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Review

An assessment of selected phytoconstituents of medicinal and aromatic plants with curative properties in common use in Africa

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Medicinal and aromatic plants are reservoirs of curative elements used by a large population of Africans in the treatment of various diseases such as malaria, diabetes, mental disorders, cancer, hypertension and human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). These medicinal and aromatic plants are used based on ethnobotanical evidence as being safer, acceptable, affordable, culturally compatible and suitable for chronic treatment. Phytochemical screening of these plants revealed that they contain bioactive chemical substances such as alkaloids, tannins, saponin, and others with therapeutic potentials. The screening of plants for various bioactive substances has led to the discovery of anti HIV drugs from plant such as *Ancistrocladus korupensis* containing the alkaloid, *michellamine* A and B. The active ingredients of medicinal and aromatic plants can be found either in the roots, leaves, stems, flowers or bark and can be extracted using an appropriate extraction method. Plant selection for drug discovery can be achieved through phytochemical screening, conducting bioassays on experimental models, ethnobotanical evidence and biologic activity report on the plant. Despite the benefits derived from plants, some of them have some unpleasant side effects which may be related to over doses or other factors. This may lead to acute toxicity and death but when these problems are carefully addressed, will help to harness the therapeutic potentials of medicinal and aromatic plants for further drug development in the future.

Key words: African, treatment, bioactive, alkaloid, health care.

INTRODUCTION

Traditional medicinal plants are a therapeutic resource used by the population of the African continent specifically for health care, which may also serve as starting materials for drugs (Sofowora, 1993). Iwu et al. (1999) reported that infectious diseases account for one-half of all deaths in the tropical countries. As a result, people of all continents have long applied poultice and imbibed infusions of indigenous plants dating back to prehistory for health purposes (Cowan, 1999). It comprises of therapeutic practices in existence for hundreds of years before the development of modern scientific medicine and is still in use today without any documented evidence of adverse effects.

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According to the World Health Organization (WHO, 1977) “a medicinal plant” is any plant which in one or more of its organ contains substances that can be used for the therapeutic purposes or which are precursors for the synthesis of useful drugs. This definition distinguishes those plants whose therapeutic properties and constituents have been established scientifically and plants that are regarded as medicinal but which have not yet been subjected to thorough investigation. The term “herbal drug” determines the part/parts of a plant used for preparing medicines (for example: leaves, flowers, seeds, roots, barks, stems, etc) (Anon, 2007a). Furthermore, WHO (2001) defines medicinal plant as herbal preparations produced by subjecting plant materials to extraction, fractionation, purification, concentration or other physical or biological processes which may be produced for immediate consumption or as a basis for herbal products.

Aromatic plants have a pleasant, characteristic fragrant smell. The fragrance of these plants is carried in the essential oil fraction. Many aromatic plants are spices. Chandarana et al. (2005), defined spices as any dried, fragrant, aromatic or pungent vegetables or plant substances in whole, broken or in ground forms that contributes relish or piguancy of foods and beverages.

Traditional medicines have been the focus for a wider coverage of primary health care delivery in Africa and the rest of the world (Elujoba et al., 2005). This medicine is traditional because it is deeply rooted in a specific sociocultural context which varies from one community to another. The therapeutic use of medicinal plant in Africa dates back to the earliest times. Ancient Egyptian writings confirm that herbal medicines have been valued in North Africa for millennia. The Ebers Papayrus (C. 1500BC), one of the oldest surviving medical texts, includes over 870 prescriptions and formulae, 700 medicinal herbs including gentian *(Gentiana lutea*), aloe *(Aloe vera*) and opium poppy *(Papaver somniferum*) and covers conditions ranging from chest complaints to crocodile bite wounds. The medicinal practices put forward in this and other Egyptian texts formed the intellectual foundation of African medicine (Prajapati et al., 2003).

Medicinal and aromatic plants contain biologically active chemical substances such as saponins, tannins, essential oils, flavonoids, ailkaloids 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 one or more of these plants. Tyler (1999) has reported that plants also contain certain other compounds that moderate the effects of the active ingredients.

Medicinal and aromatic plants have demonstrated its contribution to the treatment of diseases such as HIV /AIDS, malaria, diabetes, sickle-cell anaemia, mental disorders (Elujoba et al., 2005; Okigbo amd Mmeka, 2006) and microbial infections(Iwu et al., 1999; Okigbo et al., 2005). According to the World Health Organisation (WHO 2001), 80% of the world population use medicinal plants in the treatment of diseases and in African countries, this rate is much higher (Table 2).

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. The use of medicinal plants in developing countries as a normative basis for the maintenance of good health has been widely observed (UNESCO, 1996). 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). Moreover, in these societies, herbal remedies have become more popular in the treatment of minor ailments and also on account of the increasing costs of personal health maintenance. Survey conducted by the WHO Roll back malaria program in1998, showed that in Ghana, Mali, Nigeria and Zambia, more than 60% of the children with high fever were treated at home with herbal medicines (WHO, 2004).

The objectives of this review is to present selected phytoconstituents of medicinal and aromatic plants which have curative properties, give an overview of selected plants that have medicinal values in common use in Africa.

PHYTOCHEMICAL COMPOSITION OF MEDICINAL AND AROMATIC PLANTS

Phytochemicals are present in a variety of plants utilized as important components of both human and animal diets. These include fruits, seeds, herbs and vegetables (Okwu, 2005). Diets containing an abundance of fruits and vegetables are protective against a variety of diseases, particularly cardiovascular diseases (Okogun, 1985). Herbs and spices are accessible sources for obtaining natural antioxidants (Okwu, 2004).

Phytochemicals are chemical compounds formed during the plants normal metabolic processes. These chemicals are often referred to as “secondary metabolities” of which there are several classes including alkaloids, flavonoids, coumarins, glycosides, gums, polysaccharides, phenols, tannins, terpenes and terpenoids (Harborne, 1973; Okwu, 2004). In addition to these substances, plants contain other chemical compounds. These can act as agents to prevent undesirable side effects of the main active substances or to assist in the assimilation of the main substances (Anon, 2007a). Opium juice, for example from *Papaver somniferum*, con-tain other chemical compounds in addition to morphine (Table 3) and reports show that it gives fewer side effects than morphine administered on its own (Anon, 2007a).

In contrast to synthetic pharmaceuticals based upon single chemicals, many medicinal and aromatic plants exert their beneficial effects through the additive or synergistic action of several chemical compounds acting at single or multiple target sites associated with a physiological process. As pointed out by Tyler (1999), these synergistic pharmacological effects can be beneficial by eliminating the problematic side effects associated with the predominance of a single xenobiotic compound in the body. Kaufman et al. (1999) extensively documented how synergistic interactions underlie the effectiveness of a number of Phytomedicines.

Most of these phytochemical constituents are potent bioactive compounds found in medicinal plant parts which are precursors for the synthesis of useful drugs (Sofowora, 1993). Some of the most common phytochemical classes are described in the following sections and are

Table 1. Selected phytochemical classes of medicinal and aromatic plants.

Class	Characteristic	Use	Action	Reference
Alkaloids	Bitter taste, colourless, Nitrogen containing bases, crystalline or liquid at room temperature	Raw material for the synthesis of useful drugs	Analgesic, antispasmodiac, bactericidal effect	Harborne, 1973; Stray,1998; Okwu and Okwu, 2004
Phenols	Weakly acidic, Hydroxyl group attached directly to an aromatic ring.	Disinfection	Antiseptic, anti-inflammatory, antimicrobial, anti-tumor	Urquiaga and Leighton, 2005. Okwu, 2005
Flavonoids	Water soluble, super antioxidant and free radical scavenger	In prevention of oxidative cell damage, allergies free radicals, microbes.	Antioxdant, anticarcinogens, antimicrobial, antitumour	Kandaswami et al., 1994. Manikandan *et al* 2006
Saponins	Bitter taste, foaming property, haemolytic effect on red blood cells.	Emulsifying agent	Expectorant, cough suppressant, haemolytic activity	Sofowora, 1993; Okwu, 2005.
Essential oil	Distinctive scent, aroma and fragrance	In perfumes, flavourings and medicines	Medicating, soothing relief	Sofowora, 1993;
Tannins	Unpleasant taste, tans leather	In the production of leather and ink; in treating wounds, varicose ulcers, haemorrhoids, frostbite and burns	Soothing relief, regenerates skin, anti-inflammatory, Diuretics	Okwu and Okwu, 2004.

are summarized in Table 1.

Phenolic compounds

Phenols are a member of a group of aromatic chemical compounds with weakly acidic properties and are characterized by a hydroxyl (OH) group attached directly to an aromatic ring. The simplest of phenols derived from benzene is also know as phenol and has the chemical formula C_6H_5OH. The presence of phenols is considered to be potentially toxic to the growth and development of pathogens (Okwu and Okwu, 2004).

The structural classes of phenolic compounds include the polyphenolic (hydrolysable and condensed tannins) and monomers such as ferulic and catechol (Okwu, 2005). Polyphenols might interfere in several of the steps that lead to the development of malignant tumours, may play a role in inactivating carcinogens and inhibiting the expression of mutagens (Urquiaga and Leighton, 2000; Okwu, 2004).

Flavonoids

Flavonoids are 15- carbon compounds generally distributed throughout the plant kingdom. They are known to be synthesized by plants in response to microbial infection and have been found *in vitro* to be effective against a wide array of microorganisms (Harborne, 1973). Flavone with the molecular formula, $C_{15}H1_0O_2$, is a commonly found plant flavonoid (Martindale, 1996). Flavonoids are potent water-soluble super antioxidants and free radical scavengers which prevent oxidative cell damage, have strong anti-cancer activity and protects against all stage of carcinogens. Flavonoids in the body are known to reduce the risk of heart diseases (Urquiaga and Leighton, 2000). In terms of anti-cancer activity, they inhibit the initiation, promotion and progression of tumors (Urquiaga and Leighton, 2000; Okwu, 2004). In recent times, plant flavonoids have attracted attention as potentially important dietary cancer chemo- protective agents (Hertog et al., 1993; Elangevan et al., 1994). Some isoflavones act as allelochemicals widely used in insecticides (Kandaswami et al., 1994).

Saponins

Saponins are glycosides of both triterpenes and steroids that are characterized by their bitter or astringent taste, foaming property, haemolytic effect on red blood cells and cholesterol binding properties (Okwu, 2005).

Saponins have been shown to possess both beneficial (lowering cholesterol) and deleterious (cytotoxic and permeabilization of intestinal epithelium) properties and to exhibit structure dependent biological activity. In medicine, it is used to some extent as an expectorant and an emulsifying agent (Harborne, 1973).

Quinones

Quinones are aromatic rings with two or more ketone

Table 2. Selected medicinal and aromatic plants in africa and their medicinal values.

Plant	Family	Constituents	Action	Countries	Reference
Aloe vera Mill	Liliaceae	Barbaloin and its derivatives, resin.	Purgative	Nigeria	Sofowora, 1993
Spondias mombin L.	Anacardiaceae	Tannins, phenolic esters, Alkaloids, saponin	Antiviral Antibacterial	Southern parts of Nigeria, Africa	Kozoic and Marcia, 1998, Okwu and Okwu 2004
Papaver somniferum L.	Papaveraceae	Morphine, codeine	Narcotic, Analgesic	Egypt	Sofowora, 1993 Iwu et al., 1999 Okwu, 1999.
Xylopia aethiopica (Dunal) A.Rich.	Annonaceae	Volatile oil	Carminative, cough remedy, antimicrobial, uterine contraction in postnatal women	West, central and southern Africa.	
Rauwolfia vomitoria Afz or *R. serpentina* (L.) Benth ex. Kurz.	Apocynaceae	Reserpine, deserpidine, rescinamine, yohimbine	Antihypertensive Tranquilzer	Nigeria and many African countries	Kokwaro, 1993 sofowora, 1993
Catharanthus roseus (L.) G. Don	Apocynaceae	Vincrstine, vinblastine	Anti-leukaemic, anti-cancer	Madagascar, South Africa	Elujoba et al, 2005
Mallotus oppositfolius (Geisel) mull. Arg.	Euphorbiaceae	Alkaliods, phenols,	Anti-malarial, anti-inflammatory	Nigeria	Farombi et al., 2001, Burkhill, 1994.
Alchornea laxiflora (Benth) Pax and Hoffman	Emphorbiaceae	flavonoids, anthroquinones Alkaloids, Cardiac glycosides, saponins, phenolic compounds	Anti-inflammatory,anti-inflammatory .	Nigeria, cameroons, central and southern tropical Africa.	Ogundipe et al, 1999; Adewole, 1993.
Jatropha curcas L.	Euphorbiaceae	Vlatile oil, curcin, Saponins, tannins	Purgative, antimicrobial, antiseptic, mouth wash	Cape verde, Madagascar	Thomas, 1989
Securidaca longipedunculata fresen	Polygalaceae	Alkaloids, tannins, saponin	Purgative, antimicrobial, abortifacient,	Tanzania, East Africa, Malawi, Nigeria, Ghana.	Sofowora, 1993, Gill, 1992
Ocimum gratissmum L.	Lamiaceae	Essential oil, phenol egthymol	Anti-microbial, ophthalmaic	Nigeri, Rwanda	Onajobi, 1986 Okigbo et al, 2005
Zingiber officinale Roscoe	Zingiberaceae	Gingerol, essential oil	As condiment and medicinally as carminative and aromatic	Niger ,cote d' ivoire	Sofowora, 1993

substitutions. The natural quinone pigments range in colour from pale yellow to almost black and there are over 450 known structures (Harborne, 1973). These compounds are responsible for the browning reaction in cut or damaged fruits and vegetable and are an intermediate in the melanin synthesis pathway in human skin. Hypercin is an anthroquinone which is an example of quinine obtained from St. John's wort (*Hypericum perforatum*) has received much attention as an antidepressant, antiviral and also have several antimicrobial properties (Aarts, 1998).

Alkaloids

Alkaioids rank among the most efficient and therapeutic-cally significant plant substances (Okwu, 2005). Some 5,500 alkaloids are known and they comprise the largest single class of secondary plant substances which contain one or more Nitrogen atoms, usually in combination as part of a cyclic structure (Harborne, 1973). They are usually organic bases and form salts with acids and when soluble gives alkaline solutions. Examples include nicotine, cocaine, morphine and codeine (*Papaver sominfe-*

Table 3. Selected medicinal and aromatic plants in common use in Africa.

Plants	Parts used	Usage	Disease cured	Action	Source
Ageratum conyzoides L.	Whole plant	Juices from fresh plant and extract of the dried plant	Allergic rhinitis, wounds	Anti-inflammatory and antiallergic properties, antimicrobial	Kokwaro, 1993
Carica papaya L.	Fruits, latex, leaves	Latex is laxative against constipation	Anorexia, intestinal worms, fever inflammations, skin diseases	Appetizer, anthelmintic, anti-inflammatory, antifungal, febrifuge	Gill, 1992.
Cymbopogon citratus (DC.) Stapf	Whole plant	3-4 drop of the essential oil diluted in water.	Cold, vomiting, fever, eczema	Antifebrile, antiseptic, stomachic insecticide against mosquitoes or as a deodorant	Sofowora, 1993, Gill, 1992
Allium cepa L.	Bulbs	Aqueous extract of bulbs	Haemorrhoids, asthma, flatulence, ophthalmia, skin diseases	Antibacterial, carminative, emollient, emmenagogue, expectorant	Gill, 1992
Zingiber officinale Rosc	Rhizome	Raw, fresh or dried rhizome	Anorexia, inflammations, asthma, cough, flatulene, nausea, vomiting	Carminative, Laxative, emollient expectorant, anthelmintic.	Sofowora, 1993
Cassia alata L.	Leaves	Infusions of leaves, Poultice of fresh pounded leaves	Constipation, oedema, skin disease (ringworm, scabies and impetigo)	Antiseptic, laxative	Gill, 1992
Azadiratchta indica A. Juss	Bark, leaves seed, flowers	Decoction of leaves and bark	Skin diseases, malarial fever intestinal worms,	Astringent, anthelmintic, antiseptic, expectorant,febrifuge insecticidal	Ade- Serrano, 1982, Iwu et al., 1986
Allium sativum L.	Bulbs	Aqueous solution, poultices of bulbs is used to treat boils	Cough, bronchitis, nasal instillation, asthma	Anti inflammatory, expectorant, antibacterial.	Gill, 1992
Catharanthus roseus (L.) G.Don	Leaves and roots	Decoction of extract of roots and leaves	Hypertension, leukaemia	Antihypertensive, antileukaemic,	Elujoba et al., 2005.
Bridelia ferruginea Benth.	Stem, bark, leaves, root	Aqueous extract of leaves decoction	Diabetes mellitus, feverish pains	Hypoglycaemic activity, diuretic	Iwu, 1983

rum), quinine (*Cinchona succirubra*), reserpine (*Rauwolfia vomitoria*), which has a large demand worldwide.

Alkaloid production is a characteristic of all plant organs. They exhibit marked physiological activity when administered to animals (Okwu and Okwu, 2004). Furthermore, alkaloids are often toxic to man and many have dramatic physiological activities, hence their wide use in medicine for the development of drugs (Harborne, 1973; Okwu, 2005).

Alkaloids are usually colourless, but often optically active substances. Most are crystalline but a few are liquid at room temperature. Alkaloids have bitter tastes. The alkaloid quinine for example is one of the most bitter-tasting substances known and is already significantly bitter at a molar concentration of $1x10^{-5}$ (Harborne, 1973). Pure, isolated plant alkaloids and their synthetic deriva-tives are used as basic medicinal agents for their anal-gesic, antispasmodiac and bactericidal effects (Stray, 1998).

Quinine with a molecular formula of $C_{20}H_{24}N_2O_2$ is an anti- malarial drug extracted from the bark of a cinchona tree (*C. succirubra*). Quinine is highly valued in the treatment of unusually resistant strains of malaria.

Tannins

Tannin is a general descriptive name for a group of polymeric/phenolic substances capable of tanning leather or precipitating gelatin from a solution, a property known as astringency (Harborne, 1973). They are divided into two groups, namely hydrolyzed and condensed tannins. Hydrolysable tannins are based on gallic acid, usually as multiple esters with D -glucose, while the numerous condensed tannins (often proanthocyanides are derived from flavonoid monomers (Harborne, 1973; Okwu, 2005). Many physiological activities such as stimulation of phagocytic cells, host mediated tumor activity and wide range of anti-infective action have been assigned to tannins (Okwu and Okwu, 2004).

Essential oils and triterpenoids

Terpenoid essential oils are the main compounds found in the volatile steam distillation fraction responsible for the characteristic scent, odour or smell found in many plants. Some essential oils possess medicating proper-ties and are used in the pharmaceutical industry. They are commercially important as the basis of natural per-fumes and also of spices and are used for flavouring purposes in the food industry. Plant families particularly rich in essential oils include the Compositae, Lamiaceae, Liliaceae, Myrtaceae and others. The terpene essential oils can be divided into 2 classes; the mono and sesquiterpenes, C_{10} and C_{15} isoprenoids, which differ in their boiling points (Monoterpenes = 140 - 180°C, sesquierpenes > 200°C) (Harborne, 1973).

Triterpenoids are compounds with a carbon skeleton based on six isoprene units and which are derived biosynthetically from the cyclic C_{30} hydrocarbon, squalene. They are colourless, crystalline, often have high melting points and are optically active substances. The essential triterpenoids are saponins, steroids and cardiac glycolsides which occur mainly as glycosides. Triterpenes occur especially in the waxy coatings of leaves and on fruit such as apple and pear and they may serve a protective function in repelling insects and microbial attack (Harborne, 1973).

SELECTED PLANTS WITH MEDICINAL VALUE IN AFRICA

Africa has a long and comprehensive list of medicinal plants based on local knowledge (Ethnobotanical evidence) . Phytochemical screening of these plants revealed the presence of secondary metabolites such as alkaloids, saponins, flavonoids, phenols with biological activity. The plant part/parts where these secondary metabolites are found include the leaves, flowers, seed, roots, barks and stem and are used for preparing medicines or “herbal drug” (Anon, 2007a) . Their concentrations vary with the plant parts, age of plants and time of collection of the plant (Sofowora, 1993).

Some of these plants with their medicinal values are discussed below.

Mallotus oppositifolius

M. oppositifolius (Euphorbiacea) is a shrub of up to 13.5 cm tall and 2.5 - 10 cm wide which grows in old parts of secondary forest and thickets. It also thrives in the savannah vegetation. It is used as a herb for the treatment of dysentery and as a vermifuge. The leaves are ingredients of common anti-malarial and anti-inflammatory remedies (Burkhill, 1994).

Phytochemical screening of *M. oppositifolius*, revealed the presence of secondary metabolites such as alkaloids, phenols, flavonoids, anthroquinones and cardenolides. A higher concentration of these resides in the leaves than in the root (Farombi et al., 2001). Five hydrolysable tan-nins and cytotoxic phloroglucinol have been reported from the bark of *M. japonicus*, another *Mallotus* species (Iwu, 1993).

Garcinia kola

G. kola (Guttiferae) is a medium sized tree found in moist forest and widely distributed throughout west and central Africa. The nut of this tree is highly valued in these countries for its edibility (Hutchinson and Dalziel, 1972). The seed commonly known as bitter kola is a masticator and is a major kola substitute offered to guests of home and shared at social ceremonies. The seeds are used in folk medicine and in many herbal preparations for the treatment of ailments such as laryngitis, liver disorders and bronchitis (Iwu, 1982).

***Spondias mombin l.* (*Anacardiaceae*)**

This is a medium sized, occasionally large tree with long compound leaves. The tree is widely cultivated for its yellow, pleasantly tasting fruits and as a live fence. The small fruits are popular for eating, making juice, popsicles and ice cream. The wood is shaved and steeped in water. This concoction is used by women in rural areas as a vaginal douche and drunk to cure ailments in their reproductive systems. This treatment is popular with women living in rural areas (Morton, 1987a).

S. mombin is a versatile African medicinal plant growing in southern parts of Nigeria. Early workers on the plant isolated a series of tannins and phenolic esters, which were found to have antiviral properties (Corthout and Pieters, 1979; Kozoic and Marcia, 1998) . The juice of the fresh leaves is a remedy for thrush. A decoction of the leaves and bark is employed as febrifuge in Southwestern Nigeria, an infusion of shredded leaves is valued for washing cuts, sores and burns. It has been found (Morton, 1987a; Kozoic and Marcia, 1998) that an aqueous extract is even more effective. The juice of the crushed leaves and powdered dried leaves are used as poultices on wounds and inflammations while the gum that exudes from the bark is employed as an expectorant to expel tapeworms (Martinez, 2000).

Alchornea laxiflora

A. laxiflora (Benth). Pax and Hoffman (Emphorbiaceae) is a forest undestroyed tree of about 6 m high growing in Nigeria. It is also found in the Cameroon and it is widespread in the central and southern tropical Africa. The leaves play important role in the preservation of kolanuts widely eaten in Nigeria. The stem and branchlets are

used in Nigeria as chewing sticks (Isawumi, 1978). Decoctions of the leaves are used in the treatment and management of inflammatory and infections diseases as well as an important component of herbal anti-malarial for-mulations (Adewole, 1993)

Alchornea cordifolia, a closely related species are used in the preparation of remedies for urinary, respiratory and gas to intestinal disorders (Iwu, 1993). Its antibacterial activity on *Staphylococcus aureus* and *Escherichia coli* was attributed to Isopentenyl guanidine (Lamikanra et al., 1990). Phytochemical screening of the powdered leaf sample of *A. laxiflora* revealed the presence of alkaloids, cardiac glycosides, saponins, and phenolic compounds (Ogundipe et al., 1999). The presence of terpenoid compound was recently discovered in the root samples of *A. Laxiflor*a (Farombi et al*.*, 2003).

Ximenia americana l. (Olacaceae)

This is a common white flowered shrub or small tree up to 5 m tall. It is chiefly growing in savannah areas. The leaves may be thin, alternate and are entire and may be half- succulent, elliptic to narrow elliptic about 3 - 7 cm long and 3 cm broad. The young leaves have an odour like bitter almonds. The fruit is yellowish and smooth, about 3 cm long with acid sweet pulp. The fruit is formed from a superior ovary, ellipsoid, about 2.5 cm in diameter and glabrous. Before the fruit ripens, it has an odour like that of oil of almonds (Hutchinson and Dalziel, 1972).
The Preparations of branched leaves, barks, peeling and roots is used for headaches, tooth aches, mumps and conjunctivitis in frontal applications. In tropical West Africa, the root has been used medically for febrile headache. An infusion or a decoction of the root is drunk as medicine for venereal disease. In Tanzania, the root is used as a febrifuge and diarrhoea remedy. In Zimbabwe, a decoction of the leafy twigs is given for febril colds and cough and as laxative. Also in northern Nigeria, the decoction of the Leafy twigs is used as mouth wash to relieve toothache (Dalziel, 1956).

Jatropha curcas

J. curcas (Euphorbiaceae) is commonly known as physic nut. It is a drought-resistant species which is widely cultivated in the tropics as a living fence. Many parts of the plants are used in traditional medicine. The physic nut is a small tree or large shrub which can reach a height of up to 5 m. The trunks contain latex. Normally 5 roots are formed from seedlings, one central and four peripheral. A taproot is not usually formed by vegetatively- propagated plant. The purging nut has 5 - 7 shallow lobed leaves with a length and width of 6 - 15 cm, which are arranged alternately.

The plant is widely cultivated in the tropics as a living fence in fields and settlements. In mali, there are several thousand kilometers of *Jatropha* hedges. Purging nut is also quite common in Burkino Faso. In Cape Verde islands, the physic nut was recently planted in arid area for soil erosion control. In Madagascar it is used as a support plant for vanilla.

In medicine, preparations of all parts of the plant, including seeds, leaves and bark, fresh or as a decoction, are used in traditional medicine and for veterinary purposes. The oil has a strong purgative action and is also widely used for skin diseases and in soothing pains such as rheumatics. A decoction of leaves is used against cough and as an antiseptic after birth. Branches are used as a chewing stick in Nigeria (Isawumi, 1978). The wound healing properties of curcain, a proteolytic enzyme isolated from the latex of this plant has been demonstrated. The latex has antimicrobial properties against *Escherichia coli*, *S. aureus*, *k. pneumoniae*, *S. pyogenes* and *C. albicans* (Thomas, 1989).

APPROACHES TO DRUG DISCOVERY USING HIGHER PLANTS

Several reviews pertaining to approaches for selecting plants as candidates for drug discovery programs have been published (Suffness and Dourous, 1982; Newman et al., 2000). However, most concern screening plants for anticancer or anti-HIV activity. The approaches are outlined below

Random selection followed by chemical screening

These phytochemical screening approaches (for the presence of alkaloids, triterpenes, flavonoids, isothiocyanates, etc) (Farnsworth, 1996; Harborne, 1973; Sofowara, 1993) have been used in the past and are currently pursued mainly in the developing countries. The tests are simple to perform, but false positive and false negative tests often render results difficult to assess (Farnsworth, 1996) more important, it is usually impossible to relate one class of phytochemicals to specific biologic targets. For example, the alkaloids or flavonoids produce a vast array of biologic effects that are usually not predictable in advance.

Random selection followed by one or more biologic assays

In the past, plant extracts were evaluated mainly in experimental animals, primarily mice and rats. The most extensive of these programs were sponsored by the National Cancer Institute (NCI) (Dourous and Suffness, 1981; Suffness and Dourous, 1982; Cragg et al., 1997,) in the United States and the Central Drug Research Institute (CDRI) in India (Dhawan et al., 1980). More than 35,000

species were screened *in vitro* and later *in vivo* at NCI from 1960 to 1981. Taxol and camptothecin (Wall and Wani, 1996) were discovered in this program as well as several other plants derived compounds that were unsuccessful in human studies. In 1986, the NCI program abandoned this approach and continued to collect and screen plants using a battery of 60 human tumor cell lines and also initiated a screening of plants for anti-HIV activity *in vitro.* Calanolide A, currently in phase 1 clinical trials, was developed from this program (Kashman et al., 1992).

Follow-up of biologic activity reports

These reports showed that the plants extracts had interesting biologic activity, but the extracts were not studied for their active principles. The literature from the 1930's through 1970's containing these types of reports (Fabricant and Farnsworth, 2001).

Follow- up of ethnomedical (traditional medicine) uses of plants

Several types of ethnomedical information are available. Plants used in organized traditional medical system such as Ayurveda, Unani, Kampo, and traditional Chinese medicine have flourished as systems of medicine in use for thousands of years. Their individual arrangement all emphasize education based on an established, frequently revised body of written knowledge and theory. These systems are still in place today because of their organizationl strengths, and they focus primarily on multi-component mixtures (Bannerman et al., 1983).

Herbalism, folklore and shamanism, center on an apprenticeship system of information passed to the next generation through a shaman, curandero, traditional healer or herbalist. The plants that are used are often kept secret by the practitioner so little information about them is recorded; thus there is less dependence on scientific evidence as in systems of traditional medicine that can subject to scrutiny. The shaman or herbalist combines the roles of pharmacists and medical doctor with the cultural /spiritual/ religious beliefs of a region or people which are often regarded as magic or mysticism. This approach is widely practiced in Africa and South America (Rastogi and Dhawan, 1982).

CONCLUSION AND RECOMMENDATION

Chemotherapeutic agents continue to play pivotal roles in the general well being of individuals and management of human clinical conditions (Farombi, 2003). The discovery of natural anticancer agent with promising biological activity has demonstrated the significance of medicinal plants in nature (Roja and Rao, 2000).

The industrial scale use of aromatic plants for essential oils, flavours and fragrances contributes to the economies of developing countries through improved export earning and import substitution as well as through employment creation and the alleviation of poverty in communities. Large-scale production of these compounds has resulted in the indiscriminate felling of trees. This has placed a limit to the availability of compounds from medicinal plants which indicate the need to collect plants from the wild.

Some cancer chemotherapeutic agents isolated from plant sources have been produced in large quantities using tissue culture. For example, paclitaxel, a distinctive diterpenoid has become one of the most important lead compounds to emerge from the screening of natural products in recent years (Kingston, 1992). The chemical synthesis of paclitaxel molecule is difficult to achieve due to the complex structure of the molecule, making a comercial source of paclitaxel unlikely (Roja and Rao, 2000). Tissue culture has been suggested as an alterna-tive method to provide large amounts of paclitaxel and related compound (Roja and Rao, 2000) and the produc-tion of paclitaxel from cell cultures has been patented (Christen et al., 1991)

Presently many countries in Africa have policies directed at developing biotechnology capabilities, through funding of projects, training of researchers and creation of specialized research institutes (Sonaiya et al ., 2002). More efforts should be directed towards the use of biotechnological techniques for the production of chemotherapeutic agents, which can be used to fight some African endemic diseases such as Malaria, Liver cancer, and other tropical related diseases (Farombi, 2003).

SUGGESTIONS FOR FUTURE TRENDS

1. Active research and development are imperative for understanding the basic science involved in monitoring international scientific trends and events and in training researchers in developing biotechnology capabilities (Farombi, 2003).
2. The present research efforts on medicinal plants need to be increased with improved collaboration with developed country laboratories. This will hasten the discovery of more drugs from medicinal plants of Africa especially for diseases perculiar to Africa like sickle cell anaemia, malaria, and other parasitic diseases (Sofowora, 1993).
3. The industrial utilization of medicinal and aromatic plants should be undertaken with conservation measures in mind.
4. Emphasis should be placed on biotechnological studies and genetic improvement of medicinal plants (Farombi, 2003).
5. Greater effort should be put in the search for new

drugs from plants, especially in plants indigenous to the tropical Africa (Roja and Rao, 2000).

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