Some Wild Herbaceous Plants of Nigeria: A Biological, Pharmacognostic and Phytochemical Review

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Abstract In the twentieth century, science makes substantial breakthrough in management and cure of diseases by chemotherapy due to discovery of antibiotics and other chemotherapeutic agents. In the twenty first century, man and other animals are still, however being challenged by emergence of new infectious and non-infectious diseases that have proven to be resistant to the available novel therapeutic drugs. The available orthodox medications have either been ineffective against some causative agents of these diseases; too costly or basically unavailable to the average citizen of developing countries like Nigeria. The use of herbal remedies for prevention, management and cure of diseases is as old as antiquity, yet still common practice among the African population. A number of plants used in traditional herbal medicine have been evaluated by different researchers. This book chapter provides a concise review of traditional use, phytochemical contents, pharmacognostic and biological activities of some wild herbaceous plants that of medicinal importance in Nigeria. Plants including; *Cuminium cyminum* Linn, *Rauwolfia vomitoria* Afzel, *Cassia sieberiana* D.C, *Piliostigma thonningii* (Schumach.) Milne-Redh, *Guiera senegalensis* J.F.Gmel, *Acalypha indica* Linn, *Euphorbia hirta* Linn, *Euphobia unispina* N.E.Br, *Phyllantus muellerianus* (Kuntze) Exell, *Senna occidenatlis* Linn and *Grewia mollis* Juss are comprehensively reviewed. Phytochemicals like glycosides, alkaloids, polyphenols, flavonoids, phytosterols, terpenoids, saponins etc are widely reported to be present in various parts of these plants. The traditional herbal use of the plants in management and cure of ailments, as well as reported biological and pharmacological activities were linked to the presence of these phytochemicals. Based on the information reviewed, it is concluded that these wild herbaceous plants are potential sources of new natural bioactive substances that could be explored and exploited for their therapeutic and industrial applications.

Dedicated to Our Teachers and Mentors for Enduring Knowledge Impacted

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1 Introduction

For time *in-memoriem* plants have been a source of food and therapeutic remedy for humans and his animals. Traditional societies in Africa and elsewhere have always used herbs to promote healing (Atawodi et al. 2009, 2011; Ene et al. 2009; Focho et al. 2009). Even presently, traditional medicine is still the predominant means of health care delivery in many developing countries where larger percentage of their total population depends on it for their well being (Atawodi et al. 2014a, b, c). In addition, plants are important source of food as well as industrial raw materials for various products, and are also the basis for the development of many orthodox drugs. The medicinal values of plants lie in their component phytochemicals such as different classes of alkaloids, tannins, flavonoids and other phenolic compounds, which produce definite physiological actions on animal and human body (Ullah and Khan 2008; Atawodi and Ogunbusola 2009; Ogbe et al. 2009; Asmah et al. 2006).

Nigeria is situated in the Western part of Africa, with coastal boundary delimited by the Gulf of Guinea in the south, and shared land boundary with Cameroon and Chad in the east, Niger Republic in the north and Benin in the west. Nigeria covers a total area of 923.758 km^2 with a coastline of 853 km and land boundry of 4047 km. The latitudinal and longitudinal extent of the country is 4° to 14° N and 2° to 15° E making it one of the few countries in the world to have both tropical and sub-Saharan vegetation. As a tropical country, Nigeria is blessed with an enormous biodirversity of natural resources but unfortunately receiving an unfair share of the sun's ultraviolet radiation in addition to the tropical ecosystem's myriad of pathogenic microbes, as well as man-made disease causing agents like tobacco (Atawodi et al. 1995). African plants which were able to withstand and survive in these stressful conditions due to their abilities to accumulate biologically active phytochemicals (Atawodi et al. 2014a), should also be able to produce secondary metabolites that will protect the population.

From the mangrove rain forest of the south to the sunny, seasonal rainy savannah in the north, Nigeria is blessed with an enormous plant biodiversity. The presence of these numerous floras with ancient ethnomedicinal uses in herbal medicine inspired several studies by various researchers on the biological activities and chemical constituents inherent in these plants (Ashaf and Olunu 2011; Adejo et al. 2015). However, many of such plants which include large numbers of wild plants whose phytochemical constituents have been identified and potential biological activities confirmed are yet to be exploited pharmaceutically or industrially. This chapter attempts to concisely provide an update on the traditional use, phytochemical contents, pharmacognostic and biological activities of some Nigerian plants with particular reference to wild herbaceous plants.


Pictures 1 and 2 *Cuminia cyminum* J.F. Gmel (Source: http://magicgardenseeds.com)

Apiaceae

***Cuminium cyminum* Linn.** Synonyms: *Cuminia cyminum* J.F. Gmel., *Cuminum aegyptiacum* Merax ex DC., *Cuminum hispanicum* Bunge, *Cuminum odorum* Salisb., *Cuminum officinale* Garsault (Inval.), *Cuminum sativum* J. Sm., *Cyminon longeinvolucellatum* St.-Lag., *Linguisticum cuminum* (L.) Crantz, *Selinum cuminum* E.H. Crantz.

Common Names

Commonly called Cumin (Johri 2011); Cummin, Roman Caraway, Jeera (India) (Parashar et al. 2014) (Pictures 1 and 2).

Morphological Description

Cuminum cyminum is an annual herbaceous plant with a slender branched stem. It grows up to 30–60 cm tall. The leaf is alternate, simple or compound and have a sheathing base below. The flowers are small, pink and characteristically borne in umbrella shaped clusters. The flowers have both male and female structures together and an inferior ovary that develops into a very characteristic fruit called a cremocarp, which is a capsule that upon maturity breaks into two one-seeded bits (Parashar et al. 2014).

Geographical Distribution

Cuminium cyminum grows in many countries of Africa, as well as Asia and Europe (Johri 2011)

Ecological Requirements

Cumin needs fairly cool, less humid climate and temperatures of between 25 and 30 °C to grow. It is very sensitive to rainfall, such that rainfalls at times of harvest can drastically lower yield and crop quality. The plant is also susceptible to frost damage during flowering and initial stages of seed formation. It grows best on well drained sandy-loam soil and optimally alkaline pH range of 6.8–8.3 (Anandaraj and Sastry 2015). *Cuminium cyminum* has however, been experimented to thrive well in relatively low temperature zones as higher temperatures lower yields and affects both seedling weight and height. A temperature range of 15–25 °C has been found to be the optimum temperature for cumin seed germination rate, optimum seedling growth, seedling weight and height. With respect to timing, the last week of March – first week of April was established to be the best planting time, as this period offers significantly shorter emergence time, highest plant height and yield (Khosh-Khui and Bonyanpour 2006).

Major Chemical Constituents and Bioactive Compounds

The major phytochemicals occurring in cumin are cuminaldelyde, limonene, α- and β- pinene, 1,8–cineole, *o*- and *p*-cymene, α- and *y*-terpinene, sufranal and linalool (Johri 2011). Cumin seeds contain up to 5% of a volatile oil composed primarily of aldehydes. In addition, the seeds yield 22% fats, numerous free amino acids and a variety of flavonoid glycosides, including the derivatives of apigenin and luteolin. The cuminaldelyde content varies considerably, depending on the source of the oil (Parashar et al. 2014). Ahmad and Saeidnia (2011) also reported monoterpene hydrocarbons as major components of the plant, while sesquiterpenes are minor components. The analysis of the volatile oil from the fruit of cumin showed the presence of trans-dihydrocarvone, *y*-terpinene, *p*-cymene, α-phellandrene and *p*-menth-2-en-7-ol (Chaudhary et al. 2014).

Traditional Uses, Part(s) Used and Common Knowledge/Uses in Traditional Medicine

In Tunisian traditional medicine, cumin is considered abortive, galactagogue, antiseptic and antihypertensive (Leporatti and Ghedira 2009). In Indian traditional medical practices, cumin seeds are considered carminative, eupeptic, antispasmodic, and astringent. It is used in Nigeria for the treatment of mild digestive disorders, diarrhea, dyspepsia, flatulence, morning sickness, colic, dyspeptic headache and bloating. It promotes the assimilation of other herbs and improves liver function (Johri 2011). Cumin is also used in bronchio-pulmonary disorders and as a cough remedy.

Biological Activities

Several studies have verified the antibacterial actions of cumin against a range of useful and pathogenic gram-positive and gram-negative bacterial strains (DeMartino et al. 2009). Specifically, Chaudhary et al. (2014) reported the potency of the essential oil of cumin against *Staphylococcus epidermidis*, *Staphylococcus aureous*, *Staphylococcus haemolyticus, Propionibacterium acnes, Corynebacterium diphtheriae, Erysipelothrix rhusiopathiae, Bacillus cereus, Clostridium tetani,*

Clostridium difficile, Escherichia coli, Salmonella typhi, Klebsiella pneumoniae, Vibrio cholera, Aeromonas hydrophila, Mycobacterium tuberculosis and *Neisseria gonorrhoeae*. Bokaeian et al. (2014) have also demonstrated that essential oil from cumin possess potent antimicrobial activity against multi-drug resistant *Escherichia coli*

Antifungal activity of cumin has also been reported against soil, food, animal and human pathogens including, dermatophytes, *Vibrio* sp., yeast, aflatoxins and other mycotoxin-producing fungi (DeMartino et al. 2009; Boyraz and Ozcan 2005). Using agar-well diffusion method El-Said and Goder (2014) reported that essential oils of *Cuminum cyminum* inhibited the growth of twenty six fungal isolates, while Chaudhary et al. (2014) confirmed the antifungal activity of cumin oil against *Aspergillus niger*, *Saccharomyces cererisae* and *Colletrotrichum gloeosporiodes.* Other biological activities reported for cumin include antioxidant, anticarcinogenic, antimutagenic, antidiabetic, diuretic, immunomodulatory, and estrogenic (Johri 2011).

Apocynacea

Rauwolfia vomitoria **Afzel** (Synonyms: *Rauvolfia stuhlmannii* K.Schum) (Pictures 3 and 4)

Botanical Name and Family
Rauwolfia vomitoria belongs to the family of Apocynaceae, Its common names are swizzle stick, devil's pepper (English) and Asofeyeje (Fapojuwomi and Asinwa 2012).

Morphological Description
Rauwolfia vomitoria is a shrub or small tree that grows up to 8m, with parts, except old ones containing latex. The branches are usually whorled, while the nodes are enlarged and leaves, lumpy in threes, elliptic-acuminated to broadly lanceolate. Usually, flowers are minute, sweet-scented with branches of inflorescences that are distinctly superfluous with hardly ant-free corolla lubes, while the fruits are fleshly and red in colour (Fapojuwomi and Asinwa 2012).

Geographical Distribution
Rauwolfia vomitoria is native to tropical Africa from Senegal east to Sudan and Tanzania, south to Angola; and naturalized in China, Bangladesh, and Puerto Rico. *Rauvolfia vomitoria* occurs naturally in forest, but is mostly found in forest regrowth where fallow periods are prolonged.

Ecological Requirements
Rauwolfia vomitoria occurs in bush vegetation, gallery forest, secondary vegetation where fallow periods are long, and along roadsides, from sea-level up to 1600 m altitude. *Rauwolfia vomitoria* can be found flowering and fruiting almost throughout the year, but sometimes not and usually less abundantly during the rainy season.

Pictures 3 and 4 *Rauwolfia stuhlmannii* (Sources: Authors and prota4u.org)

The flowers are pollinated by insects such as small bees and flies, and the fruits are dispersed by birds.

Major Chemical Constituents and Bioactive Compounds

Rauwolfia vomitoria contains a large number of indole alkaloids, between 40 and 80. Most occur in very small amounts and several are disputed. Most alkaloids occur in an unstable complex, and seasonal variation is present as well. Leaves contain 0.03–0.8% total alkaloids, stem bark about 0.6%, roots 0.15–0.2% and root bark 1.5–2.0%.The alkaloids of *Rauwolfia vomitoria* can be grouped into 5 main types: (1) yohimbine and derivatives, including reserpine and deserpidine (11-demethoxyreserpine); (2) the heteroyohimbine type, including ajmalicine (raubasine), reserpinine (rescinnamine) and reserpiline; (3) sarpagane derivatives, including sarpagine (raupine); (4) the dihydro-indole type, including ajmaline; (5) the anhydronium bases, including alstonine, serpentine and serpenticine. Other groups include the oxindoles and pseudoindoxyls. Serpentinine is the only dimeric yohimbin-related alkaloid isolated so far.

In the root bark reserpiline is the major component, followed by reserpine, reserpinine and ajmaline. In the stem bark reserpiline is also the major component, with small amounts of isoreserpiline and yohimbine. The leaves were found to contain mainly geissoschizol, but no reserpine, reserpinine or ajmaline. The alkaloids in the leaves comprised about 41% heteroyohimbines and 52% oxindoles. The unripe fruit contains several alkaloids, amongst which is 2,6-Dimethoxybenzoquinone, a benzoquinone that is a toxic chemical compound (Van-Dilst and Leeuwenberg 1991).

Traditional Uses, Part(s) Used and Common Knowledge/Uses in Traditional Medicine

In the entire distribution area of *Rauwolfia vomitoria,* a root decoction, root macerate or powdered root in water is taken to treat diarrhoea, rheumatism, jaundice, venereal diseases and snakebites. Root products are also widely taken to treat hypertension, and as a sedative to calm people with epilepsy, and people who are

psychotic or mentally ill; they are also used to wash children with colic or fever. Externally, macerated or powdered root or sometimes pulped fruit are applied to a range of skin problems, such as rash, pimples, chicken pox, wounds, scabies, psoriasis, leprosy, hemorrhoids, head lice and parasitic skin diseases. A root decoction is used as a mouth wash against gingivitis or thrush. The stem bark or leaves are also used for these purposes, but to a lesser extent. The stem bark, leaf decoction and latex of young twigs are widely used as purgative or emetic (Burkill 2000).

In Guinea the root maceration is applied to tumors. In Liberia a bark infusion is taken to cure fever. A leaf infusion is rubbed in against yaws. Dried or fresh pulverized roots in palm wine or oil are taken to treat female sterility. A root decoction is used in massages and baths to treat rheumatism, tiredness and rachitis. In Togo pulverized root bark in brandy is taken to treat tuberculosis. In Cameroon a decoction of powdered roots is taken to treat diabetes and malaria. In the Central African Republic a root decoction is taken to treat hernia. In Côte d'Ivoire leaf sap is rubbed between the toes to treat infections caused by humidity. A leaf maceration is used for bathing children with fever. In Gabon chopped and boiled leaves mixed with fat are applied to the skin to cure rheumatism and sprains. A mixture of pulverized root or leaf sap with plant oil or lemon juice is applied to the hair to stop hair loss. In Nigeria the root and leaves in decoction are taken to treat indigestion, as a tonic, and as an abortifacient. In Equatorial Guinea the latex is used for cicatrization of wounds (Terashima and Ichikawa 2003).

In the Central African Republic the roots of *Rauwolfia vomitoria*, alone or together with seeds of *Strophanthus gratus* (Wall & Hook) Franch. are pounded to a paste, which serves as arrow poison. In DR Congo, the roots are a common additive to *Periploca nigrescens* Afzel. hunting poison, while in Equatorial Guinea, the root scrapings are mixed with cassava meal and used as a rat poison. In Nigeria and other West African countries, the root is considered aphrodisiac when taken in palm wine (Latham 2004).

Rauvolfia vomitoria is used to treat leprosy in the Democratic Republic of Congo. The plant is very important and useful in the treatment of lunatic patients; the root is added to gin and given to mentally ill persons. It can also be ground into powder and taken with pap, and can be taken in form of decoction used for rheumatic pains. An infusion of the root bark is used to treat jaundice and gastro-intestinal disturbance (Fapojuwomi and Asinwa 2012).

Biological Activities

Of the *Rauwolfia* alkaloids, five are used in medicine: reserpine, reserpinine, deserpidine, ajmalicine and ajmaline. There are several patented methods for the extraction of the main component reserpine. Furthermore, several simple and accurate methods have been developed to identify *Rauvolfia* alkaloids, e.g. reserpine, serpentine and ajmaline.

Reserpine is a well-known antihypertensive, antipsychotic and sedative. It is a sympatholytic agent acting indirectly on the peripheral and central nerve terminals (Bedu-Addo 1993). It impairs the storage of biogenic amines resulting in depletion of norepinephrine, dopamine, and serotonin. Depletion of norepinephrine induces a

lasting drop in blood pressure. Contra-indications for using reserpine are depression, peptic ulcer, and hypersensitivity to the alkaloid, while the side effects of the medication include drowsiness, nasal congestion, salivary and gastric hypersecretion, paradoxical anxiety, depression and retention of water and Na^+. Overdose may also cause respiratory depression, slowed heartbeat, hypotension, confusion, tremors, convulsions and gastro-intestinal distress. Reserpine has been shown to enhance the hypoglycaemic effect of insulin and the hyperglycaemic effect of adrenalin, and has inhibited the physiological hyperglycaemic response in diabetic patients (Nwodo et al. 2003). Because of the necessary high doses and the resulting dangerous side effects, reserpine lost its importance as a medicine. It is only used in low doses for mild to moderately severe high blood pressure, often together with ajmalicine. Reserpinine and deserpidine are reserpine analogues. Both alkaloids have the same effects as reserpine, and can be used to treat the same conditions, while their side effects are reported to be less pronounced. Reserpiline is marked sympatholytic and hypotensive with no noticeable depressant effects on the central nervous system and no sedative properties, and also lacks most of the side effects of reserpine and its analogues.

Ajmalicine is an α-adrenergic blocking spasmolytic which, at high doses, moderates the activity of the vasomotor centres, especially in the brain stem causing an increase of the blood flow to the brain. It is mainly used in products that treat the psychological and behavioural problems associated with senility, stroke and head injuries. Ajmaline is an anti-arrhythmic, which substantially decreases the rate of depolarization of artrial and ventricular cells. Its toxicity has limited its uses and it is mainly prescribed against rapid irregular cardiac beat. Because of its toxicity, it is no longer marketed in several countries. Several other *Rauwolfia* alkaloids have hypotensive or sedative activities, but most are less effective (Nwodo et al. 2003).

An ethanolic leaf extract of *Rauwolfia vomitoria* caused a reduction in blood sugar levels of normal and alloxan-induced diabetic rabbits, comparable to that of tolbutamide, while decoction of the root has no adverse effect on the oestrous cycle, fertilization or implantation, and also has no effect on the foetus or hormone-induced infertility in rats. The root bark extract has been reported to show antibacterial, antiprotozaol activity in vitro against several human pathogens (Fapojuwomi and Asinwa 2012).

Caesalpinacea

***Cassia sieberiana* D.C** (Synonym: *Cassia kotschyana* Oliv.) (Picture 5)

Cassia sieberiana DC, (family: Caesalpiniaceae) is distributed widely from Senegal, through Nigeria, and Gambia eastward to DR Congo and Uganda (Van der Maesen 2007).

Picture 5 *Cassia sieberiana* (Source: http://www.zimbabweflora.co.zw)

Common Names
African laburnum, West African laburnum (English), Casse du Senegal, Casse de sieber, Casser agrappes, Casse-flute (French), Mzangaya, Mzangaye (Swahili) (Van der Maesen 2007).

Morphological Description
Cassia sieberiana is an annual plant that grows in the world tropical zones. It is an upright growing plant that can reach a height of 4 ft with large green leaves and very bright yellow flowers. The seed range in colour from greenish brown to dark brown with smooth surfaces and may have small bright colored bands on the outer surface (Olapade et al. 2014).

Geographical Distribution
Cassia sieberiana is distributed widely from Senegal, through Nigeria and Gambia east to DR Congo and Uganda (Van der Maesen 2007).

Ecological Requirements
It occurs in tree or shrub savanna with less than 800 mm annual rainfall. Acid sandy soil is preferred (Van der Maesen 2007).

Major Chemical Constituents and Bioactive Compounds
Cassia sieberiana leaves contain flavones (quercitrin, isoquercetrin), an anthraquinone (rhein) and tannins. Anthraquinones and sterols are also present in the root (Van der Maesen 2007). Polyhydroxy and phenolic substances were identified in the root extract (Nartey et al. 2012) while the seeds contain tannins, alkaloids, phenols, oxalate, cardiac glycosides and flavonoids (Olapade et al. 2014).

Cassia sieberiana is included in Nigerian Herbal Pharmacopoeia (NHP) and West African Herbal Pharmacopoeia (WAHP) (Ajayi et al. 2014).

Traditional Uses, Part(s) Used and Common Knowledge
The entire plant is purgative and diuretic. In Senegal, an infusion of the entire plant is given against all children's diseases. Different parts of the plant are applied to teeth to cure toothache. Across Africa, it is also used to treat skin diseases, malaria, stomachache, ulcer, diarrhea, gonorrhea and sleeping sickness. The decoction of the root is used to treat haemorrhoids, bilharzia, dropsy, bloody dysentery and intestinal worms. The root decoction is also considered an aphrodisiac (Van der Maesen 2007).

In Senegal, the aqueous root extract of *C. Sieberiana* was used in traditional medicine to treat pain and inflammation (Kerharo-Adam 1974). The roots, boiled in water, are used to treat haemorrhoids, bilharzia, leprosy, dropsy and bloody dysentery. In Côte d'Ivoire the decoction is taken in large doses to treat intestinal worms including tapeworms, although this is risky. An infusion of the root bark is employed against venereal diseases, sterility and dysmenorrhoea. After soaking the roots in water, the liquid is used for a bath against tiredness and for body massage. A decoction of the roots is considered an aphrodisiac. In Burkina Faso a pinch of powdered dried decorticated roots taken at the end of each meal is said to prevent malaria. Crushed roots are rubbed on the temples to treat headache. Debarked roots are boiled with bark of *Terminalia macroptera* Guill. & Perr. to combat eczema (Van der Maesen 2007).

Biological Activities
Leaf extracts of *Cassia sieberiana* exhibit antibacterial action against *Staphylococcus lutea*, *Mycobacterium phlei, Bacillus subtillis* and *Proteus* sp (Van der Maesen 2007). Several compounds exhibiting a broad spectrum antimicrobial activity have been isolated from *Cassia sieberiana*. A crude extract of the leaves showed antiplasmodial activity against *Plasmodium* including activity against chloroquine-resistant strains of *Plasmodium falciparum*, and flavonoids and isoflavonoids have been isolated as active ingredients. The plant has also been reported to have antioxidant, gastroprotective, laxative, anti-diarrheal anti-inflammatory and analgesic activities (Asase et al. 2005; Nartey et al. 2012)

Piliostigma thonningii **(Schumach.) Milne-Redh** (Synonym: *Bauhinia thonningii* Schumach. & Thonn.)

Botanical Name and Family
Piliostigma thonningii (Schumach.) Milne-Redh is a leguminous plant belonging to the Caesalpiniaceae family (Jimoh and Oladiji 2005).

Common Names
Camel's foot, Monkey bread (English), Kalgo (Hausa), Abefe (Yoruba), Okpoatu (Ibo) (Jimoh and Oladiji 2005) (Picture 6).

Morphological Description
Piliostigma thonningii is a deciduous dioecious tree that grows up to 10–40 m tall, but the bole can be branchless for 2–3 m. The outer bark is rough, longitudinally fissured and dark brown to grey or black. The leaves are alternate, conspicuously

Picture 6 *Piliostigma thonningii* (Source: Authors)

bi-lobed for one eighth to one third of the length. The stipules are 3–6 mm long, the petiole is 2–7 cm long and the blade grows to between 17 and 21 cm, with base, usually a strong cordate. The apex of lobes are rounded to acute, leathery, upper surface glabrous. The lower surface has rusty brown crisped hairs and conspicuous reticulate venation, palmately veined with 11–15 basal veins. Inflorescence is a panicle, usually alternately leaf-opposed and axillary along branches, male inflorescence very narrowly pyramidal, up to 25 cm × 5.5 cm, female inflorescence up to 7 cm long, few flowered. The many-seeded fruit is an oblong to linear-oblong pod, 12–37 cm × 3–7 cm, woody, brown-pubescent when young but later glabrescent, persisting on the tree but finally decaying on the ground. The seeds are obovoid to ellipsoid, 4–9 mm × 2–7 mm × 3–4 mm dark brown to blackish, compressed. Seedling is with epigeal germination (Lemessa 2010).

Geographical Distribution

Commonly called camel's foot tree, *Piliostigma thonningii* is native to tropical Africa, widespread in the Sudano-Guinean region from Senegal eastward to Eritrea and occurs southward to Namibia, Botswana, Mozambique and South Africa. It also occurs in Yemen (Lemessa 2010).

Ecological Requirements

Piliostigma thonningii occurs from sea level up to 2200 m altitude in areas with annual temperature of 20–2 °C, an average rainfall of 400–1500 mm and a dry season of 6–11 months. It is sensitive to frost, grows on all soil types but heavy clay soils or medium loamy soils are preferred. *Piliostigma thonningii* is common in secondary and gallery forest, woodland, wooded grassland, bush land and also river valleys (Lemessa 2010).

Major Chemical Constituents and Bioactive Compounds

The phytochemicals contained in *Piliostigma thonningii* seed include saponins, flavonoids, phenolics, glycosides, anthraquinones and cardiac glycosides. It is also a good source of antioxidant micronutrients such as iron, calcium, selenium, zinc and manganese (Jimoh and Oladiji 2005; Bello et al. 2013) Epicatachin and inositol have been identified in the fruit while saponins, flavonoids, phenolics, anthraquinones and glycosides are in the seeds. The bark contains tannins whereas the leaf contains 2-phenoxychromone, 6,8-di-*C*-methylquercetin-3-methyl ether, 6-*C*-methylquercetin-3,7-dimethyl ether and 6,8-di-*C*-methylquercetin-3,7-dimethyl ether. Quercetin and quercitrin are also present in the leaf (Lemessa 2010).

Traditional Uses, Part(s) Used and Common Knowledge

The bark of *Piliostigma thonningii* is commonly used in tying hut, fence and bridge building. Fibre extracted from the bark and root is widely used for making string, rope, and cloth. The fruit is eaten as a snack or as an emergency food, especially by children and herdsmen. An infusion of the bark, leaf or pods is used to coagulate Funtumia latex used in making rubber. The leaf extract is effective in treating inflammations, bacterial infections, worm infestation and to arrest bleeding (Ozolua et al. 2009).

Biological Activities

The root, bark and leaf extracts possess antiviral activity against Herpes simplex virus type 1 and 2, HIV and different strains of influenza and syncytial viruses. The root bark also possesses antitussive, anti-inflammatory and analgesic properties. The stem bark has antibacterial activity against *Bacillus subtilis*, *Corynebacterium pyogenes*, *Escherichia coli*, *Proteus vulgaris*, *Shigella dysenteriae* and *Staphylococcus aureus*. The bark extract also have larvicidal and antihelminthic properties. Butanol and ethylacetate extracts have antioxidant activity (Lemessa 2010).

Uses in Traditional Medicine

A root preparation is applied on wounds and ulcers as a haemostatic and to promote healing. It is also used as a diuretic and for the treatment of diarrhea, dysentery, worms and other intestinal problems. Root preparations are also used as remedy for cough and snake bite (Jimoh and Oladiji 2005). Preparations of the bark are used to treat pneumonia, skin infections, pains, rheumatism and inflammation. Preparations of the leaf are used for respiratory problems, as antiseptic and to promote wound healing. They are also administered to treat epilepsy and heavy menstrual flow (Lemessa 2010; Bello et al. 2013). The leaf extract is effective in treating inflammations, bacterial infections, worm infestation and to arrest bleeding (Ozolua et al. 2009).

Picture 7 *Guiera senegalensis* (Source: Authors)

Combretaceae

Guiera senegalensis J.F Gmel. (Picture 7)

Botanical Name and Family
Guiera senegalensis (Family: Combretaceae) is one of the most important West African medicinal plants often used to treat a variety of microbial infections and the most frequently used part is the leaf (Silva et al. 2008).

Common Names
Guier du Senegal (French). Sabara (Hausa), Shafi pitu (Marghi), Tadar (Tangale), Kashishi (Kanuri)

Morphological Description
Guiera senegalensis is a shrub that can grow to a height of 3–5 m according to habitat. Its stem presents numerous knots that send out branches. The ash-grey stem and branches have fibrous and pubescent bark and bear opposing short petiolated oval leaves, sometimes mucronated, sometimes even cordate, about 2 to 4 cm long by 1 to 2 cm wide. The grey-green leaves, darker on their upper surface display black spots on their lower surface and are slightly downy on both sides (Somboro et al. 2011).

Geographical Distribution
Guiera senegalensis is a shrub found abundantly in the savannah region of West Africa (Oshobu and Geidam 2014). It is widely distributed in the savannah region of West and Central Africa – Nigeria, Senegal, Gambia, Mali, Niger, Burkina Faso and Ghana (Salihu and Usman 2015).

Ecological Requirements

Guiera senegalensis is is found in shrub savanna, tree savanna and fallow land from sea level up to 1000 m altitude. It grows in areas with 200–800 mm annual rainfall and can thrive on all types of soil, but mainly on dry sandy or degraded soils, sometimes in areas which are temporarily flooded. It does not tolerate heavy shading. *Guiera senegalensis* is considered an indicator of overgrazing and is very drought resistant (Sanogo 2012).

Major Chemical Constituents and Bioactive Compounds

Among the phytochemicals identified in different parts of *Guiera senegalensis* such as leaves, fruits, root and stem bark are resins, alkaloids, tannins, saponins, glycosides and terpenes (Onwuliri et al. 2009), terpenoids, anthraquinones, coumarins, flavonoids, cardiotonic and cyanogenic heterosides (Somboro et al. 2011). The gall extract is particularly rich in flavonoids and polyphenols (Sombie et al. 2011).

Traditional Uses, Part(s) Used and Common Knowledge

Guiera senegalensis is active against cough, respiratory congestion and fever. It is prescribed as an antitussive, to ease breathing and to treat lung and bronchial disorders and malaria. Various parts are prescribed for stomach pains, dysenteric diarrhea, syphilis, beriberi, leprosy and impotence. A decoction of the leaf is applied against eczema, cold and chest conditions. Veterinary uses of the plant are in diets designed to increase body weight, reproductive capacity and milk secretion in animals (Somboro et al. 2011). It is one of the most important West African medicinal plants often used to treat a variety of microbial infections, including trypanosomiasis (Atawodi et al. 1995), and the most frequently used part is the leaf (Silva et al. 2008).

Biological Activities

Aqueous (cold and hot) and methanolic extracts of *Guiera senegalensis* were tested for antimicrobial efficacy against *Staphylococcus aereus, Salmonella typhi, Escherichia coli*, and *Streptococcus pyrogenes* by determining the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) of the extracts using standard methods. Results showed that all the extracts inhibited the growth of *S. aereus, S. typhi* and *E. coli* at all concentrations while *S. pyrogenes* was only inhibited at 250 and 200 mg/ml on some of the extracts (Onwuliri et al. 2009). Other biological activities identified in *Guiera senegalensis* include antioxidant (Atawodi and Onaolapo 2010), trypanocidal (Atawodi 2005), effect on central nervous system, on cancer cells and as a snake venom detoxicant (Somboro et al. 2011).

Uses in Traditional Medicine

In certain climes, people mix galls from *G. senegalensis* (gall nuts are frequently formed on the above-ground parts of the plant) with charcoal to make a highly diuretic powder prescribed in serious cases of oligouria and even anuria, and in particular for cerebral malaria. Other people reduce the galls to powder with the pith from *Combretum aculeatum* stems and salt. This powder is diluted in water immediately before use and is prescribed for painful stomach cramps with mucous stools

Picture 8 *Acalypha indica* (Source: http://pixgood.com)

and vomiting. A tea made from leaves is prescribed by the oral route (one litre daily) to treat eczema and is also used against attacks of fever, and to cure chest conditions and colds. Fresh mashed, chewed or cut leaves when placed on a wound staunch bleeding. Powdered dried leaves associated with *Melanther ascandens* are administered by the nasal route to treat headaches and sinusitis. The leaves are also used as a poultice on tumors and against Guinea worm (Somboro et al. 2011).

Euphorbiaceae

***Acalypha indica* Linn** (Synonyms: *Acalypha ciliata* Wall., *Acalypha canescens* Wall., *Acalypha spicata* Forsk.)

Common Names Three-seeded mercury, Acalypha (Indian), Ricinelle des Indes, orielle de chatte, herbe chatte (French) (Picture 8)

Botanical Name and Family
Acalypha indica belongs to the family Euphorbiaceae and is commonly called 'Indian acalypha', or Indian copperleaf (Jagatheeswari et al. 2013).

Morphological Description
Acalypha indica is a monecious, annual to sometimes short-lived perennial herb up to 1.5 to 2.5 m tall. Stems are sparingly to densely hairy and leaves are simple and arranged spirally.Stipules are linear, about 2mm long and the petiole up to 12 cm long. The flowers are unisexual. The male flowers have four lobed, minute, granular,

dotted, greenish calyx, they have eight stamens. The female flowers have three triangular-ovate, ciliate sepal and superior ovary. The fruit is a 3-lobbed capsule splitting into three cocci, each 2-valved and 1-seeded (Schmelzer and Gurib-Fakim 2008).

Geographical Distribution

Acalypha indica occurs in Nigeria and from Sudan eastward to Somalia and Southwards through Democratic Republic of Congo and East Africa and up to South Africa. Also found in Indian Ocean Islands, India, South East Asia and Oceania (Schmelzer and Gurib-Fakim 2008).

Ecological Requirements

Acalypha indica thrives on sandy margins of rivers and seasonal water courses, usually in the shade of thickets. It also grows on rocky hillside and as a weed on fields from sea level up to 135 m altitude. *Acalypha indica* flowers throughout the year in regions without a pronounced dry season (Schmelzer and Gurib-Fakim 2008).

Major Chemical Constituents and Bioactive Compounds

Acalypha indica is reported to contain alkaloids, tannins, saponins, steroids and proteins (Rajaselvam et al. 2012). The dried aerial parts contain a cyanogenic glycoside, acalyphin, which is a 3-cyanopyridone derivative. Flavonoids, such as the kaempferol glycosides mauritianin, clitorin, nicotiflorin, and biorobin have been isolated from the flowers and the leaves. The plant also contains tannins, β-sitosterol, acalyphamide, aurantiamide, succinimide and the pyraquinolinone alkaloid flindersin.

Traditional Uses, Part(s) Used and Common Knowledge

Acalypha indica is used as a diuretic, antihelmintic and for respiratory problems such as bronchitis, asthma and pneumonia (Rajaselvam et al. 2012).

The main parts that are usually exploited in medicine and the roots, leaf, stalk and flowers they are used as emetic, expectorant, laxative and diuretic. The plant is useful in bronchitis pneumonia and pulmonary tuberculosis. It also has anti-diabetic properties (Ishak et al. 2013).

In East Africa, the leaf sap is used to treat eye infections, while the leave powder is applied to maggot infested wounds. It is used in Comoros to treat joint pains and a root decoction is used in the Seychelles to treat stomach ache and intestinal wounds. In Madagascar, the crushed aerial parts are applied to skin parasite and an infusion is taken as a purgative and vermifuge, while in Mauritius, the juice of the crushed leaves mixed with salt or a decoction of the aerial parts is applied to scabies and other skin problems (Schmelzer and Gurib-Fakim 2008).

Biological Activities

Antimicrobial studies of the aqueous and acetone extracts of *Acalypha indica* shared that the extracts inhibited the growth of *Escherichia coli, Klepsiella* sp, *Staphylococcus aureous* and *Bacillus Subtilis* (Rajaselvam et al. 2012). Ishak et al. (2013) also reported that the petroleum ether, chloroform and methanol extracts of

fresh parts of *Acalypha indica* exhibited antibacterial effect on *Staphylococcus aureous* and antifungal effect on *Candida albicans*.

Cytotoxic activity against Hela cell lines has also been reported while and ethanol leaf extract of the plant showed significant inhibition to *Viper russelli* venom-induced lethality, hemmorhage, necrotizing and mast cell degranulation in rats. It also has cardiotoxic and neurotoxic effects on isolated frog tissue (Schmelzer and Gurib-Fakim 2008).

Acalypha indica was formerly listed in the British Pharmacopoeia, and because of its numerical uses in India, it is listed in the pharmacopoeia of India (Schmelzer and Gurib-Fakim 2008).

Uses in Traditional Medicine

It has been reported to be useful in treating pneumoniae, asthma, rheumatism and several other ailments. The dried leaves of *Acalypha indica* was made into a poultice to treat bedsores and wounds and the juice of *Acalypha indica* is added to oil or lime and used to treat a variety of skin disorders (Jagatheeswari et al. 2013). It is also used as a purgative, a very good remedy in the treatment of piles, and the root is used as a dewormer in children when administered in the morning empty stomach. When the leaves are used with turmeric, it is useful in relief from acne and pimples (Kucinggalak 2015).

***Euphorbia hirta* Linn** (Synonyms: *Chaemescyle hirta*)

Common Names Asthma herb (English), Odane Inenemili (Ibo), Kinkerechintara, Lupka (Nupe), Nonon kurciya, Janyaro (Hausa), Emile/Egele (Yoruba) (Picture 9)

Morphological Description

Euphorbia hirta is a plant belonging to the family: 'Euphorbiaceae'. It is a branched annual herb, prostrate to ascending, with branches up to 50 cm long, with latex; all parts short-hairy and with sparse yellow hairs c. 1.5 mm long. Leaves opposite, distichous, simple; stipules linear, up to 2.5 mm long; petiole up to 3.5 mm long; blade ovate, 1–4 cm × 0.5–2 cm, base very unequal, one side cuneate, the other side rounded, apex almost acute, margin finely toothed, often with a purple blotch near the midvein. Inflorescence a terminal or axillary cluster of flowers, called a 'cyathium', with several cyathia densely clustered into a cyme c. 15 mm in diameter; peduncle up to 15(–20) mm long; cyathia with a cup-shaped involucre c. 1 mm in diameter, tinged purple, lobes triangular, fringed, glands 4, tiny, elliptical, green or purplish, with minute white to pink appendages, each involucre containing 1 female flower surrounded by many male flowers. Flowers unisexual; male flowers sessile, bracteoles linear, fringed, perianth absent, stamen 1, c. 1 mm long; female flowers with short pedicel, perianth a rim, ovary superior, short-hairy, 3-celled, styles 3, minute, apex 2-fid. Fruit a just exserted, acutely 3-lobed capsule c. 1 mm in diameter, base truncate, short-hairy, 3-seeded. Seeds oblong-conical, c. 1 mm long, slightly wrinkled, pinkish brown, without caruncle (Johnson et al. 1999).

Picture 9 *Euphorbia hirta* (Source: Authors)

Geographical Distribution

Euphorbia hirta is said to be native to Central America, but a very common weed of the tropics and subtropics; it occurs throughout tropical Africa and also in South Africa.

Ecological Requirements

Euphorbia hirta grows in cultivated fields, gardens, roadsides and waste places, from sea-level up to 2000 m altitude.*Euphorbia hirta* is considered a weed, and can be a nuisance in crops due to the large number of seedlings.

Major Chemical Constituents and Bioactive Compounds

Important constituents of the aerial parts are terpenoids, including triterpenes: α-amyrin, β-amyrin, friedelin, taraxerol, and esters of it: taraxerone, 11α, 12α-oxidotaraxerol, cycloartenol, 24-methylene-cycloartenol, and euphorbol hexacosoate. The aerial parts and roots also contain diterpene esters of the phorbol type and ingenol type, including 12-deoxyphorbol-13-dodecanoate-20-acetate, 12-deoxyphorbol-13-phenylacetate-20-acetate, ingenol triacetate, as well as the highly toxic tinyatoxin, a resiniferonol derivative. Other terpenoids isolated are sterols including β-sitosterol, campesterol, cholesterol and stigmasterol (Abu-Sayeed et al. 2005).

Tannins isolated from the plant include the dimeric hydrolysable dehydroellagitannins euphorbins A, B, C, E and terchebin, the monomeric hydrolysable tannins geraniin, 2,4,6-tri-*O*-galloyl-*β*-*D*-glucose and 1,2,3,4,6-penta-*O*-galloyl-*β*-*D*-glucose and the esters 5-*O*-caffeoylquinic acid (neochlorogenic acid) and 3,4-di-*O*-galloylquinic acid, and benzyl gallate (Adedapo et al. 2005)

Acids isolated include ellagic acid, gallic acid, tannic acid, maleic acid and tartaric acid (Adedapo et al. 2005). Flavonoids isolated include quercetin, quercitrin, quercitol and derivatives containing rhamnose, quercetin-rhamoside, a chlorophenolic acid, rutin, leucocyanidin, leucocyanidol, myricitrin, cyanidin 3,5-diglucoside, pelargonium 3,5-diglucoside and camphol. The flavonol glycoside xanthorhamnin was also isolated. The stems contain the hydrocarbon hentriacontane and myricyl alcohol. The latex contains inositol, taraxerol, friedelin, β-sitosterol, ellagic acid, kaempferol, quercitol and quercitrin (Abu-Sayeed et al. 2005).

The mineral content of a sample of the dried leaves was: Ca 1.1%, P 0.3%, Fe 0.03%, Mg 0.5%, Mn 0.01%, Zn 0.01% and Cu 0.002%. Fresh leaves from *Euphorbia hirta* plants of Nigerian origin were found to contain high levels of Mn (189 ppm), Cu (30.5 ppm), Zn (152 ppm), and NO_3 (4600 ppm). Varying proportions of Fe, Mg, K, Ca and Na were found (Wallace et al. 1990).

Traditional Uses, Part(s) Used and Common Knowledge/Uses in Traditional Medicine

Euphorbia hirta is an important medicinal herb used throughout its distribution area, including tropical Africa. It is held in high esteem, as a decoction or infusion, to treat gastrointestinal disorders, including intestinal parasites, diarrhoea, peptic ulcers, heartburn, vomiting and amoebic dysentery (Oyewale et al. 2002).

It is also regarded as an outstanding medication to treat respiratory system disorders, including asthma, bronchitis, hay fever, laryngeal spasms, emphysema, coughs and colds. The leaves are mixed with those of *Datura metel* L. in preparing ‘asthma cigarettes (Hienmann and Bucar 1994).

Other principal uses are as a diuretic to treat uro-genital diseases, such as kidney stones, menstrual problems, sterility and venereal diseases. The plant is also used to treat affections of the skin and mucous membranes, including warts, scabies, tinea, thrush, aphthae, fungal afflictions, measles, guinea-worm and as an antiseptic to treat wounds, sores and conjunctivitis (Edwin et al. 2007).

The plant has a reputation as an analgesic to treat severe headache, toothache, rheumatism, colic and pains during pregnancy. It is used as an antidote and pain relief of scorpion stings and snakebites. It is antipyretic and anti-inflammatory (Ogbulie et al. 2007).

It is also used in the treatment of jaundice, hypertension, oedema, anaemia and malaria, as an aphrodisiac, and to facilitate childbirth. In West Africa the plants are widely used as a galactagogue, and in Nigeria they are marketed for this purpose. In Uganda whole plants are chewed to induce labour during childbirth (Hienmann and Bucar 1994).

Biological Activities

Several of the traditional medicinal uses of *Euphorbia hirta* have been supported by in-vitro studies. Ethanol, petroleum ether and dichloromethane extracts of whole plants showed significant in-vitro antiplasmodial activity (IC_{50} = 3 μg/ml) and decreased growth of *Plasmodium falciparum* by 89–100% at a test concentration of 6 μg/ml (Tona et al. 2004). *In vivo*, the extracts reduced parasitaemia in mice infected with *Plasmodium berghei berghei* at oral doses of 100–400 mg/kg per day.

From a methanolic extract of the aerial parts the flavonol glycosides afzelin, quercitrin and myricitrin were isolated, which showed proliferation inhibition of *Plasmodium falciparum*, with IC_{50} values of 1.1, 4.1, 5.4 μg/ml respectively, while they exhibited little cytotoxic effect against human epidermoid carcinoma KB 3–1 cells.

An ethanolic extract was active in selectively inhibiting Herpes simplex virus type-1 (0.001–0.1 mg/ml) (Somchit et al. 2001). Lyophilized aqueous extract of the aerial parts has been evaluated for analgesic, antipyretic and anti-inflammatory properties in mice and rats. The extract exerted central analgesic properties at doses of 20 and 25 mg/kg, and antipyretic activity at doses of 100 and 400 mg/kg, whereas anti-inflammatory effects against carrageenan-induced oedema in rats were observed at a dose of 100 mg/kg (Ogbulie et al. 2007).

The aqueous extract of the aerial parts has been found to strongly reduce the release of prostaglandins, and thus depress inflammation (Hienmann and Bucar 1994). An ethanolic extract of the aerial parts was found to possess a prominent anti-anaphylactic activity and also showed significant antihistaminic, anti-inflammatory and immunosuppressive properties in various animal models. Water and ethanolic leaf extracts produced a time-dependent increase in urine output in rats. A methanol extract of leaves and stems inhibited the activity of angiotensin-converting enzyme by 90% at 500 μg and 50% at 160 μg. The extract (10 mg/100 g, intraperitoneally) significantly decreased the amount of water consumed by rats. An ethanolic extract of the whole plant showed a dose-dependent ulcer protective effect in rats (Rao et al. 2003). The active compound was found to be quercetin, which had an anti-ulcer activity ranging from 48–64% comparable to 61–80% of the standard drug ranitidine. An ethanolic extract of the aerial parts showed significant hepatoprotective activity in rats. Extracts of whole plant material have oestrogenic activity in female guinea pigs, when given orally. In organ bath tests with ileum preparations, shikimic acid and choline extracted from the aerial parts had relaxing and contracting properties, respectively (Lanhers et al. 1990). Shikimic acid also has acute toxicity, mutagenicity and carcinogenicity. The aqueous crude extract significantly reduced the faecal egg count of helminths in dogs (Johnson et al. 1999).

Several of the extracts of *Euphorbia hirta* showed potential for controlling plant diseases and pests (Hienmann and Bucar 1994). For example, a whole plant extract inhibited growth of vascular wilt (*Fusarium oxysporum*) and the causal agent of sheath rot of rice, *Sarocladium oryzae*; aqueous extracts of the aerial parts inhibited aflatoxin production by *Aspergillus parasiticus* on agricultural crops, including rice, wheat, maize and groundnuts. Leaf extracts completely inhibited soft rot infection caused by the bacteria *Erwinia carotovora* pv. *carotovora*. The infectivity of tobacco mosaic virus on *Nicotiana glutinosa* L. was strongly inhibited (>80%) by tannins extracted from the aerial parts. The latex inhibited sugarcane mosaic virus-A by 78.5% and sugarcane mosaic virus-F by 80%. Root and leaf extracts showed nematicidal activity against *Meloidogyne incognita*; a whole plant extract effectively reduced hatching in the nematode *Heterodera avenae*. A 10% ethanol crude extract showed significant larvicidal action against the larvae of the tick *Boophilus microplus*. Aqueous stem, latex and leaf extracts have potent molluscicidal activity against

the freshwater snails *Lymnaea acuminata* and *Indoplanorbis exustus*, both intermediate hosts of *Fasciola hepatica* and *Fasciola gigantica*, which cause endemic fascioliasis in cattle and livestock (Singh and Khandelwal 2010). Toxicity of the extracts was time dependent and dose dependent against both snails. The doses that can be used for killing 90% of the *Lymnaea acuminata* populations are safe for the fish *Channa punctatus*.

An aqueous extract of the whole plant acts as an antidiarrhoeic agent by antiamoebic, antibacterial and antisplasmodic activities. The antidiarrhoeal activity is attributed to quercitrin through the release of the aglycone quercetin in the intestine (Singh and Khandelwal 2010). Quercitrin showed antidiarrhoeic activity at doses of 50 mg/kg in mice. A crude plant extract and an ethanolic extract had significant antiamoebic activity against *Entamoeba histolytica* in vitro at 35 mg/ml. An aqueous lyophilysate of the whole plant showed higher activity against *Entamoeba histolytica* than either the ethyl acetate or methanol extracts, at 30 mg/ml. An aqueous plant extract showed concentration-related activity against non-pathogenic amoebae of the *Amoeba proteus* type. Different extracts from the aerial parts showed antibacterial activity against a wide spectrum of both gram-positive and gram-negative bacteria. Extracts of the aerial parts showed strong antibacterial activity against *Shigella dysenteriae*, a causal agent for dysentery in humans. The active compound was found to be ethyl gallate, which has broad spectrum antibiotic activity at non-toxic doses. A crude ethanol extract of the whole plant showed dose-dependent activity against *Candida albicans*, but not against several other pathogenic fungi. Some of the isolated antibacterial compounds were taraxerone and 11α, 12α-oxidotaraxerol, which showed low cytotoxicity.

The levels of chemicals in *Euphorbia hirta* are high enough to constitute a source of toxicosis to animals consuming the plants and should also be a source of concern in medicinal use. Few toxic effects have been documented for *Euphorbia hirta*. An ether extract was found to be toxic in a brine shrimp lethality test, whereas ethyl acetate and aqueous extracts were within safe limits (Ogbulie et al. 2007). In another test, however, an aqueous crude extract was found to cause testicular degeneration in sexually mature male rats as well as a reduction in the mean seminiferous tubular diameter. Several other extracts given orally to rats caused dullness and anorexia and induced a 20% mortality rate. Some fractions from the ethanolic extract showed potentially deleterious effects on the blood serum chemistry of rats (Adedapo et al. 2005). In feeding experiments with rats however, no difference in the blood serum was found after a prolonged period of adding *Euphorbia hirta* to the diet. It was also found that drying *Euphorbia hirta* prior to extraction considerably reduces the cytotoxic activity of certain of its extracts.

Euphorbia unispina N.E. Br

Common and Local Names Candle plant (English) (Newton 2008) and Oro Adete in Yoruba language (Picture 10).

Picture 10 *Euphorbia unispina* (Source: Authors)

Morphological Description
Euphorbia unispina is a monoecious, sparsely branching shrub that can attain 3.5 m tall. The branches are cylindrical, up to 2.5 cm in diameter. It is silvery-grey in colour and covered with shallow tubercles and horny spine. The leaves are simple and arranged spirally at the stem apex in 4–5 ranks, the stipules are modified into two stout spines, 6–10 mm long. The petioles are short and thick, and blades are oblong to spoon-shaped, 5–12 cm × 1.5–5 cm. The base is long-cuneate, apex notched and fringed, acute or rounded, almost entire, fleshy, glabrous, pinnately veined. The inflorescence is an axillary cyme at the ends of branches, consisting of clusters of flowers, each cluster called a cyathium. The flowers are red, unisexual, male flowers sessile, perianth absent, stamen shortly exserted. Female flowers are with curved pedicel, 4–8 mm long in fruit, perianth 5-lobed, ovary superior, 3-celled, glabrous, styles 3, up to 2 mm long, slender, fused at base, bifid at apex. The fruit is an obtusely 3-lobed capsule, about 6 mm in diameter, glabrous and three-seeded. The seeds are ovoid in shape (Newton 2008).

Geographical Distribution
Euphorbia unispina is found in Africa from Guinea and Mali east to southern Sudan.

Ecological Requirements
Euphorbia unispina grows on rocky hills and slopes in savanna (Newton 2008)

Chemical Constituents
The latex of *Euphorbia unispina* contains esters of diterpene alcohols of the tigliane type, 12-deoxyphorbol and 12-deoxy-16-hydroxyphorbol, and the daphnane type, resiniferonol, as well as several macrocyclic esters of the diterpene alcohol 18-hydroxyingol (Rao et al. 2003).

Uses

The latex of *Euphorbia unispina* is applied to the neck to cure sleeping sickness in the West African countries of Guinea, Mali and Cote d'Ivoire because it is believed that the disease is caused by ganglia in the neck. In Cote d'Ivoire and Nigeria, the latex is applied to leprosy sores. An inhalation of the stem ash is used to treat asthma in Benin, while a mixture of palm oil with the latex is taken to treat constipation and colic. Skin diseases and hemmorroids are treated by a macerate of the stem in water while in Northern Nigeria, the latex is rubbed onto the body to treat mental illness. The latex is also use in dental care by dropping it on carious tooth to relieve tooth-ache or to help loosen the tooth and render extraction easier. Smoking of the dried leaves in a pipe is used to treat bronchitis. In a mixture with other ingredients such as *Strophanthus* species, the latex is used in the preparation of arrow poison (Newton 2008). The root of *Euphorbia unispina* is also used to treat cancer (Soladoye et al. 2010).

Biological Activities

Euphorbia unispina latex is very caustic and toxic. It is very irritating to the skin and mucous membranes. It can cause blindness when in contact with the eyes. In Northern Nigeria, the latex is used as a poison to commit murder and suicide (Newton 2008).

Phyllanthus muellerianus (Kuntze) Exell (Pictures 11 and 12)

Botanical Name and Family

Phyllantus muellerianus belong to the family Euphorbiaceae.

Morphology

It is a monoecious, glabrous, straggling or climbing shrub or small tree up to 12 m tall; branches spreading or pendulous, main branches stout, angular, reddish tinged, branchlets 15–20(–25) cm long, with several short axillary shoots; branch basis transformed into a pair of spines c. 4 mm long, purplish brown. Leaves alternate, distichous along lateral twigs, simple, glabrous; stipules lanceolate, *ca*. 2 mm long,

Pictures 11 and 12 *Phyllantus muellerianus* (Source: faunaandfloraofvietnam.blogspot.com, www.prota4u.org)

acuminate; petiole 3–5 mm long; blade ovate, elliptical-ovate to ovate-lanceolate, 3–9 cm × 2–4.5 cm, base cuneate to rounded, apex acute to obtuse, with 10–14 pairs of lateral veins. Inflorescence a false raceme on short axillary shoots, 2–6 cm long, solitary or several together, with flowers in clusters having 2–3 male flowers and 1 female flower in each cluster. Flowers unisexual; perianth lobes 5, elliptical, c. 1 mm long, rounded, greenish white or greenish yellow; male flowers with pedicel c. 1.5 mm long, disk glands 5, free, minutely warted, fleshy, stamens 5, free, unequal, anthers very small; female flowers with stout pedicel c. 1 mm long, disk glands 5, free or fused, knobbly, fleshy, ovary superior, ellipsoid, warty, 4–5-celled, styles 4–5, free, c. 0.5 mm long, 2-fid at apex. Fruit a fleshy, nearly globose capsule 3–4 mm in diameter, usually smooth, green, becoming red, later black, 6-seeded. Seeds angular, c. 1 mm long, with faint ridges, bright reddish brown or yellowish brown.

Geographical Distribution

Phyllanthus muellerianus occurs from Senegal and Guinea Bissau east to Sudan and Kenya and south to northern Angola and northern Mozambique. It is a large genus comprising about 750 species in tropical and subtropical regions, with about 150 species in mainland tropical Africa and about 60 in Madagascar and the Indian Ocean islands (Burkill 1994).

Ecological Requirements

Phyllanthus muellerianus occurs in riverine forest and wooded grassland, on deep and well-drained soils, from sea-level up to 1600 m altitude. In Nigeria, *Phyllanthus muellerianus* is reported as a weed of rice fields. *Phyllanthus muellerianus* can be propagated through seeds and stem cuttings (Arbonnier 2004).

Major Chemical Constituents and Bioactive Compounds

From the extracted essential oils of the leves was found to be (*E*)-isoelemicin (Brusto et al. 2012). Preliminary phytochemical screening of the leaves and stem methnolic extracts showed that both the extracts contained tannins, flavonoids, saponins, alkaloids, and anthraquinones. From the stem bark the triterpenoids 22-β-hydroxyfriedel-ene and 1β,22β-dihydroxyfriedelin were isolated.

Traditional Uses, Part(s) Used and Common Knowledge/Uses in Traditional Medicine

Phyllanthus muellerianus is widely used to treat intestinal troubles. An infusion of the young shoots is taken to treat severe dysentery. In Sierra Leone a leaf decoction is taken to treat constipation. In Ghana and Nigeria cooked roots, sometimes with maize meal or other plants, are taken to treat severe dysentery. In Congo powdered roasted roots with palm oil are taken to treat stomach problems and as an anti-emetic. In Tanzania roots are pounded in water and the liquid is drunk to treat diarrhoea. Boiled roots are also applied as enema to treat stomach-ache.

In West Africa leaf sap or sap from the thick hollow stem is applied as eye drops to treat pain in the eyes, eye infections or to remove a foreign body. In Côte d'Ivoire and Burkina Faso twigs are sucked to prevent toothache. Powdered roots are used as a snuff and a bark decoction is taken to treat a sore throat, cough, pneumonia and

enlarged glands. Pulped leafy twigs are rubbed on the body to treat paralysis. In Nigeria a root bark decoction is taken as an alternative to treat fever. A twig and root decoction is taken to treat jaundice and urethral discharges. In the Central African Republic fresh root bark is crushed and macerated in water or palm wine, and the liquid drunk as an aphrodisiac. In Gabon roasted powdered twigs are eaten with plant ash to treat dysmenorrhoea. In DR Congo dried bark powder is sniffed to treat colds and sinusitis. A root bark decoction is applied to swellings and is drunk to treat gonorrhea. Stem ash is applied to scarifications to treat rheumatism and intercostal pain. In Tanzania a root decoction is taken to treat hard abscesses; powdered dried roots and stem bark are sprinkled on wounds as a dressing.

Throughout West Africa pounded leaves are applied as wound dressing. In Côte d'Ivoire the leaves are eaten, together with young leaves of *Funtumia elastica* (Preuss) Stapf, to improve male fertility. In Ghana and Nigeria leaves boiled with palm fruit are given to women after delivery as a general tonic. In Cameroon a maceration of the leaves and roots is used to wash the body to treat rash with fever in children. In DR Congo a leaf decoction is taken to treat anaemia and also used as a mouthwash to treat toothache. A leaf extract is used as a bath and a vapour bath to treat venereal diseases. Cooked leaves are applied to the gums to treat toothache. A flower infusion is cooling and gently aperient. The fruits are edible and slightly acidic. In Sierra Leone and Nigeria the sap from the hollow branches is considered potable.

In Cameroon the bark is sometimes added to palm wine to render it strongly intoxicating. In Kenya the stems are considered excellent firewood; branches thicker than 15 cm become hollow and are less used. In East Africa the brown dye from the bark is used to dye mats and fishing lines. From the whole plant a black dye is obtained used to colour fibres. In Zambia the wood is used for rafters and other construction work. It is also used to make fish traps and basketry. The leaves are used as fodder. In Sierra Leone and Nigeria leaves are sometimes cooked with food or in soup as a seasoning. In Nigeria twigs are used as chew-sticks after removal of the spines. Fruit pulp is used as a hair fixative. In Gabon *Phyllanthus muellerianus* is used in magic to lift taboos.

Biological Activities

Phytochemical screening of the leaves and stem bark showed the presence of tannins, flavonoids, saponins, alkaloids and anthraquinones. A leaf extract showed moderate antiplasmodial activity (IC_{50} = 9.4 μg/ml) and low cytotoxicity on mammalian cell lines. Both the aqueous and methanol extracts of the leaves and stem bark showed high antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The activity of the extracts was relatively stable at high temperatures and was enhanced at low pH. In another test a chloroform extract showed high antifungal activity against *Candida albicans* and antibacterial activity against *Escherichia coli*. A crude aqueous extract orally administered to rats caused significant changes in haematological and biochemical parameters, which are used as indices of toxicity (Anuka et al. 2005).

Fabaceae

***Senna occidentalis* Linn** (Synonyms: *Cassia occidentalis* L., *Ditremexa occidentalis* (L.) Britt. & Rose. *Senna occidentalis* (L.) Roxb.; *Senna occidentalis* var. sophera (L.) (Pictures 13 and 14)

Botanical Name and Family
Senna occidentalisis of the family- Fabaceae (Leguminosae) and sub-family Caesalpinioideae, is commonly called stink weed (Saidu et al. 2011).

Common Names
Coffee senna, ant bush, antbush, arsenic bush, negro coffee, Nigerian senna, septicweed, sickle pod, stink weed, stinking pea, stinking weed, stinkingweed, stinkweed, styptic weed.

Morphological Description
Senna occidentalis is an erect herb commonly found by the road sides in ditches and waste dumping sites (Saidu et al. 2011). The leaves are alternate, compound and pinnate, consisting of four or five pairs of leaflets widely spaced along a common stalk. The leaflets are pointed at the tips and the flowers are yellow and produced in loose clusters in the terminal leaf axils. The fruits are in form of thin pods, 3–4 in long and pale green when tender, thick and dark green when mature. It brings out pods from September to November and the pods are slightly curved, with paler longitudinal stripes along the edges. Each pod contains 50–60 small seeds together weighing 1.90 to 2.25 g. From December onwards, the pods start drying up, turn brown and the seeds turn dark brown (Vashishtha et al. 2009).

Geographical Distribution
Senna occidentalis is found across West Africa (Saidu et al. 2011).

Ecological Requirements
Senna occidentalis is a weed found in degraded pastures and plantations, which is poisonous to cattle and other domestic animals (Modena et al. 2012). It was shown experimentally that *Senna occidentalis* can survive under widely variant

Pictures 13 and 14 *Senna occidentalisis* (Source: Anand Kumar Reddy, http://pinpicsnow.com)

light intensities. Although it occurs at optimal temperature of 25.0 °C, it also survives at its extreme temperatures of 10.0–12.5 °C (low) and 45 °C (high). Optimal pH is 6 although it relatively prefers more acidic condition than basic. The sandy loam soil is better preferred by the plant.

Major Chemical Constituents and Bioactive Compounds

Phytochemical screening of aqueous extracts of *Senna occidentalis* revealed the presence of flavonoids, cardenolides, saponins, anthraquinones and alkaloids (Saidu et al. 2011). The hexane, ethyl acetate and methanol extracts revealed the presence of tannins, alkaloids, reducing sugar, phenols, anthraquinones, resins, saponins and glycosides (Odeja et al. 2014). Senna occidentalis has also been reported to contain carbohydrates, saponins, sterols, flavonoids, resins, alkaloids, terpenes, anthraquinones, glycosides and balsam, which are indicators to its medicinal attributes. Flavonoids and resins might be responsible for its anti-inflammatory properties; alkaloids known for decreasing blood pressure, balancing the nervous system in case of mental illness and antimalarial properties. Tannins help in wound healing and anti-parasitic properties. Tannins possess antitumor and antviral properties and eudesmane sesquiterpenes possess antibacterial properties (Vijayalakshmi et al. 2013). Other compounds reported include 1,8-dihydroxyl-2-methyl anthraquinone, 1,4,5-trihydroxyl-3-methyl-7-methoxy anthraquinone, cassiaoccidentalin A,B and C which are C-glycosides, achrosine, anthrones, apigenin, aurantiobtusin, campesterol, cassiollin, chrysotusin, chrysophanic acid, chrysarobin, chrysoeviol, essential oils, funicolosin, galactopyranosyl, helminthosporin, islandicin, kaempferol, lignoceric acid, linoleic acid, linolenic acid, mannitol, mannopyranosyl, matteucinol, obtusifolin, oleic acid, physcion, quercetin, rhamnosides, rhein, rubrofusarin, sitosterols and xanthorin (Vijayalakshmi et al. 2013).

Traditional Uses, Part(s) Used and Common Knowledge

Senna occidentalis is effective in the treatment of dysentery and diarrhea which are mainly caused by microorganisms. An infusion of the leaf is also used to treat typhoid fever (Saidu et al. 2011). The leaves and roots are used as remedy for bacterial and fungal infections and can also boost immune function. The leaves and roots are ingredients of tonics used to treat liver disorders, abscesses, insect bites, scorpion sting, constipation, diabetes, oedema, fever, inflammation, itch, rheumatism, ringworm, scabies, skin diseases, snakebite and wounds (Vashishtha et al. 2009)

The pods and seeds are considered toxic to grazing animals that feed on them as they become seriously ill and may die (Vashishtha et al. 2009)

Biological Activities

The hexane, ethylacetate and methanol extracts of *Senna occidentalis* at varying concentrations inhibited the growth of *Staphilococcus aureus, Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumonia, Candida albicans, Aspergillus niger, Penicillium notatum* and *Rhizopus stolonifer* to varying extent (Odeja et al. 2014). The methanol, aqueous, benzene, petroleum ether and chloroform extract of *Cassia occidentalis* leaf were screened for antibacterial activity. The methanol extract inhibited the growth of *P. aeruginosa*,

K. pneumonia, P. mirabilis, E. coli, S. aureus and *S. epidermidis*. The aqueous extract was effective against *P. vulgaris, K pneumonia*, and *P. aeruginosa* while the benzene and petroleum ether extracts were effective against *P. mirabilis* and *E. coli.* The chloroform extract was ineffective against all the test organisms (Arya et al. 2010). The extract of *Senna occidentalis* flower showed maximum growth inhibition against *Klebsiella pneumonia* but no activity against *Staphylococcus aureus*, *Streptococcus pneumonia* and *Pseudomonas aeruginosa* (Daniyan et al. 2011). The crude leaf extract also inhibited the growth of *Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli, Bacillus subtillis* and *Candida albicans*.

Senna occidentalis also possess antioxidant, hepatoprotective, anti-inflammatory, larvicidal, antimalarial, antidiabetic, analgesic, antipyretic and antidepressant properties (Vijayalakshmi et al. 2013).

Uses in Traditional Medicine

Senna occidentalis is used as a broad spectrum internal and external antimicrobial to treat bacterial and fungal infections. Also used for liver disorders (jaundice, lepatitis, cirrhosis, detoxification, injury and failure, bile stimulant, etc) and as treatment for intestinal worms, internal parasites, skin parasites. Moreso, used as a cellular protector and preventative to cell damage, viz: immune, liver, kidney and cancer (Sadiq et al. 2012).

Malvaceae

Grewia mollis **Juss** (Synonyms: *Grewia venusta* Fresen and *Grewia pubescens* P.Beauv) (Picture 15)

Picture 15 *Grewia mollis* (Source: Author)

Morphological Description

Grewia mollis is a shrub or small tree up to 20 ft tall, of Malvaceae family (previously belonging toTiliacaea family) widely distributed within the Northern, middle belt of Nigeria and some African countries. *Grewia mollis* is often gregarious, with branch-suckering leading to the formation of thickets various parts of the plant are used in food and medicine (Asuku et al. 2012). It is a shrub or small tree up to 10.5 m tall, often multi-stemmed; stem diameter up to 30 cm; young branches densely stellate-pubescent, turning dark grey to purple with age; outer bark black, thick, rough, flaking and deeply fissured, inner bark yellowish to brown, fibrous. Leaves alternate, simple; stipules lanceolate, 5–10 mm long, slightly hairy, caducous; petiole 4–13 mm long, greyish to reddish brown pubescent; blade elliptical to elliptical-oblong. Inflorescence is a cyme. Flowers bisexual, regular, 5-merous, slightly scented; pedicel 3–11 mm long; sepals linear-oblong, 6–11 mm long, greyish hairy outside; petals obovate to oblong, 4–6(–8) mm × c. 2 mm, sometimes notched at the apex, bright yellow; apex densely hairy; stamens numerous, 3–6 mm long; ovary superior, 1.5–2 mm long, densely hairy. Fruit a globose drupe 4–8 mm × 5–8 mm, finely whitish hairy, yellow turning black; endocarp hard and woody.

Geographical Distribution

Grewia mollis occurs widely in tropical Africa, from Senegal and Nigeria eastward to Somalia and southward to Zambia and Zimbabwe.

Habitat and Ecology

Grewia mollis occurs in tropical climates with annual average rainfall of 600–1400 mm. It is usually distributed in lowlands of West Africa up to high altitude zones in East Africa and thrives in forest, open woodland, riverine and seasonally flooded grassland. It is known to be highly resistant to fire.

Collection Practices

Grewia mollis is distributed in the tropical and subtropical parts of Africa and Asia .Germination of *Grewia mollis* often occurs after a bush fire followed by rains but growth is slow. Flowering is around the end of March and October depending on locale. The parts of *Grewia mollis* are normally collected from the wild but it can be propagated by seed or seedlings. Seeds are usually collected from dried fruits fallen on the ground.

Chemical Composition

Hanan and co-workers (2012) have investigated extensively the plant *Grewa mollis* and isolated the following compounds, 7-(1-*O*-*β*-*D*-galacto turoniole-4-(1-*O*-*β*-glucopyranesyl-3,4,5,7 tetrahydroxyflavone, lutelion, 7-*β*-hydroxy-2,3-endeoxojessic acid, 7-*β*- hydroxy-2,3-deoxojessic acid sitesterol and *β*-sitosterol-3-*O*-glucoside,from the aerial part of the plant. Further phytochemical investigation on biologically active methanolic extract resulted in the isolation of luteloin, 7-(1-*O*-*β*-*D*-galacturonide)-4′-(1-*O*-*β*-glucopyranosyl)-3′4′,5,7-tetrahydroxyflavone, 7-*β*-hydroxy-23 enedeoxojessic acid , 7-*β*-hydroxy-23- deoxojessic acid , *β*-sitosterol and *β*-sitosterol-3-*O*-glucoside. Two other compounds; triterpene lup-20-en-2-ol and 1,3-hexyloxacyclotridec- 10-en-2-one, have been isolated from the roots of the plant (Efiom and Oku 2012).

Uses in Traditional Medicine

In Nigeria the fruit of *Grewia mollis* is used as a febrifuge. The stem bark, branch, trunk, decoction is used to cure constipation. The mucilaginous bark and leaves are applied to ulcers, cuts, sores and snakebies and acclaimed to have laxative property. Bark and root preparations are taken to treat cough. Extracts of bark and leaves are reportedly drunk to treat fever. In Togo a decoction of the stem bark is drunk to treat diarrhoea, and a macerate is taken to ease childbirth. An infusion of the bark is used to treat colic dysentery (Adamu et al. 2005). In East Africa leaves pounded and mixed with water are taken against stomach problems and also given to constipated domestic animals. In Côte d'Ivoire a decoction of the leaves is used in baths and drinks to cure rickets in children. A decoction of the roots is drunk in Senegal in case of palpitation. In Central Africa sap from root-shavings is placed under the eyelid to treat sore eyes, whereas a liquid obtained by kneading the root bark in water is drunk to treat stomach-ache, colic and poisoning by certain plants. In Ghana a paste of ground roots is applied to rheumatic swellings and inflammation (Bekalo et al. 2009; Asuku et al. 2012).

Biological and Cytotoxic Activities

The *invitro* antibacterial activity of the aerial part of *Grewia mollis* was investigated by Hanan and co-workers (2012) against various strains of bacteria such as *Staphylococcus epidermidis, Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Escherichia coli*. The methanolic extract showed significant activity against *Staphylococcus epidermidis, Bacillus subtilis and Staphylococcus aureus* when compared with the standard antibiotics. Methanolic extract of *G. mollis* aerial part showed inhibitory activity against oral cavity pathogen with extract exhibiting a concentration-dependent killing of *Staphylococcus aureus* and also preventing the formation of water-insoluble glucan. This researchers further demonstrated the antiinflammatory and antihypertensive activities of the aerial part of *G.mollis.* The antioxidant an activity of the leaves extract of the plant has also been reported (Asuku et al. 2012). The researchers further demonstrated the protective and ameliorative potentials of this plant against experimentally induced liver injuries in rats.

2 Conclusion

The properties, uses and application of some wild herbaceous plants distributed throughout Nigeria have been reviewed. The active compounds variously isolated as well as their pharmacognostic and biological properties of the plants reviewed have been highlighted. Since many of the biological activities of these plants have been validated experimentally, further studies on the potential industrial use of these plants in developing countries like Nigeria should be seriously explored, such as in drugs development, as well as production of natural supplements, nutraceuticals, natural insecticide, phytochemicals for industrial usage etc. The cultivation of wild

but useful plants could be an essential step that can bring about the much needed turn-around in the nations' agricultural system, economy and conservation of plant biodiversity in Nigeria.

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