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Full Length Research Paper

Evaluation of plant-based non-timber forest products (ntfps) as potential bioactive drugs in South-western Nigeria

I. O. Lawal[1]*, A. B. I. Igboanugo[1], B. Osikarbor[3], O. P. Duyilemi[1], A. A. Adesoga[1], T. I. Borokini[2] and B. A. Adeyanju[1]

[1]Forestry Research Institute of Nigeria, Ibadan (FRIN), Oyo State, Nigeria.
[2]National Centre for Genetic Research and Biotechnology, Moor Plantation, Ibadan, Oyo State, Nigeria.
[3]Federal College of Forestry, Jericho, Ibadan, Oyo State, Nigeria.

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Non - timber forest products (NTFPs) are a very important aspect of the tropical forestry that cannot be overlooked. Medicinal plants – that cater for the health of over 80% of the human population in developing countries and about 25% of human population in developed nations, an estimate of over 4 billion people – are classified as part of the Non-timber forest products (NTFPs), and are repositories of phytochemicals, which are useful for the development of pharmaceutical drugs and other therapeutic products. This study was conducted to screen for the presence of phytochemicals and secondary metabolites in 15 samples prepared from 12 different plant species. The results reveal that different phytochemicals are present in different parts of different plant species, and therefore the need to screen different plant parts for the presence of secondary metabolites. It was also noted that the quantity of the secondary metabolites in the plant samples vary to a very high degree. Therefore, further phytochemical screening should be done on the medicinal plants to ascertain their curative properties and potentials revealed in ethnobotanical surveys. When such is done, the phytochemicals found in them are good potentials for the development of bioactive drugs and other pharmaceutical products.

Key words: Non-timber forest products (NTFPs), medicinal plants, secondary metabolites, phytochemicals, pharmaceutical drugs.

INTRODUCTION

Non-timber forest products (NTFPs) are defined as all the biological material (other than industrial round wood and derived sawn timber, wood chips, wood-based panel and pulp) that may be extracted from natural ecosystems, managed plantations etc and can be utilized within the household, be marketed or have social, cultural or religious significance (Wickens, 1991). Furthermore, Non-Timber Forest Products (NTFPs) consist of goods of biological origin other than wood, derived from forests, other wooded lands and trees outside forests (FAO, 1999). According to Emery (2001), non -timber forest products (NTFPs) are considered as any commodity obtained from the forest that does not necessitate harvesting trees. It includes game animals, fur-bearers, nuts and seeds, berries, mushrooms, oils, forages, medicinal plants, peat, fuel wood, forage etc.

Non-Timber Forest Products (NTFPs) have been used by man and continue to play an important role in live-lihood support in Africa and for Africans in Diaspora. For example, an estimated 105 tones of *Dacryodes edulis* and 100 tones of *Gnetum africanum* are exported from Cameroon, Congo, Gabon and Democratic Republic of Congo to France and Belgium annually (Tabuna, 1999). In recent decades, interest has grown in using NTFPs as an alternative or supplement to forest management practices such as clear cut logging. NTFPs serve as raw materials for industries ranging from large-scale floral greens suppliers and pharmaceutical companies to micro-enterprises centered on basket-making, wood carving, medicinal plant harvesting and processing, and a

*Corresponding author. E-mail: ibroodula@yahoo.com

variety of other activities. The importance of NTFP use to people from all corners of the world is evident in the enormity and variety of species collected for personal consumption and as a source of income. The term 'Plant-based non-timber forest products' could be used to describe all the non-woody or non-timber forest products derived from plants in forests and other wooded lands. Such plant-based non-timber forest products include medicinal plants, oils, fibers, forage and products used as food, fruits etc. Of these plant-based Non - Timber Forest Products, medicinal plants are considered as the most important and most significant.

According to World Health Organization, more than 4 billion people rely on traditional plant-based systems of medicine for their primary health care. Large segments - estimates are 80% of the populations of developing countries – depend on traditional plant medicines (Holley and Cherla, 1988; WHO, 1999; World Bank, 2001a, 2001b). According to the World Health Organization (WHO), the majority of the world's human population, especially in developing countries, depends on traditional medicine based on Medicinal and Aromatic Plants (WHO 2002). In Africa, up to 80% of the population uses traditional medicine for primary health care and the global market for herbal medicines currently stands at over US$60 billion annually and is growing steadily (WHO, 2003). The tropical rainforest, of which Nigeria is a part, has been described by Sofowora (1982) as a reservoir of phytomedicines. Medicinal plants contain biologically active chemical substances such as saponins, tannins, essential oils, flavonoids, alkaloids and other chemical compounds (Harborne, 1973; Sofowora, 1993) which have curative properties. These complex chemical substances of different compositions are found as secondary plant metabolites in or more of these plants. 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 (Iwu et al., 1999; 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.

However, the quality, potency and chemical composition of the phytochemicals could be affected by the location of the plant (whether cultivated or in wild natural habitat). In addition, Dietrich (2003) stated that the active principles of plants are generally secondary metabolites and their biosynthesis is controlled genetically and strongly influenced by the soil, climatic and agronomic factors. Many of the plants collected for their medicinal potentials are collected from the wild, while a few of them are semi - cultivated, domesticated or cultivated (Adeniji, 2005). Therefore, the present study was conducted to identify and collect some cultivated medicinal plants in IITA Arboretum and Agodi Botanical Garden, both in Ibadan; and as well conduct a phyto-chemical screening on the plants to reveal the secondary metabolites as potential sources of pharmaceutical products and drugs. The results of the phytochemical screening will be compared with similar screening done for such plants collected from the wild. Together, this work is expected to make case for bio - prospecting of medicinal plants collected from the South Western part of Nigeria.

MATERIALS AND METHODS

Study area

The research was carried out in IITA Arboretum and Agodi Botanical Garden, both located in Ibadan, Oyo State. Ibadan is located between latitudes7.38 and longitude 3.93 Ibadan lies within the lowland tropical rainforest zone of Nigeria.

Selected plants

Selected plants used for the study are 12. Table 1 shows the botanical and local names of the selected 12 plants and their families.

Data collection

The Study employed a combination of primary and secondary data collection methods. The main data sources consisted of a series of semi - structured questionnaires and informal interviews administered on local herb sellers and staff of IITA Arboretum and Agodi Botanical Garden, to collect ethnobotanical information on the selected medicinal plants. The inventories of local medicinal plants were obtained from the annals of the two arboreta where the 12 selected plants were collected. The information of the ethnobotanical and medicinal data were obtained through market surveys from local herb sellers in Bode, Oje, Omi and Oranyan areas of Ibadan metropolis. The scientific names of the selected plants were verified by taxonomists (Mr Femi Shasanya) at the Forestry Herbarium, Ibadan (FHI), Forestry Research Institute of Nigeria (FRIN).

Phytochemical screening

Screening for presence of secondary metabolites was performed following standard micro - chemical tests (Harborne and Harborne, 1998; Evans, 2002).

Cardiac glycosides

Two tests were conducted to test for the presence of Cardiac glycosides in the plant extracts. Keller-Killani test and Kedde test were used.

Keller-Killani test: 5 ml of each of the extracts were 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 (H_2SO_4). A browning of the interface indicates a deoxysugar characteristic of cardiac glycosides. Below the brown, a violet ring was observed, while in the acetic acid layer, a greenish ring was observed.

Tannin

The method of Trease and Evans (1989) was adopted. 0.5 g powderad crude drug was dissolved in 5 ml of distilled water, then boil

Table 1. List of the 12 selected plants for the present study.

S/N	Botanical Name	Family	Local name
1	*Isoberlinia doka* (Craib and Stapf)	Caesalpinioideae	Baabo
2	*Azadirachta indica* (A. Juss)	Meliaceae	Dongoyaro
3	*Pterocarpus santalinoides Lam*	Papilionoideae	Bembutu
4	*Pterocarpus osun* (Guill and Perr.)	Papilionoideae	Osun
5	*Xylopia aethiopica* (Dunal)	Annonaceae	Erunje
6	*Newbouldia laevis* (Seem)	Bignoniaceae	Akoko
7	*Spondias mombin* (Linn.)	Ancardiaceae	Iyeye
8	*Khaya ivorensis* (Welw.)	Meliaceae	Oganwo
9	*Chrysophyllum cainito* (Linn.)	Sapotaceae	Agbalumo
10	*Sarcosaphelus latifolius* (Smith)	Rubiaceae	Egbesi
11	*Rothmannia whitfeildii* (Dandy)	Rubiaceae	Buye nla
12	*Pentaclethra macrophylla* (Benth)	Mimosaceae	Apara

gently and cooled. 1 ml of this solution was put in a test tube and 3 drops of Ferric Chloride solution was added. A deep greenish - black colouration indicates a positive test for tannins.

Alkaloids

Dragendoff's reagent was used and the method described by Harborne (1973) was adopted. Powdered leaves (0.2 g) were extracted with 95% ethanol and 30 ml boiling water respectively in a Sohlet extractor for six hours and the extract evaporated to dryness using a vacuum evaporator. The residue was redissolved in 5 ml of 1% HCl and 5 drops of Dragendoff's reagent were added. The formation of orange precipitate indicates the presence of alkaloids.

Saponin

The persistent Frothing test for Saponin described by Odebiyi and Sofowora (1978) was used. To 1 g of the extract, 30 ml of tap water was added. The mixture was vigorously shaken and heated to boil. Frothing that persisted for 30 min shows the presence of Saponin.

Anthraquinone (Borntragerrs test)

1 g of powdered vegetable sample was gently boiled with 2 ml of 10% HCL for 5 min in water bath, filtered while hot and allows cooling. The cool filtrate was partitioned against equal volume of chloroform with gentle shaking. The chloroform layer was carefully transferred to another test tube and mixed with 4 ml of 10% ammonia solution and shaken. Rose pink colouration ion the aqueous layer indicates the presence of anthraquinone.

RESULTS AND DISCUSSIONS

The Tables shows the results of the ethnomedicinal significance and the phytochemical screening of the 12 selected plants used for this study.

Table 2 reveals the ethnomedicinal significance of the 12 selected plants collected and used for this study. The wide variety of the medicinal uses of these plants is an indication of the fact that they are well known and well used plants in the South western region of the country. In addition, different parts of the plants are used for the treatment of different and/or same ailments. Furthermore, the application of the plant parts for treating different diseases involves different preparation of the herbal medicine, and this includes infusion, decoction, charring (burning) and poly herbal formulations.

Table 3 reveals the results of the phytochemical screening of different parts of the 12 selected plants used for the study. The leaf and bark of the plants were tested for the presence of secondary metabolites such as anthraquinones, saponin, tannins, alkaloids and cardiac glycosides. Anthraquinone was observed to be present in large quantity in *Spondias mombin* bark, in moderate quantity in *Isoberlinia doka* leaf, and trace quantity in the bark of *Xylopia aethiopica* and *Pterocarpus santalinoides*; while it is absent in the rest of the samples scrennedfor anthraquinone. Saponin was found to be present in large quantities in the barks of *Azadirachta indica, Xylopia aethiopica, Nauclea latifolia, Chrysophyllum cainito;* and in moderate quantity in the bark of *Khaya ivorensis* and the leaves of *Isoberlinia doka* and *Rothmannia whitfeildii.* It is present in small quantity in *Isoberlinia doka* leaves and the bark of *Newbouldia laevis* and *Pterocarpus santalinioides.*

Alkaloid was not abundant in the 15 selected samples for the phytochemical screening. *Khaya ivorensis* and *Pterocarpus santalinoides* barks have moderate quantities of alkaloids, while *Newbouldia laevis* and *Isoberlinia doka* barks possess small quantity of alkaloids, while it is found in trace quantity in the barks of *Pterocarpus osun* and *Nauclea latifolia.* Tannins were found in large quantity in *Nauclea latifolia, Pentaclethra macrophylla* and *Spondias mombin barks as well as Isoberlinia doka* leaf sample. Furthermore, it is also found in moderate quantity in Khaya ivorensis bark and *Rothmannia whitfeildii* leaf. *Isoberlinia doka* leaf and *Pterocarpus santalinioides* bark were tested to contain small quantities of tannin. Two tests were conducted for

Table 2. Ethnomedicinal significance of the 12 selected plants used for this study.

S/N	Plant	Part used	Preparation and use
1	*Isoberlinia doka* (Craib and Stapf)	Bark, root and leaves	Root is used for scrotal elephantiasis (Decoction), Bark for infertility (Tincture) and leaves for jaundice by infusion.
2	*Azadirachta indica* (A. Juss)	Leaves, stem, bark and seeds (Kerharo et al., 1974)	Leaves and stem bark decoction used for malaria treatment (dosage: one cup of the decoction a day for 3 days). Root bark is anthelmintic, antipyretic, carthatic and emetic. Stem and root bark and leaf decoction are used for skin diseases, jaundice and liver complaints. Ripe fruits are recommended for urinary diseases, pile and as blood purifier. Seed oil is recommended as an antiseptic in dressing leprosy.
3	*Pterocarpus santalinoides Lam*	Root, stem bark and fruit (Bamgbose et al., 1979)	Used as astringent, antipyretic and nervous sedative.
4	*Pterocarpus osun* (Guill and Perr.)	Leaves, stem and bark	The powder of the dried leaves and bark is made into paste with any brand oil and is applied for superficial skin diseases such as eczema, candidiasis and acnes.
5	*Xylopia aethiopica* (Dunal)	Fruit, bark	Fruit decoction mixed with the root and bark of *Strychnos inoqua, Gardenia ensiifolia, Olax subscorpioidea, Uvaria chamae* and *Annona senegalensis* is given as remedy for stomche ache. Open dried fruits (without seed) is burnt and ground into powder and mixed with palm oil. The mixture is licked as remedy for cough, neurugia, as a carminative and purgative. The fruit is grinded and added to snuff to increase pungency. A decoction of 7 fruits of *Xylopia aethiopica*, leaves of *Alstonia boonei* and *Wissadula ampellisime* used to bathe the child act as anticonvulsant for children. Fruit decoction of *Xylopia aethiopica* and stem bark of *Newbouldia laevis* is given as remedy for amennorhea (Dalziel, 1977).
6	*Newbouldia laevis* (Seem)	Bark, leaves and root	Young leaves crushed in little water and the extract applied directly to treat eye inflammation and redness. It also administered to stop vaginal bleeding in threatened abortion (Kargbo, 1982). Root and leaves are used as roundworm expellants, treatment of elephantiasis, dysentery, malaria, stomachic, migraines and convulsion.
7	*Spondias mombin* (Linn.)	Bark, leaves, fruit	In Igbo land, the fresh leaves extract is applied to the eye once to cure eye ailment, dizziness especially after childbirth. The leaves and bark decoction is a remedy for cough, fever, yaws and is diuretic. Lambo (1979) stated that the leaves are gargle for sore throat, cold and diarrhea. In Yoruba land, the decoction of 61 leaves each of *Spondias mombin* and *Rauwolfia vomitoria* and 7 fruits of *Xylopia aethiopica* are used for bathing ascites patient (Gbile, 1986). Leaf Decoction is remedy for gonorrhea, leaf infusion taken as laxative.
8	*Khaya ivorensis* (Welw.)	Stem and root bark (Gbile, 1988)	Stem and root bark decoction used as remedy for malaria (one wine glass thrice a day). It is anthelmintic, emetic and emmenagogue. Also used along with maceration of root of *Ziziphus mucronata*, whole plant of *Allium ascalonicum* and *Mondia whitei* for the treatment of jaundice, taken orally.
9	*Chrysophyllum cainito* (Linn.)	Bark (Gelfand, 1964)	Stem bark decoction for fever, cold, as an antiperiodic and stomachic. Bark infusion in cold water as carminative.
10	*Sarcosaphellus latifolius* (Smith)	Leaves, stem and fruit (Hotellier et al., 1975)	Leaf decoction used to treat stomach upset in children in Igbo land. Root infusion to treat stomach upset in adults. Adesina et al. (1987) reported that leaf and root infusion is given to improve fertility, also as a febrifuge, to treat jaundice and dizziness.
11	*Rothmannia whitfeildii* (Dandy)	Fruit (Sofowora, 1979)	Fruits are used as febrifuge, analgesic, emetic and for filiariasis and dysentery.
12	*Pentaclethra macrophylla* (Benth)	Leaves, bark, root	Leaves boiled with *Piper guineensis* and a wine glassful taken twice daily for treatment of general weakness. The leaves are chewed and applied to the abdomen of a pregnant woman to ensure good development of the foetus. Bark decoction is used as fever remedy, stomach ache, appetizer and a healing lotion for sores. The bark is used as fish poison.

the presence of cardiac glycosides in the samples used for the phytochemical screening: Keller-Killani test and Kedde test. The results obtained for the two independent tests almost corresponded in all the 15 samples, with exception of few. In summary, cardiac glycosides were found to be present in large quantities in the barks of *Nauclea latifolia* and *Newbouldia laevis*. In addition, it was also found to be present in moderate quantities in *Azadirachta indica* bark, *Xylopia aethiopica* bark, *Isoberlinia doka* leaf, Chrysophyllum cainito bark and *Pentaclethra macrophylla* bark. In all, *Khaya ivorensis* leaf tested negative to all the secondary metabolites used

Table 3. Phytochemical Screening of the 12 selected plants used for the study.

S/N	Sample	Part	Anthraquinone	Saponin	Alkaloid	Tannin	Cardiac glycoside	
							Keller-Killani test	Kedde test
1	*Khaya ivorensis*	Leaf	-	-	-	-	-	-
		Bark	-	++	++	++	+-	-
2	*Pterocarpus osun*	Bark	-	-	+-	-	+	+
3	*Azadirachta indica*	Bark	-	+++	-	++	++	++
4	*Xylopia aethiopica*	Bark	+-	+++	-	-	++	++
5	*Nauclea latifolia*	Bark	-	+++	+-	+++	+++	+++
6	*Isoberlinia doka*	Leaf	++	++	-	+++	++	++
		Bark	-	+	+	+	++	+
7	*Chrysophyllum cainito*	Bark	-	+++	-	-	++	++
8	*Rothmannia whitfeildii*	Leaf	-	++	-	++	+	+
9	*Spondias mombin*	Bark	+++	-	-	+++	-	+
10	*Pentaclethra macrophylla*	Bark	-	-	-	+++	++	++
11	*Newbouldia laevis*	Bark	-	+	+	-	+++	+++
		Leaf	-	-	-	-	++	-
12	*Pterocarpus santalinoides*	Bark	+-	+	++	+	+	+-

+++ Highly present; ++ Moderately present; + Small quantity; +- Trace; - Absent.

for the phytochemical screening, while *Isoberlinia doka* leaf and *Nauclea latifolia* bark were tested positive for all, except one phytochemical each.

DISCUSSIONS

Plants are significant sources of medicines that are used in the treatment of various categories of human diseases. The tropical rainforest, of which Nigeria is a part, has been described by Sofowora (1982) as a reservoir of phytomedicines.

Medicinal plants contain biologically active chemical substances such as saponins, tannins, essential oils, flavonoids, alkaloids and other chemical compounds (Harborne, 1973; Sofowora, 1993) which have curative properties. These complex chemical substances of different compositions are found as secondary plant metabolites in or more of these plants. 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 (Iwu et al., 1999; 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.

Phytochemicals, generally have a wide range of pharmacological activities or actions (Trease and Evans, 1989; Swain, 1966). 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, infections and malaria (Trease and Evans, 1989; Omotayo and Omoyeni, 2009). Tannins are well known for their anti-oxidant and anti-microbial properties. Saponins lower the cholesterol level; have anti-diabetic and anti-carcinogenic properties (Trease and Evans, 1989). The results indicate that the different phytochemicals are present in different parts of different plant species, and therefore the need to screen different plant parts for the presence of secondary metabolites. It was also noted that the quantity of the secondary metabolites in the plant samples vary to a very high degree. Therefore, further phytochemical screening should be done on the medicinal plants to ascertain their curative properties and potentials revealed in ethnobotanical surveys. When such is done, the phytochemicals found in them are good potentials for the development of bioactive drugs and other pharmaceutical products.

Therefore, these plants and the phytochemicals present in them are great potentials for the development of pharmaceutical products and drugs to treat even the dreaded human diseases. In addition, this can be a source of income generation for individuals and the country at large, as well as source of self employment and job creation. We have earlier discussed the market demand for medicinal products and its impact on the economy and the health of the nation.

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