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CONTENTS

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NON-TIMBER FOREST PRODUCTS IN PHYTOMEDICINE AND CULINARY USES.

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Abstract

This paper is focused on medicinal and culinary uses of non-timber forest products. A medicinal plant is any plant which one or more of its organs contain(s) substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. Culinary plants on the other hand are those plants or products thereof used to flavour foods or beverages before, during or after their preparation. There is no clear distinction between spices and condiments. In the same vein, the distinction between food and medicinal plant is not clear-cut as many edible plants are also used in traditional medicine. Examples of these include: Vernonia amygdalina; Pterocarpus spp. Vitex doniana, Gongoronema laitfolium, Ocimum gratissimum, Crassocephalum rubens; Xylopia aethiopica; Piper guineense and Lactuca taraxacifolia. An attempt is made here to present information on some common medicinal plants with emphasis on their common, scientific and family names; ailment(s) they are used to treat, part(s) of plant used and the relevant authority. Culinary plants including spices and aromatics and the problems militating against the sustainable utilization of these valuable products are discussed while possible conservation methods are proposed.

Key words: *Non-timber, Forest , Medicinal, Culinary, sustainability, conservation*

Introduction

The term *Non-timber forest products (NTFPs)* has been variously defined by different authors and organizations. For instance Okafor (1978) , Falconer (1991), Clark and Sunderland (2000) defined non-timber forest products as a vast number of edible and non-edible products utilized by rural and urban people for subsistence or for local and external trade. Non-timber forest products include: medicinal plants, fibers, resins, latex, fruits, food and construction materials other than timber that are sourced from forest ecosystem by forest user groups (Laird and Sarah, 1995; Padock and DeJong, 1995, Clark and Sunderland). Closely related to the term non-timber forest products is *non-wood forest products*, which is sometimes used interchangeably with NTFPs. According to Wickens (1994) non-timber forest products are all biological materials (other than wood products) that may be extracted from natural ecosystems and managed plantations and that can be utilized within the household, be marketed or have social, cultural or religious significance. Going by FAO (2000), non-wood forest products consist of goods of biological origin other than wood derived from forests, other wooded land and trees outside forest. For the purpose of this paper, NTFPs shall be regarded as goods of biological origin obtained from the forest or associated ecosystems for domestic consumption, trade, and cultural or traditional uses. Some of the uses include food and food supplements, shelter, healthcare, household income supplement, rural employment, cultural and traditional benefits, recreation and tourism.

Use Of Plants In Phytomedicine

Phytomedicine includes drugs in diverse forms such as decoction, infusion, concoction, powder, ointment or liquid whether orthodox or traditional which are derived from plants. The

active ingredient may be extracted from leaves, roots, bark, flower, seed or even stem and in some cases whole plants especially where herbs are concerned. Any plant, which either in part or whole, is able to provide ingredients employed in healthcare delivery, is therefore a medicinal plant. Man has realized the medicinal properties and probably toxic effects of plants around him as far back as 3000 years B.C. (Sofowora 1993). According to Lewington (1993) over 35,000 plant species are utilised in various human cultures globally for medicinal purposes. Various traditional medicinal practitioners such as herbalists, village midwives, traditional psychiatrists, spiritual healers and traditional bonesetters make use of plant materials in health care delivery.

According to Hutchens (1973), pharmacognosy, which has now developed to the stage of specific therapeutic chemicals, actually originated from the indigenous knowledge of traditional medicinal practitioners. Several plant parts either used singly or in combination with others have been utilized effectively for the treatment of virulent ailments such as arthritis, asthma, cancer, cholera, diabetes mellitus, hernia, hypertension, hemorrhoids, oedema and typhoid fever (Olson, 1991; Kafaru,1994; Olapade, 1995 and Adebisi, 1999).

FAO (1991) observed that there is an increasing demand in the western world for the use of specific official herbal materials in preference to synthetic pharmaceuticals. Over 25% of all prescription drugs in the Organization for Economic Cooperation and Development Countries (OECD) and up to 60% of those in Eastern Europe prove to consist of unmodified or slightly altered higher plant products (the Lancet 1994). Therapeutics such as contraceptives, steroids (e.g. predinisone) and muscle relaxants for anesthesia and abdominal surgery are made from wild yam (Dioscorea) composite, diosgenine from Dioscorea deltoids; codeine from *Papaver somniferum*; aspirin from *Salix capensis*, reserpine from *Rauvolfia vomitoria* and many others (Sofowora, 1993).

The knowledge of the medicinal properties of plants is passed down usually orally from one generation to the other. Sometimes treatment of a particular ailment or disease such as epilepsy and mental disorder is the exclusive right of a particular family in parts of Africa. Such family secrets are usually jealously guarded from outsiders. Some of the diseases commonly treated by general herbal practitioners and the herbs used for the treatment are discussed next. Leaf infusion of Madagascar periwinkle – Carttaranthus roseus is used in Madagascar, South Africa, Philippines, Jamaica, India and Australia for treating diabetes (Parry 1981). Leaves of Solanum nigrum are used as a fomentation for various skin diseases, wounds and sore eyes. The fresh seeds can reduce blood sugar level in diabetic patients. Also the fruits of *Passiflora edulis* are mildly narcotic, astringent and have soothing properties. It is used in southeast Asia as a sedative and analgesic in cases of itching, skin complaints, headaches hemorrhoids and painful arthritic swelling (FAO 1984). Furthermore, roots and leaves of Annova senegalensis are used in traditional medicine in East Africa (FAO 1983). The coca plant – Erythoxylum coca has been known to mankind for several thousand years. Although its use has been abused through consumption of cocaine, it is believed to be physiologically beneficial for Andean Indians in their adaptation to hunger, cold and fatigue at high altitudes (Lausane 1981). Several useful drugs also contain chemicals extracted from the coca plant (Erythroxylum coca).

As reported by Irvine (1961), the leaves of Aristolochia bracteata are used as an antidote for snake poison and scorpion stings and also as a cure for boils and guinea worm. Sofowora (1993) also reported the use of the root and stem extracts of the same plant for the stimulation of uterine contractions in pregnant women.

Furthermore, Sofowora (op.cit) reported the usefulness of *Momordica charantia* in phytomedicine. The roots are used as an aborifacient and aphrodisiac in India, Ghana and Nigeria while the leaves are used Democratic Republic of Congo for colic; fruits are used as an anthelmintic and leaves decoction as a purgative.

A decoction of the herb Euphorbia hirta collected in the flowering and fruiting stages is

used in asthma and respiratory tract inflammations, and are sometimes combined with bronchial sedatives like Grindelia robusta in preparations for inhalation in East and Central Africa (Oliver 1959 and Kokwaro 1993). Furthermore leaf decoction of *Moringa oleifera* is used as anthelmintic, fruit is useful in treating diseases of the liver and pancreas. Root bark is used as a diuretic, stomachic and aborifacient (Oliver 1959; Watt and Breyer Brandwidjk, 1962).

In Nigeria the leaves of *Rauvolfia vomitoria* are sued as an infusion for the treatment of diabetes and hypertension (Kafaru 1993, Olapade 1995 and Adebisi 2001). Powdered roots of the same plant are used as an aphrodisiac and a sedative for mentally disturbed patients while that of Rauvolfia serpentine is used as an antidote for snake and scorpion poisons (Jensen 1981).

According to Irvine (1961) the roots of Tamarindus indica is used as a remedy against sleeping sickness and also as a component of poison antidote and component of drug used in treating leprosy in northern Nigeria. It is used against heart pain in Tanzania. The root is sued together with the barks and leaves of *Diospyros mespiliformis* against leprosy in Nigeria (Kafaru 1994). The leaves of Vernonia amygdalina are sued against diabetes, menstrual pains, malaria and urinary inflammation. The leaves are also used together with the leaves of Ocimum gratissimum in the treatment of hemorrhage and abdominal pains in Nigeria.

Ricinus communis leaves are used against hemorrhoids. The seeds are laxative and also used for wound dressing and treatment of mental illness. The leaves of Carica papaya are used in the treatment of malaria in Nigeria. Fruits and roots are used against snakebite, tooth and stomach aches. Olapade (1995) recommended the consumption of unripe pawpaw for the treatment of diabetes mellitus. Roots, leaves and barks of Anacardium occidentale are used against vomiting and coughs.

These are only few examples of plants used in phytomedicine, the list is in – exhaustible as more and more discoveries are being made as scientists interact with the local people for the acquisition of indigenous knowledge. A summary of the common medicinal plants, their uses, part(s) of the plant used and the relevant authorities is presented in Table 1.

S.N.	*Scientific Name*	Common Name(s)	Family	Uses	Part(s) Used	Authority
1.	*Elaeis guineensis*	Oil-palm tree	Palmae	Aphrodisiac;;	Urine	Dalziel(1937); Kokwaro (1968);
2	*Annona senegalensis*	Sour sop	Annonaceae	Analgesic	Wood. leaves and roots	FAO 1984 Parry (1969)
3.	*Xylopia aethiopica*	Negro pepper/ Guninea Pepper	Annonaceae	Nervousness	Fruits	FAO 1984 Parry (1969)
4.	*Hibiscus sabdariffa*	Cauliflower	Malvaceae	Nervousness, asthenia and guinea worm	Flower	FAO 1984 parry (1969)
5.	*Corchorus olitorius*	Indian jute/Jew's mallow	Tiliaceae	Vertigo	Seeds	FAO 1984 parry (1969)
6.	*Passiflora edulis*	Passion fruit	Passifloraceae	Hypertension, high blood pressure	Fruits	Adebisi (pers. Comm.. 2002).)
7.	*Passiflora foetida*	Passion fruit	Passifloraceae	Mild nacrotic; astringent sedative, analgesic	Leaves and fruits	FAO (1983)
8.	*Sesuium portulacastrum*	Purslane sesuvium/ Sea purslane	Portulacaceae	Flavouring agent	Leaves	FAO (1983)

9.	*Solanum nigruum*	Black nightshade	Solanaceae	Treatment of skin diseases wounds and sore eyes ,cosmetics and anti diabetic	Seeds	FAO (1983)
10.	*Combretum mucronatum*	Combretum	Combretaceae	Guinea worm	Root	Sofowora (1993)
11.	*Rauvolfia Vomitoria*	Asofeyeje (*Yor.*)	Apocynaceae	Sedative; anti diabetic	Roots; leaves	Jansen (1981)
12.	*Rauvolfia serpentine*	Indian snake root	Apocynaceae	Antidote to snake bite and scorpion sting	Root	Jansen (1981)
13.	*Aristolochya bracteata*	Dutchman's pipe	Aristolochiaceae	Antidote to snake bite and scorpion strings, uterine contractions in pregnant women and treatment of fowl and neglected ulcers	Leaves, stems and root	(Irivine 1961 and Sofowora 1993)
14.	*Momordica charantia*	Bitter apple/bitter cucumber	Curcubitaceae	Abortifacient, aphrodisiac, anthelmintic purgative and gastro intestinal disorders	Roots and leaves	Sofowora (1993)
15.	*Euphorbia hirta*	Australian Asthma herb / cat's hair/ hairy herb	Euphorbiaceae	Asthma and respiratory tract inflammation and together with Grindelia robusta as brandial sedatives	Whole plant	Oliver 1959; Kokwaro 1993
16.	*Moringa oleifera*	Horse radish/drumstick/Radish tree/Ben-nut tree	Moringaceae	Anthelmintic liver and pancreas diseases; goiter and acute rheumatism and as a remedy for hysteria and scurvy Diuretic, stomachic and aborifacient	Leaves; fruit, Root back	Oliver lasa; widjk, 1962
17.		Country mallow	Malvaceae	Dysentery	Root	Jansen (1981)
18.	*Acacia nilotica*	Acacia	Mimosaceae	Dysentery, febrifuge; haemorhoids, Lactogenic	Bark	Jansen (1981)
19.	*Adansonia digitata*	Baobab	Bombacaceae	Against vomiting, baby tonic	Root, bark together with coconut husk	Adebisi (pers. Comm.. 2002).

20.	*Ageratum conyzoides*	Goat weed	Compositae	Wound dressing; jaundice; intestinal infections	Leave decoction	Adebisi (pers. Comm..2002).
21.	*Allium sativum*	Garlic	Amaryllidaceae	Ulcer; hemorrhoids; stomachic disorder.	Bulb	Sofowora (1993)
22.	*Allophylus africana*	African allophylus.	Sapindaceae	Anthelmintic; venereal disease	Leaves; fruits	Jansen (1981)
23.	*Aloe spp.*	Alloe vera	Asphodelaceae	Earache; pile; eye diseases, laxative; febrifuge, spleen and liver complaints	Leave latex	Jansen (1981)
24.	*Anacardium occidentale*	Cashew	Anacardiaceae	Cough and vomiting	Leaves roots and bark fairly ripe fruits	Jansen (1981)
25.	*Anogeissus* leiocarpa(D.C.) Guillemin&Perrottet	Ayin (Yor.)	Combretaceae	Dysentery	Fruit	Jansen (1981)
26.	*Balanites aegyptiaca*	Soap berry	Agiaciadaceae	Disinfectant wound dressing anthelmintic and laxative	Leave extract and decoction	Jansen (1981)
27.	*Asparagus asiaticus*	Asparagus	Liliaceae	Paralysis, gonorrhea febrifuge	Leaves and roots	Jansen (1981)
28.	*Brassica nigra*	Black mustard	Brassicaceae	Amoebic dysentery, stomach ache, constipation and abscess dressing	Seed	Jansen (1981)
29.	*Calotropsis procera*	Apple of Sodom	Asclepiadaceae	Nose inflammation; leprosy, small pox and venereal diseases	Sap	Jansen (1981)
31.	*Capsicum annuum*	Hot pepper	Solanaceae	Febrifuge; common cold, stomach ache; hernia	Seed	Jansen (1981).
32.	*Carica papaya*	Pawpaw	Carcaceae	Yellow fever and jaundice	Unripe fruit latex	Adebisi (pers. Comm..2002).

53.	*Sena anguistifolia*	Cassia	Caesalpiniaceae	Laxative	Leaves & fruits	Jansen 1981
54.	*Cassia occidentalis*	Cassia	Caesalpiniaceae	Febrifuge	Leaves	Jansen 1981
55.	*Celosia argentea*	Celosia	Amaranthaceae	Dysentery; menstruation	Flower	Jansen 1981
56.	*Combretum paniculatum*	N.A.	Combretaceae	Leprosy	Herb	Jansen 1981
57.	*Crotalaria retusa*	Rattle box	Papilionaceae	Wound dressing bloat	Leaves root	Jansen 1981
58.	*Cymbopogon citrates*	Lemon grass	Gramineae	Chest, heart and stomach complaint	Leaves	Jansen 1981
59.	*Datura metel*	Purple thorn apple	Solanaceae	Narcotic; pain-killing	Leaf-smoke seed-oil	Jansen 1981
60.	*Eleusine corocana*	Goose grass/bull grass	Gramineae	Dysentery	Seed	Jansen 1981
61.	*Grewia chaueinfurthii*	N.A.	Tiliaceae	Wound dressing	Leaves	Jansen (1981)
62.	*Gardenia lutea*	Box wood	Rubiaceae	Syphilis, haemostatic	Leaves	Jansen (1981)
63.	*Heliotropium indicum.*	Scorpion weed	Boranginaceae	Wound dressing, constipation and bloat	Leaves	Jansen (1981)
64.	*Hibiscus sabdarifa*	Cauliflower	Malvaceae	Aphrodisiac	Seed	Jansen (1981)
65.	*Jatropha curcas*	Physic nut/ Purging nut	Euphorbiaceae	Purgative	Seed	Jansen (1981)
66.	*Phoenix reclinata*	Wild date palm/Senegal date palm	Palmae	Plenritis	Root	Jansen (1981)
67.	*Podocarpus gracilor*	Yellow wood	Podocarpaceae	Gonorrhea skin diseases	Fruit	Jansen (1981)
68.	*Portulaca oleracea*	Common purslane	Portulacaceae	Diaphoretic	Herb	Jansen (1981)
69.	*Pterolobium stellatum*	N.A.	Mimosaceae	Tuberculosis	Leaves	Jansen (1981)
50.	*Ricinus communis*	Castor oil	Euphorbiaceae	Hemorrhoids laxative, wound dressing and mental illness	Seed	Jansen (1981)
51.	*Tephrosia uniflora*	Tephrosia	Papilionaceae	Scorpions sting	Seed	Irvine 1961
52.	*Vernonia amygdaelina*	Bitter leaf	Compositae	Menstruation pains; purgative, malaria; vermifuge; wound dressing urinary inflammation	Leaf decoction	Jansen 1981
53.	*Zingiber officinale*	Alligator pepper	Zingiberaceae	Stomach disorder; mental illness; cough and common cold	Seed	Adebisi (pers. Comm..2002).
54.	*Zizyphus mauritiana*	Common jujube	Rhamnaceae	Astringent	Root	Jansen 1981

54.	*Zizyphus mauritiana*	Common jujube	Rhamnaceae	Astringent	Root	Jansen 1981
55.	*Solanum nigrum*	Garden egg	Solanaceaae	Antidiabetic, hypotonic	Leaves & seeds	
56.	*Ocimum gratissimum*	Sweet basil	Lamiaceae	External application against snakebite and scorpion sting eye diseases and rheumatic pain. Aphrodisiac diuretic and purgative	Leaves	Jansen 1981
57.	*Cissampelos owariensis*	Pareira	Menispermaceae	Antidiarrhoea and antiabortion	Leaves	Gbile 1986
58.	*Capsicum frutescens*	Hot pepper	Solanaceae	Mouth sore hernia toothache	Fruits	Adebisi 1999

Although thousands of plants are utilised in healthcare delivery globally, only very few of them have been analysed pharmacologically to isolate the active principles. Interestingly local herbal practitioners are often opposed to the isolation of active ingredient from plants as they are of the opinion that the creator has perfected the healing constituent of each plant. According to Kafaru, (1994) and Adebisi,(1999) the usual side effects that occur in the consumption of orthodox drugs are as a result of the activity of man in removing or isolating only the supposed active ingredients from the plant thereby, neglecting the natural neutralizer of such chemical, which God has put in the plant. Nevertheless, scientists have succeeded in extracting some very useful active ingredients from plants, which are being used in the treatment of virulent diseases such as cancer, diabetes and fever. Table 2 presents a list of some medicinal compounds of plant origin.

Table 2: Some Orthodox Drugs of Plant Origin and Their Uses

SN	PLANTS	DRUGS	USE(S)
1.	*Dioscorea deltoids*	Diosgenine	Oral Contraceptive
2.	*Papaver somniferum*	Codeine, Morphine and Thebaine	Analgesic, energizer and anabolic
3.	*Atropa belladonna*	Atropine,Buscopan and Donnatal	Anticholinergic
4.	*Hyoscyamus niger*	Hyoscyamine	Anticholinergic
5.	*Digitalis lanata*	Digoxine	Cardio-tonic
6.	*Digitalis purpurea*	Digitoxine	Cardio-tonic
7.	*Datura stramonium*	Scopolamine	Anticholinergic
8.	*Pilocarpus jabonandi*	Pilocarpine	Cholinergic
9.	*Cinchona ledgeriana*	Quinidine	Antimalaria
10.	*Salix carpensis*	Aspirin	Antipyretic and analgesic
11.	*Rauvolfia vomitoria*	Reserpine	antihypertensive
12.	*Ocimum gratisimum*	Thymol	Antiseptic, antidiarrhoea and anthelmintic.
13.	*Sena angustifolia*	Anthraquinone	Purgative
14.	*Catharanthus roseus*	Velban and vincristine	Leukemia
15.	*Claviceps purpurea*	Ergotine and Ergometrin	Uterine contraction
16.	*Erythroxylum coca*	Cocaine	Local anaesthetic
17.	*Penicillium notatum (fungus)*	Pencilin	Antibiotic
18.	*Aloe vera*	Barbaloin	Purgative
19.	*Strychnos muxromica*	Strychnine	Stimulant
20.	*Pysostigma venenosum*	Pysostigmine	Eye treatment
21.	*Smilax spp*	Diosgenin	Oral contraceptive
22.	*Anninckia clorantha*	Beberine	Malaria
23.	*Moringa oleifera*	Pterygospamine	Antibacterial
24.	*Momordica charanthia*	Foetidine/charantin	Antibacterial
25.	*Ephedra spp.*	Ephedrine	Energizer/anabolic

There is no clear demarcation between what constitutes medicine or food when non-timber forest products are concerned. Many plants utilized in both traditional and orthodox medicines are also consumed either as food (e.gs. Annona mauricata, Carica papaya, Treculia africana *and* Mangifera indica; *food supplements (egs.* Dacryodes edulis; Ocimum gratissimum; Vernonia amygdalina; Crasocephalum rubens; Talinum triangulare*); snacks (e.g.* Phoenix dactylifera; Chrysophyllum albidum, *and* Garcinia kola*) and spices and flavours (eg.* Allium sativum, Tetrapleura teraptera; Parkia biglobosa; Pipper nigrum; Ocimum spp; Zingiber officinale; Pipper guineense *etc).* All those plants consumed directly or as food supplements, snacks or spices and flavours are referred to as culinary plants in this paper.

NTFPs IN CULINARY USES

The culinary uses of plants include consumption as food, food supplements, snacks, spices, condiments and flavouring.

NTFPs AS FOOD AND FOOD SUPPLEMENTS

Some plants and their parts particularly fruits and seeds are consumed as food and food supplements in many parts of the world. Some of the plants in this category include: *Carica papaya; Artocarpus spp; Treculia africana; Dacryodes edulis; Kigelia africana and Pentaclethra macrophyla.* Also included in this category are vegetables, which are usually prepared in soups and sauces and consumed along with other food items. Examples of these include: *Vitex doniana; Lactuca taraxacifolia; Sesamum indicum; Sesamum radiatum; Ceratotheca cesamoides; Crassocephalum rubens; Cucumeropsis mannii; Celosia trigyna, Celosia laxa, Adansonia digitata; Bombax brevicuspe; Talinum triangulare; Moringa oleifera; Gnetum africanum; Solanum melongina; Irvingia gabonensis; Irvingia wombulus; Colocasia escullenta; Chochorus tridens, prosopsis africana and Hibiscus sabdarifa.*

NTFPs AS SNACKS

There are many forest plants whose fruits or seeds are eaten as snacks by young children as well as adults. Some examples of these include: *Blighia sapida; Chrysophyllum albidum; Monodora myristica; Parkia biglobosa, Dialium guineense; Tamarindus indica; Vitallaria paradoxa; Tetracarpidium conophorum; Spondias mombin; Synsepalum dulcificum; Carpolobialutea; Dioscoreophyllum cumminsii; Passiflora edulis; Garcina kola; Cola hispida , Phoenix dactylifera, Mimosops paviflora, Terminalia catapa and Adansonia digitata.* Many of these plants are eaten directly without roasting or cooking. They are thus ready-made emergency food particularly for children and even adults during the "hunger season".

NTFPs AS SPICES, CONDIMENTS AND FLAVOURS

Spices and condiments are plants or their products used to flavour foods or beverages before, during or after preparation (Jensen 1981). Natural flavours, spices and aromatics are mainly secondary metabolites of various woody and non-woody plants. They may be extracted from barks, sap, stems, leaves, roots, flowers and seeds. They are useful in industries such as foods, pharmaceuticals, cosmetics and toiletries. They are also part of regular domestic diets. Virtually all edible fruits and aromatic herbs that stimulate taste buds and olfactory organs are flavour plants. Many examples of aromatics, spices and condiments abound in the tropical rainforests from where they are harvested for various uses (Table 3).

Table 3: Some Common Spices , Flavours and Condiment Species

SN.	Scientific Name	Common Name	Family Name	Uses	Part(s) used
1.	*Pimenta officinalis*	Alspice	*Myretaceae*	*Spice*	Berry fruits
2.	*Capsicum Spp*	Capsicum	*Solanaceae*	Spice	Fruits
3.	*Ellettaria cardamomum*	Cardamomom	*Zingiberaceae*	Spice	Fruits

4.	*Cinnamomum zeylanicum*	Cinnamon	*Lauraceae*	Spice	Bark
5.	*Caryophyllus aromaticus*	Clove	*Myrataceae*	Flavour	Flower buds
6.	*Zingiber officinale*	Ginger	*Zingiberaceae*	Spice/condiment	Rhizome
7.	*Myristica fragrans*	Nutmeg	*Myristicaceae*	Spice	Aril
8.	*Piper nigrum*	Black pepper	*Piperaceae*	Spice	Fruits
9.	*Crocus satirus*	Saffron	*Iridaceae*	Spice	Fruits
10.	*Trigonella serumgraecum*	Fenugreek	*Leguminaceae*	Spice	Seeds
11.	*Papaver somniferum*	Poppy	*Papaveraceae*	Spice	Seeds
12.	*Menthe piperianta*	Peppermint	*Labiatae*	Flavour/spice	Leaves
13.	*Ocimum Spp*	Sweet bail	*Labiatae*	Flavour	Leaves
14.	*Thymus vulgaris*	Thyme	*Labiatae*	Flavour/condiment	Leaves
15.	*Allium sativum*	Garlic	*Liliaceae*	Flavour/spice	Bulbs
16.	*Pipper guineense*	Guinea pepper	*Piperaceae*	Spice	Seeds
17.	*Tetrapleura tetraptera*	Aidan (Yor.).	*Leguminaceae*	Flavour	Fruits
18.	*Piper umbelatum*	Shrubby pepper	*Mimosaceae*	Flavour	Leave
19.	*Xylopia aethiopica*	Guinea pepper	*Annonaceae*	Spice	Fruits & seeds
20.	*Aframomum corronima*	False cardamomum	*Zingiberaceae*	Flavour	Seeds
21.	*Tamarindus indica*	Tamarind	*Caesalpinacea*	Sweetener	Fruits
22.	*Prosopsis Africana*	Iron wood	*Mimosaceae*	Condiment/flavour	Seeds
23.	*parkia biglobosa*	locust bean	*Mimosaceae*	condiment/flavour	Seeds
24.	*aframomum melegueta*	alligator pepper	*Zingiberaceae*	Spice	Seeds
25.	*Eugenia aromatica*	Clove	*Myritaceae*	Spice	Flower buds

According to Hulse (1996), natural flavour, spices and aromatic herbs may be classified into the following categories:

a. Pungent spices: This is exemplified by Pipper nigrum, Pipper guineense, Capsicum annum, Allium sativum and Zingiber officinale.

b. Aromatic leaves, fruits and seeds – e.g. *Ocimum sp; Myristica fragrans, Sinapsis alba; Syzigium aromaticum.*

c. Aromatic bark – These include *Cinnamomum verum and Cinnamomum aromaticum.*

d. Aromatic plants – These are plants or their parts used to impart desirable and attractive aroma on foods or drinks. *Pimenta racemosa, Lumbelculania carlifornia, Pipper umbelatum; Ocimum gratissimum; Tetrapleura tertraptera* and *Allium sativum* are few examples.

e. Edible Mushrooms: Edible mushrooms constitute a valuable food material in the rural area. The realization of the great contributions of plant proteins to human health has further popularized this forest product even in the urban centres. People with ailments such as high blood pressure and heart problems are often advised to consume fat free food as much as possible. Hence, there has been renewed interest in mushrooms. Mushroom is served as a delicacy in many countries of Asia and Europe.

According to Duta (1986) there are about 200 species of edible fungi. They are mostly parasites obtaining their food readily from other organisms on which they usually cause diseases. They are a good source of protein, minerals and vitamins. According to FAO (2002) mushrooms contain 20 to 40 percent crude protein, 3 to 28 percent carbohydrates and a wide range of both macro and microelements.

Mushrooms are cultivated in Europe, North America, South-east Asia and Australia (Oei 1996). Nevertheless, most mushrooms consumed globally are still harvested from the wild. Despite the large number of edible mushrooms, there are many which are not edible while more than 12 species have been found to be out- rightly poisonous (Duta 1986). It takes carefulness and experience to be able to differentiate between edible and poisonous fungi. Duta (op.cit) confirmed that all puffballs are edible particularly when they are young. In Nigeria, Ekpo(2002) listed the following species of edible mushrooms: *Chlorophyllum molybdites; Termitomyces mammiformis; Termitomyces clypeatus, Termitomyces robustus, Schizophyllum commune, Letinus squarobulus, Volvaniella volcacea, Letinus tuberregium and Auricularia auricular.*

FAO (2002) reported that over 60 species of mushrooms are consumed in Zimbabwe; the commonest four being: *Amanita sp, Cantharellus sp., Termatomyces sp and Lactarius sp.* The average household consumption of edible mushrooms per annum in Zimbabwe was estimated at 20kg while about 20 tonnes of fresh mushrooms are exported from *Miombo woodlands* annually fetching about US$500,000 to corporate organizations.

The *Miombo* woodlands of many Eastern, Central and South African countries are unique in mushroom production. Munyanziza (1996) attributed this to the prevalence of certain suitable host species including *Julbernardia sp, Brachystegia sp, Afzelia sp, Isoberlinia sp* and Uapaca sp. Many of the useful plants are however fast disappearing due to a number of anthropogenic factors, which include the followings:

Destructive Harvesting Methods:

This applies to both animals and plants. Medicinal plants harvesting is still very crude, unregulated and hence unsustainable in many cases. More often than not, the very organs of reproduction or regeneration such as fruits, seeds, flowers and leaves are extracted for medicinal purposes. The harvesting method is such that little or no consideration is given to the sustainability of the species concerned. This is the situation in the cases of species such as *Tetrapleura tetraptera* (fruit & seed); *Pipper guineense* (seeds); *Xylopia aethiopica* (fruit & seeds); *Passiflora edulis* (fruits), *Cassia anguistifolia* (fruits); *Podocarpus gracilor* (fruits) *Caryophyllus aromaticus* (flower buds) and *Kigelia africana* (fruits). Root mining is another example of destructive harvesting in medicinal plants and this applies in the cases of *Rauvolfia spp; Zantoxylum zanthoxyloides; Afzelia bella; Combretum mucronatum, Abutilon bidentatum; Securidaca longipedunculata; Griffonia simplicifolia; Voacanga africana* and *Voacanga thouarsii.*

In many species where the active ingredient of medicinal value is located in the stem bark, the tree is sometimes completely stripped of the bark thereby, exposing the tissue to pathogenic and pest attacks. In some cases the tree is starved to death as the phloem tissue responsible for translocation of photosynthates from the leaves to the trunk is already cut off. Also some trees are felled completely in order to extract the back. Examples of species in this category include: *Anninckia chloranta (Syn. Enantia chloranta); Entandrophragma angolensis; Prunus africana; Bridelia spp; Alstonia booneii; Anacardium occidentale* and *Morinda lucida.*

Deforestation:

Deforestation is another serious problem which has contributed to the dwindling availability of NTFPs in both reserved and non-gazetted forests. Destruction of forests for purposes such as shifting cultivation, plantation establishment, urban and industrial development and uncontrolled logging has assumed as dangerous dimension in the recent past. FAO (2005) reported that the annual rate of deforestation is about 2.6%. Many useful species of plants and animals are destroyed in the process while habitats and breeding grounds of birds, fishes and wild animals are either modified or out rightly destroyed, thereby exposing such species to danger of predation and death from natural causes.

Over harvesting:

Over harvesting is a serious problem which militates against the sustainability of non-timber forest products. It is not uncommon to find plants, which are completely defoliated, debarked or uprooted. This also applies to local populations of particular species. In some cases, certain species are so useful that people often descend on them excessively virtually exterminating the local population. This is true in the cases of species such as *Ocimum spp. Mushrooms, Pipper guineense; Vernonia amygdalina;* and *Gnetum africanum.*

Overgrazing:

Overgrazing by animals contributes to gradual disappearance of useful plants. The *animals concentrate on the palatable species such as* Faidherbia albida; Khaya spp; Securidaca *longipedunculata and Tephrosia spp.* The effect of overgrazing is that the favoured species particularly the juveniles are rendered weak as a result of repeated browsing thereby, putting them at a competitive disadvantage within the ecosystem. In such situations the species are gradually replaced by more vigorous ones thereby threatening their continued existence.

Policy Failure:

Regulatory rules on NTFPs harvesting are weak, inadequate and obsolete, thus, encouraging illegal and destructive harvesting particularly in developing nations. Often time the fines and punitive measures stipulated for forest offences are too low to serve as deterrent to other offenders. Also the machinery for the collection of fines and permit licenses is inadequate in many developing countries. The effect of this is that people evade payment of such fines thereby depriving the government of the revenue that should accrue to it. This has been an important factor that contributes to deforestation in Africa.

Increasing Demand for Forest Products:

The economies of many developing countries have grown from bad to worse in the last two decades. This has therefore led to widespread poverty, which reduces the purchasing power of the common people since they cannot afford manufactured goods. People increasingly turn to the forest for their food and medicine. According to Falconer (1991), apart from the rapid population growth, which has increased demand for NTFPs in developing countries, the problem of economic depression has further pushed more people into the forest in search of sustenance. Furthermore, because of the realization in the developed world of the fact that many synthetic drugs have side effects, many people now turn to natural products both for food and drugs. The implication of all these is that the demand pressures on the forest keeps increasing by the days thereby threatening the sustainability of the resources.

Since non-timber forest products form the basis of health care system in most developing nations and contribute immensely to the household food security, the loss of genetic resources of certain plants or their scarcity would definitely have a negative impact on human welfare. No doubt, thousands of useful plant species as important as *Penicillum notatum and Ancistrocladus korupensis* that could be very useful medicinally are still awaiting discovery. It is important that plants of medicinal potentials are adequately conserved so that many of them would not be lost before their usefulness is discovered. It is equally important to embark on meaningful conservation programmes that would ensue that the genetic resources of these valuable plants are not lost. The following approaches are suggested for the conservation and sustainable utilization of non-timber forest products in Nigeria.

STRATEGIES FOR CONSERVATION OF NON-TIMBER FOREST PRODUCTS

1. Domestication of useful plant species

In order to conserve the genetic resources of NTFPs, particularly those that have commercial values, cultivation of wild species in agroforestry plots, forest plantations or home gardens is a sure way of relieving pressure on natural forest stocks. Private cultivation of these useful plants will supplement rural employment and household income thereby, contributing to

rural poverty alleviation. Species such as *Pipper guineense; Thaumatococus daniellii. Vernonia amygdalina, Jatropha curcas. Zingiber officinales Ocimum gratissimum. Xylopia aethiopica, Gnetum africanum and Lactuca taraxacifolia* can be easily incorporated into the traditional farming system, existing forest plantations or home gardens.

2. In-situ and Ex-situ conservation:

Useful plant and animal species may be conserved in their natural place of occurrence (in-situ). This may include species in peculiar environments such as hilly terrains; swamps, forest reserves; national parks and sacred groves. They may also be conserved in ex-situ conservation sites such as botanical gardens; zoological gardens, agroforestry plots, home gardens, farm and homestead hedges. In this case genetic materials of the species such as stem/root cuttings; buds; seeds and fruits are raised in ex-situ plots outside their natural environment. The usual objective is to multiply their genetic resources with a view to re-introducing them into the field in future via planting in different locations within their ecological range in order to prevent total loss of their germplasm.

3. Conservation through Biotechnology

Biotechnology could be very useful in the conservation of non-timber forest products since large number of plants and their products can be produced within a limited space (Schumacher, 1991). Tissue culture may be used in plant conservation in form of undifferentiated suspension cultures when only a special synthetic capacity or gene is all that needs to be conserved.

4. NTFPs Trade Regulation

If conservation programme is to succeed, trade in NTFPs should be regulated. According to Cunningham (1997), prices paid to NTFPs gatherers are very low compared to the potential impact of the harvesting on the ecosystem. Because incomes from these materials are low, harvesters therefore, collect beyond the sustainable level so as to realize reasonable income. In order to bring the prices up to reasonable levels, the flood of cheap bark/roots "mined" from the wild stocks should be reduced through better protection of conserved forests. Forest legislation should be introduced to restrain the quantity of a particular product that is removed to the market at a time.

5. Medicinal Plants Farming

In order to provide alternative to overexploitation of traditional medicinal plants, it is necessary that large-scale cultivation of these plants be established. Though, this had been suggested over sixty years ago in South Africa for scarce and effective species such as *Alepidea amatymbica* (Gestner 1938) and *Warburgia salutaris* (Gestner 1946); there had been no large-scale cultivation of medicinal plants until very recently. The reasons for this observation as identified by Cunningham (1997) included: lack of institutional support for large scale production and the low return on investment compared to arable and cash crops which readily fetch income to farmers.

It is believed that careful adoption of any or a combination of the above strategies will go a long way in reducing the threats on the genetic resources of non-timber forest products harvested from wild sources.

Recommendations and Conclusion

In view of the crucial roles played by the non-timber forest products in human welfare and environmental stability, the following recommendations may be considered to ensure their continued existence.

(1) There should be public education on sustainable harvesting of non-timber forest products. The harvesters should be encouraged to reject destructive harvesting methods such as root mining, complete debarking and total defoliation.

(2) NTFPs harvesters, marketers and traditional medicinal practitioners should be encouraged to raise plants of everyday importance and scarce species in their backyard and home gardens.

(3) Product Certification: This can be

very useful in cases of commercial species such as *Irvingia spp; Zingiber officinale and Acacia senegalensis,* which are traded internationally. Government should not allow any product(s), which it is not certified harvested in a sustainable manner or from a sustainably managed forest in the export market.

(4) Improvement in processing methods: Most of the processing methods for medicinal and condiment plants are still very crude and wasteful. Harvesters, marketers and users should be trained on better ways of handling these products so as to improve conversion efficiency and minimizing wastage. Knowledge of the particular part(s) of plants that yield the desired ingredients should be imparted on harvesters and users such that only those parts are carefully harvested thereby minimizing injury to the plant and invariably the ecosystem.

(5) Government should review forest tariffs and license fees to promote the values of forest products to realistic levels such that harvesters and users would appreciate their values. This will also put forestland in a competitive advantage against other land use alternatives particularly arable farming, which is the major contributor to deforestation in the tropics.

(6) A participatory approach to biodiversity conservation should be embraced by building public support for the conservation of non-timber forest products through communication and cooperation.

The continued availability of these valuable products will depend on collaborative efforts of all concerned to embrace sustainable management and conservation of their genetic resources.

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