a bath against yaws, scabies and syphilis.	(Ogbamgba and Wekhe, 2005; Ohene-Coffie, 2008)
12	*Waltheria americana* L.	Sterculiaceae	Leaves used as a blood tonic, an immune booster and for strengthening young children; possesses anti inflammatory and antifungal properties. The cortex (root bark) is chewed as a very effective natural medicine for sore throat. The plant is taken internally for arthritis, neuralgia, common cold, cough, bronchial phlegm or mucous, diarrhea, eye baths, fatigue; used as a bitter tonic as well as for chronic asthma.	(Wagner et al., 1990)
13	*Corchorus aestuans* L. (Y – idapopo)	Tiliaceae	Leaves' decoction used for treating anaemia; root extract mixed with that of *Sida rhombifolia* root is taken once daily by pregnant women to relieve from predelivery trouble.	
14	*Corchorus olitorus* L. (Y – ewedu, I – ahuhara)	Tiliaceae	Leaves' decoction used for treating iron deficiency, folic acid deficiency, as well as treatment of anaemia. Leaves also act as blood purifier. Seeds are used as purgative, leaves are used as diuretics, leaf infusion is taken as febrifuge, against constipation and in chronic cystitis and dysuria; root scrapping is used to treat toothache, root decoction taken as a tonic, leaf twigs is used against heart troubles, cold leaf infusion is taken to restore appetite and strength, leaves used for ascites, pains, piles, tumours, gonorrhoea and fever.	(Ayeloja and Bello, 2006; Mazumder et al., 2003; Fondio and Grubben, 2004; Fasinmirin and Olufayo, 2009)
15	*Glyphaea braevis* (Spren) Monochino (Y – atori)	Tiliaceae	Leaves' decoction for the treatment of sexually transmitted infections. Leaves used as abortifacient, ecbolic, antiemetic, for eye treatment, liver problems and naso-pharyngeal affections, and as genital stimulants, pain-killers, treatmen of pulmonary troubles, oedema and gout. The roots are used to treat diarrhea, dysentery, as febrifuge, for paralysis, epilepsy, convulsions and spasms.	(Burkill, 1985)

Table 1. Contd.

16	*Triumfetta cordifolia* A. Rich (Y – akee-eri)	Tiliaceae	Leaves' decoction for treatment of backache; flowers taken as laxative and for malaria. The leaves are also used as psychotropic	(Banzouzi et al., 2008b)
17	*Uvaria chamae* P Beauv. (Y – eruju, I - mmimi ohea, H – kas kaifi)	Annonaceae	Decoction of the stem is used for the treatment of diarrhea; sap from the roots, stem or leaves is applied to wounds and sores for quick and proper healing of wounds; the root bark is used for catarrh and the root extract is used for the treatment of piles, menorrhegia, epiostaxis, haematuria and haemalysis. Extracts of the roots, barks or leaves are used to treat gastroenteritis, vomiting, dysentery, wounds, sore throats, inflamed gums; root bark taken infusion few hours before sexual intercourse to act as contraceptive.	(Igoli et al., 2005; Nwosu, 2000)
18	*Markhamia tomentosa* (Benth) K. Schum (Y – akoko, I – egbo)	Bignoniaceae	Leaves used as anti snake venom/bite, sore eyes, heart pain and scrotal elephantiasis. The bud sap is used for eye treatments. Decoction of bark and leaves is given as a mild laxative; leaf decoction and chewed leaves are used for general body pains, headache, backache, lumbago.	(Irvine, 1961; Burkill, 1985; Arbonnier, 2004; Aladesanmi et al., 2007)
19	*Ehretia cymosa* Thonning. (Y – jaoke)	Boraginanceae	Leaf used as febrifuge, laxative, pain-killer, for paralysis, epilepsy, convulsions and spasm. Sap from the fresh leaves is a mild laxative for children. The bark decoction is used to regulate menstrual cycle	(Burkill, 1985)
20	*Crataeva adansonii* Oliv. (Y – eegun-orun)	Capparaceae	Leaves' decoction is used as flavourant, as a stomachic, tonic, febrifuge and anti-pyretic, as well as for the treatment of rheumatic pains and swellings. Infusion of leaves and twigs to treat indigestion and douche for post menopausal women; leaves are used to treat night blindness, bad eyesight, jaundice and high blood pressure; root is chewed at regular interval for a month to treat penis weakness (decreased libido) in males. The bark is useful in disorders of urinary organs, urinary tract infections, pain and burning micturition, renal and vesical calculi.	(Nwosu, 2000; Arbonnier, 2004; Okoli et al., 2007)
21	*Platostoma africanum* P. Beauv.	Lamiaceae	Leaf juice used for treatment of snake bite, gastroenteritis and microbial infections. Leaves used to treat waist pain, as pain-killers; antiaborifacient; febrifuge and naso-pharyngeal affections. The root is used as a febrifuge and for the treatment of arthritis and rheumatism.	(Burkill, 1985)
22	*Leea guineensis* G. Don (Y – lewu ope/aledo)	Leeaceae	Leaves' decoction is used for reinstating pregnancy, for the treatment of gastroenteritis, as an anti-scorbutic, and to strengthen the system, as well as for rheumatism. Aqueous extract of the leaves is used to treat enlarged spleen in children. Leaf decoction used to treat abdominal pains and malaria.	(Okafor and Ham, 1999; Falodun et al., 2007; Jiofack et al., 2010)

Table 1. Contd.

23	*Tapinanthus globiferous* (A. Rich) Van Tiegh (Y – afomo, H – kauchi)	Loranthaceae	Leaves' decoction for blood tonic, medicine for cancer, diabetes and hypertension. Decoction of leaves and flower is used for the treatment of convulsion, diabetes and diarrhea and as an antidote.	(Jiofack et al., 2010)

Key: Y – Yoruba; I – Igbo; H – Hausa.

Table 2. Table showing phytochemical screening of the 23 plant species selected for the study.

S/N	Plant name	Alkaloids	Tannins	Saponins	Steroids	Phlobatannins	Terpenes	Flavonoids	Cardiac glycosides
1	*Bombax buonopozense*	+	+	+	+	-	-	+	+
2	*Alchornea laxiflora*	+	+	+	-	+	-	+	+
3	*Acalypha wilkesiana*	+	+	+	-	-	+	+	+
4	*Flueggea virosa*	+	+	+	-	+	+	+	-
5	*Calopogonium mucunoides*	+	+	+	-	-	-	+	+
6	*Millettia thonningii*	+	+	+	+	-	+	+	+
7	*Mucuna pruirens*	+	+	+	+	-	+	+	+
8	*Vigna racemosa*	+	+	+	-	-	+	+	+
9	*Sida urens*	+	+	+	-	-	+	-	+
10	*Hibiscus lunariifolius*	+	+	+	+	+	+	-	-
11	*Mansonia altissima*	+	+	+	+	-	+	+	+
12	*Waltheria americana*	+	+	+	+	-	+	+	+
13	*Corchorus aestuans*	+	+	+	+	-	+	+	-
14	*Corchorus olitorus*	+	+	+	-	-	+	-	-
15	*Glyphaea braevis*	+	+	+	-	-	+	-	+
16	*Triumfetta cordifolia*	+	+	+	+	-	+	+	+
17	*Uvaria chamae*	+	+	+	+	+	+	+	+
18	*Markhamia tomentosa*	+	+	+	+	-	+	+	-
19	*Ehretia cymosa*	+	+	+	-	-	+	+	-
20	*Crateva adansoni*	+	+	+	-	-	+	+	+
21	*Platostoma africanum*	+	+	+	+	-	+	+	-
22	*Leea guineensis*	+	+	+	+	+	+	+	+
23	*Tapinanthus globiferus*	+	+	+	-	-	+	+	+

Table 3. Indicators for the presence of the phytochemicals.

S/N	Secondary metabolites	Positive indicator	Total of plants where tested present
1	Alkaloids	Orange precipitate	23
2	Tannins	Greenish-black colouration	23
3	Saponins	Presence of froths/foams	23
4	Phlobatannins	Red precipitate	5
5	Terpenes	Reddish-brown coloration of the interface	20
6	Flavonoids	Yellow precipitate	19
7	Cardiac glycosides	Brown interface, violet ring below and greenish ring at lowest part	16
8	Steroids	Blue colouration	12

infections (6 plants), malaria (7 plants), eye problems (5 plants), skin infections, venereal diseases, convulsions, blood purification, arthritis, inflammations, kidney/urinary problems, measles, heart diseases, pile, leprosy, diabetes, epilepsy and many other infections. This is an indication that these selected plants have been widely used in the management of various human illnesses in the times past in various ethnogeographical areas. It is also interesting to note that many of the diseases treated with these plants are part of the diseases classified as tropical diseases, because of their common occurrence in the tropical regions of the world, of which Nigeria is one. Therefore, these plants are significant in the treatment of some common ailments in the country, indicating the relevance of the plants in phytotherapy. It is often said that there is hardly any human disease that has no cure from the plants; and that there is no plant without its therapeutic potency against one human disease or the other, including the so called weeds. This table showing the ethnomedicinal significance of these plants is another confirmation of these assertions. The fact that the medicinal uses of diverse tropical plants have not been totally discovered and maximally utilized is a strong reason for intensifying efforts on medicinal plant research, especially in Africa, where up to 90% of the population depends on them for primary health care. Furthermore, it could be observed from the table that various parts of the plants are used for different purposes. These plant parts include leaves, roots, stem bark, flower, seeds, wood ash etc., while different herbal preparatory methods were adopted, such as decoction, charring, infusion, squeezing among other methods. However, decoction appeared to be the most frequently used preparatory method in this ethnobotanical survey. Table 2 reveals the distribution of the secondary metabolites in all the twenty three plants used for this study, while Table 3 summarizes Table 2.

Alkaloids tested were present with the formation of orange precipitate and was detected in all the twenty three plant samples used. Previous studies on some of the plants by authors confirm these findings. Akinyemi et al. (2006) had earlier reported that *A. wilkesiana* contains alkaloids, while Ogundipe et al. (1999), Schmelzer (2007) and Njayou et al. (2008) confirmed the presence of alkaloids in *A. laxiflora*. Tabuti (2007) had reported detecting alkaloids in *F. virosa*, while Falodun et al. (2007) had confirmed the presence of alkaloids in *L. guineensis*. Alkaloids, the most revered of all the phytochemicals, are said to be pharmacologically active and their actions are felt in the autonomic nervous system, blood vessels, promotion of diuresis, respiratory system, gastrointestinal tract, uterus, malignant diseases and malaria (Trease and Evans, 1989). A cross reference of the pharmacological actions with the ethnomedicinal profile of the selected plants indicate that alkaloids might responsible for the antimalarial actions of six of the selected plants (*B. buonopozense, A. laxiflora, F. virosa, T. cordifolia, A. wilkesiana* and *M. tomentosa*) that were reported with therapeutic effects for malaria and fever. This may also reflect a high quantity of alkaloids in the plant samples. Because of the pharmacological actions of alkaloids in the gastrointestinal tract, it is suggested that alkaloids may also be responsible for the ethnomedicinal uses of some of the plants (*F. virosa, C. mucunoides, A. wilkesiana, L. guineensis, P. africanum* and *U. chamae)* in treating stomach ache, vomiting, intestinal worms, constipation, dysentery and diarrhea. Furthermore, alkaloids have been ranked among the most efficient and therapeutically significant plant substances (Okwu, 2005). Some 5,500 alkaloids are known (Harborne, 1973). Examples include nicotine, cocaine, morphine and codeine in *Papaver sominferum*; quinine in *Cinchona succirubra*; reserpine in *Rauwolfia vomitoria*, all of which have large demand worldwide. In addition, solasodine, an example of alkaloids have been indicated as a starting material in the manufacture of steroidal drugs (Maxwell et al., 1995). Alkaloids have analgesic, antiplasmodiac and bactericidal effects (Stary, 1998; Okwu and Okwu, 2004). Therefore, the analgesic properties of alkaloids may explain the relevance of *F. virosa, T. cordifolia, M. tomentosa, Ehretia cymosa* and *Creteva adansonii in* the treatment of aches, pains and migraine.

The actions of alkaloids on the autonomic nervous

system suggests that they may be responsible for the management of insanity, spasms, convulsions, paralysis and epilepsy as observed in *E. cymosa* and *B. buonopozense.* They have marked physiological effects on animals (Edeoga and Eriata, 2001). Alkaloids, comprising a large group of nitrogenous compounds are widely used as therapeutic agents in the management of cancer (Chabner and Horwitz, 1990). Chewonarin et al. (1999) isolated an alkaloid from *Hibiscus sabdariffa* and demonstrated its ability to prevent mutagenesis. Tannins are tested positive in the plant samples by the formation of greenish-black colouration. In this study, tannins were found to be present in all the selected plants used. Likewise, saponins are inferred to be present if frothing or foams are observed in the sample. Saponins, like alkaloids and tannins are present in all the twenty three plants used for this study. This result correlates with Alade and Irobi (1993) and Akinyemi et al. (2006) who had earlier reported the presence of tannins and saponins in *A. wilkesiana*. Furthermore, Ogundipe et al. (1999), Schmelzer (2007) and Njayou et al. (2008) had also reported the presence of saponins in *A. laxiflora*. According to Falodun et al. (2007), saponins were also noted to be present in *L. guineensis*.

Tannins are also well known for their anti-microbial properties; therefore this suggests that they may be useful in the treatment of venereal diseases. This was demonstrated in the presence of tannins in *Glyphaea brevis*, which may be responsible for its ethnomedicinal usefulness in treating sexually transmitted infections (STIs). In addition, tannins have soothing relief, helps to regenerate the skin, it is anti-inflammatory and diuretic (Okwu and Okwu, 2004). Tannins are complex phenolic polymers which can bind to proteins and carbohydrates resulting in reduction in digestibility of these macromolecules and thus inhibition of microbial growth (Nwogu et al., 2008). The oxidation inhibiting activities of tannins have been known for a long time and it is assumed to be due to the presence of gallic and diagallic acids (Ihekoronye and Ngoddy, 1985). Tannins from the bark, roots and other parts of many plants especially Euphorbiaceae are used to treat cells that have gone neoplastic (Duke and Wain, 1981). In this study, *Mucuna pruriens* was reported to have anti-neoplastic properties, and the phytochemical screening indicated that *M. pruriens* possess tannins. This could suggest that tannins have anti-neoplastic properties. Tannins are reported to have astringent properties on mucous membranes (Egunyomi et al., 2009). In addition to all these, tannins are also used in the treatment of wounds emanating from varicose ulcers and haemorrhoids (Nguyi, 1988) and to stop bleeding during circumcision (Joshua, 2006). The skin regeneration actions of tannins could explain its usefulness in wound healing, as recorded in the ethnomedicinal uses of *A. wilkesiana* and *U. chamae*. Saponins are glycosides of both triterpenes and steroids having hypotensive and cardiac depressant properties, and have been detected in over seventy plant families (Basu and Rastogi, 1967; Olaleye, 2007). They have been shown to possess beneficial properties by lowering the cholesterol level, have anti-diabetic and anti-carcinogenic properties (Trease and Evans, 1989) as well as being used as an expectorant and emulsifying agent (Edeoga et al., 2006). This could suggest that saponins may be responsible for the therapeutic effects of *M. pruriens* and *T. globiferus* against diabetes. Saponins bind to cholesterol to form insoluble complexes. Dietary saponins in the gut of monogastric combine with endogenous cholesterol excreted via the bile. This prevents cholesterol reabsorption and results in a reduction of serum cholesterol (Cheeke, 1971). Saponins have been found to be potentially useful for the treatment of hypercholesterolaemia which suggests that saponins might be acting by interfering with intestinal absorption of cholesterol (Malinow et al., 1977a, b). Saponins are reported as a major component acting as antifungal secondary metabolite (Onwuliri and Wonang, 2003). Saponins are also surface active agents which interfere with or alter the permeability of the cell wall and this facilitates the entry of toxic materials or leakage of vital constituents from the cell (Onwuliri and Wonang, 2003). Steroids are tested positive in plant samples by a blue colouration after adding concentrated sulphuric acid (H_2SO_4). In this study, only twelve plants were tested to possess steroids. Steroids regulate carbohydrate and protein metabolism, and possess anti-inflammatory properties; and this might correspond to the ethnomedicinal significance of *U. chamae* in the treatment of pile.

Phlobatannins are tested positive by the formation of red precipitate in tested samples. Only five of the plants used in this study possess phlobatannins. This secondary metabolite has astringent and styptic properties. Positive results for terpenes/terpenoids' test using Salkowski test is indicated by the formation of reddish-brown colouration of the interface. Twenty (20) plants out of 23 used for this study tested positive for terpenes. Earlier, Farombi et al. (2003) had discovered the presence of terpenoid compounds in the root samples of *A. laxiflora*. Terpenes or terpenoids have anti-hepatoxic properties, thus helping to prevent liver damage (cirrhosis), they equally have anti-microbial or anti-septic properties. This may explain the ability of *F. virosa* in the management of liver problems.

Flavonoids were inferred positive with the formation of yellow precipitate on the plant samples. Nineteen (19) of the plant samples tested in this study possess flavonoids.

It is also interesting to note that all members of the Fabaceae family used in this study possess flavonoids. Flavonoids are 15-carbon compounds generally distributed throughout the plant kingdom (Harborne, 1988). They are produced by plants in response to microbial infection and have been useful against an array of micro-organisms (Harborne, 1973). Flavonoids significantly

recognized for their anti-oxidant, anticarcinogenic, antimicrobial and antitumour properties (Kandaswami et al., 1994; Manikandan et al., 2006), and they might play a role in disease resistance (Salisbury and Ross, 1992). This may explain the ability of *W. americana* to boost the immune system. Flavonoids are a group of phytochemicals found in varying amounts in foods and medicinal plants which have been shown to exert potent anti-oxidant activity against the superoxide radical (Hertog et al., 1993). Its consumption has been documented not to be associated with mortality due to coronary heart disease. This may be as a result of its antioxidant activity and subsequent inhibitions of low density lipoproteins (LDL) oxidation known to have been attributed to the dietary and supplemental intake of flavonoids and other micronutrients. Epidemiologic studies indicate an inverse relationship between intake of dietary flavonoids and coronary artherosclerotic disease (Knekt et al., 1996). Antioxidants are radical scavengers which protect the human body against free radicals that may cause pathological conditions such as ischemia, anaemia, asthma, arthritis, inflammation, neuro-degenertion, Parkinson's diseases, mongolism, ageing process and perhaps dementias (Polterait, 1997) Flavonoids and flavones are widely distributed secondary metabolites with antioxidant and antiradical properties (Nakayoma and Yamada, 1995). This suggests that taking foods rich in flavonoids help to reduce the risk of heart diseases, and this is of great importance in pharmacology, medicine and human nutrition. In addition, flavonoids are phenolic in nature, and they act as cytoplasmic poisons which have been reported to inhibit the activity of enzymes (Dathak and Iwu, 1991). The anti-oxidant properties of flavonoids may be responsible for ability of some of the selected plants, such as *F. virosa* to treat several diseases like arthritis, anaemia and so on.

Using Keller Killiani test, Cardiac glycosides are tested positive when a brown interface appears, with violet ring below it and a greenish ring observed at the lowest part (acetic layer). In this study, 16 of the plants tested possess cardiac glycosides.

Cardiac glycosides are cardioactive compounds belonging to triterpenoids class of compounds (Brian et al., 1985). Their inherent activity resides in the aglycone portions of their sugar attachment. Their clinical effects in cases of congestive heart failure are to increase the force of myocardiac contraction (Brian et al., 1985). They exert their hypotensive effect by inhibiting Na+-K+ ATPase. Cardiac glycoside acts on the heart muscles and increase renal flow (diuresis). They also act directly on the smooth muscle of the vascular system. They exert a number of effects on neural tissue and thus indirectly influence the mechanical and electrical activities of the heart and modify vascular resistance and capacitance (Olaleye, 2007).

It is of pharmacological importance to note that *U. chamae* and *L. guineensis* are the only two plant samples in this study that contains all of the eight phytochemicals tested for in this study. *U. chamae* (Annonaceae) contains all the eight phytochemicals, and this could be used to support the fact that this plant has wide medicinal uses in various traditional communities across Africa. The antifungal and antibacterial inhibitory properties of *U. chamae* have been reported (Irvine, 1961). *L. guineensis* is the second plant used in this study that possesses all the eight secondary metabolites. However, much is not known or discovered about the ethnomedicinal uses of the plant. This calls for further studies on the ethnobotany of the plant, as well as the pharmacological significance of the secondary metabolites found in the plant. According to Oke and Hamburger (2002), *L. guineensis* was found out to possess antioxidant in low quantity. Furthermore, Falodun et al., (2007) had found out that aqueous extract *L. guineensis* leaves contained saponins, alkaloids and reducing sugars. It is interesting to note in this study, that plants representing family Sterculiaceae have the highest number of phytochemicals, the two representatives containing all the phytochemicals, except Phlobatanin.

The results of this study correlate with previous studies by Akinyemi et al. (2006) who had earlier reported that *A. wilkesiana* contained tannins, saponins, alkaloids, flavonoids and anthraquinones. Furthermore, studies by Alade and Irobi (1993) indicated that *A. wilkesiana* contains saponin, tannin, anthraquinones and cardiac glycoside. Schmelzer (2007) confirmed the presence of alkaloids, cardiac glycosides, saponins and phenolic compounds in the roots and leaves of *A. laxiflora*; a finding which correlated with the studies of Njayou et al. (2008) on *A. laxiflora*. In addition, phytochemical screening of the powdered leaf samples of *A. laxiflora* revealed the presence of alkaloids, cadiac glycosides saponins and phenolic compounds (Ogundipe et al., 1999; Adewole, 1993), while the presence of terpenoid compounds was recently discovered in the root samples of *A. laxiflora* (Farombi et al., 2003). Pilot studies of the crude and purified fractions of the leaves and roots revealed the presence of potent antiinflammatory and antimicrobial activities in the methanol extract (Ogundipe et al., 1999). Subsequently, quercetin– 7,4'-disulphate, quercetin, quercetin–3',4'-disulphate, quercetin–3,4'-diacetate, rutin and quercetrin were characterized from the methanolic leaf extract of *A. laxiflora* (Ogundipe et al., 2001). The isolated compounds were found to possess anti-microbial activity detected in Gram-positive, Gram-negative and fungal organisms (Ogundipe et al., 2001).

Furthermore, literature studies reveal that all parts of *F. virosa* contain indolizidine alkaloids, mainly isomers and derivatives of the highly toxic securinine, which is known from the arrow poison plant *Securidaca longipedunculata* Fresen. The main alkaloids related to securinine are virosecurinine (0.5% in the leaves), viroallosecurinine, norsecurinine, dihydronorsecurinine (virosine); other alkaloids include hordenine and N-methyltetrahydro-β-

carboline. Other compounds isolated from the leaves are the isocoumarine bergenin, gallic acid and ellagic acid, and the flavonoids quercetin and rutin. In addition, Methanol and water extracts of the leaves showed strong antimalarial activity, significantly inhibiting the growth of *Plasmodium falciparum in vitro* in a dose-dependent manner (Tabuti, 2007).

In this study, Fabaceae family was represented by four species, all of which tested positive for the presence of alkaloid, tannin, saponin and flavonoid. Three of the species also contain terpene, except *C. mucunoides*. In addition, only *M. thonningii* and *M. pruirens* contains steroids; while all the four lacks phlobatannin. This indicates a striking similarity in the phytochemical content of these selected plants in this plant family. Furthermore, the two members of the family Sterculiaceae (*M. altissima* and *W. americana*) contains all the phytochemicals, except phlobatannin. This is another example of striking resemblance in the phytochemical constituents of plants belonging to the same family. Furthermore, the three representatives of the family Euphorbiaceae have relatively wide differences in the secondary metabolites they contain. This observation is the same for the two species representing the family Malvaceae. The similarity and wide diversity in the distribution of secondary metabolites among plants in the same genus and family, as revealed in this study, is of taxonomic importance. As a result, the use of phytochemical constituents in plants as a taxonomic tool in classification has wide acceptability. It could also be observed that some of the phytochemicals have similar pharmacological actions, like tannins and flavonoids possess antimicrobial effects; anticancer actions of alkaloids, saponins and flavonoids, indicating that either of the three or their combination might play a contributory role to the therapeutic efficacy of *T. globiferus* in the management of cancer; anti-inflammatory properties of steroids and tannins; and hypotensive effects of cardiac glycosides and saponins. Previous studies have revealed that these phytochemicals have synergistic effects; thereby they complement each other in the manifestation of their pharmacological actions. Kaufman et al. (1999) extensively documented how synergistic interactions underlie the effectiveness of a number of phytomedicines. Therefore, alkaloids, cardiac glycosides and/or tannins may be responsible for treating kidney and urinary related problems as in *F. virosa.* Steroids and/or tannins may be responsible for the treatment of oedema, inflammations and elephantiasis, as observed in *B. buonopozense, A. laxiflora, F. virosa, C. adansonii, U. chamae* and *M. tomentosa*. Furthermore, flavonoids and/or tannins may play active role in the management and treatment of venereal (microbial) infections.

In conclusion, the results of this study indicate a wide diversity in the distribution of the secondary metabolites among the twenty-three plants used for this study.

Furthermore, it could be said that the ethnomedicinal significance of the selected plants for this study corresponds to the pharmacological actions of the secondary metabolites they contain. It is therefore, pertinent that further studies be carried out on the quantitative analysis of the phytochemicals in the samples were they are tested present. From that point, the specific metabolites can be screened and separated to undergo pharmacological processes and become a potent drug.

Furthermore, there is the need to focus research on the plants with antimicrobial properties, with the aim of screening the secondary metabolites in them against microbial growth. This is necessary because of the microbial resistance manifested by some of the pathogenic microorganisms against the common antibiotics (Fagbemi et al., 2009).

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