

# Medicinal Plant Use in Ghana: Advancement and Challenges

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## Abstract

In Ghana, the use of medicinal plants is a known and an acceptable practice common to all the regions and ethnic groups, with about 60% to 70% of Ghanaians depending on traditional medicine for their healthcare needs. Even though medicinal plants are all over the country and are of great benefits to a lot of Ghanaians, there is little or no proper documentation on medicinal plants use in Ghana; how it all started and where it is today, as well as what is being done to promote its use and some challenges being faced with its use as a country. This paper therefore sought to assess and compile generally, Medicinal plants use in Ghana; focusing on the use of some plant medicine, development and advancement in the herbal medicine practice, as well as associated challenges. Available literature and information on medicinal plants use in Ghana were compiled by searching through electronic database such as Google Scholar, PubMed, Science direct, SciFinder and other relevant websites, as well as books and reports. A brief history, measures taken to develop and advance plant medicine use and some specific challenges facing plant medicine practice and use in the county have been discussed in detail in this write-up. This compilation is believed to bring to book the value of some medicinal plants in Ghana and the efforts being made to promote herbal drugs to complement orthodox medication.

## Keywords

Medicinal Plant Practice, Herbal Products, Herbal Institutions, Policies and Regulations

## 1. Introduction

The use of Medicinal plants to cure various diseases and as supplement has be-

come a known and an acceptable practice all over the world. Apart from this common use of medicinal plants, they also contribute as plant based pharmaceutically active compounds for conventional drug production and towards new drug discovery [1] [2]. In Ghana, there are great economic benefits of medicinal plants use and they are widely recognized all over the country, with about 60% to 70% of the populace estimated to depend directly on it for their primary health care [3]. In most cases of sickness, herbal medicine is the first line of treatment, after which orthodox treatment is sought should the condition persist. This may be as a result of its availability, cost effectiveness and accessibility to majority of the population in Ghana who reside in the rural communities [4] [5]. Medicinal plants such as, *Azadirachta indica*, *Caripa papaya*, *Mangifera indica*, *Moringa oleifera*, *Elaeis guineensis*, *Hibiscus sabdariffa* and others are very common, accessible and readily available to a number of people in the country, on which they depend for treatment of common ailments and their holistic wellbeing.

Even though medicinal plants are all over the country and are of great benefit, knowledge on their usage and benefits are barely known to a lot of Ghanaians especially the youth, and seem to be only locked up with mostly herbalists and some few elderly people [6]. Also, there is little documentation on medicinal plants use in Ghana; how it all started and where it is today, as well as what is being done to promote its use and some challenges being faced with its use as a country. This article therefore sought to assess and compile generally, information on medicinal plants use in Ghana, focusing on its development and advancement, as well as associated challenges.

Objectives are to:

- Identify measures put in place to advance and enhance medicinal plant use in Ghana.
- Identify medicinal plants and their local uses, reviewing some biological and pharmacological activities reported by researchers in Ghana, to help confirm their traditional uses.
- Compile the list of medicinal plant products developed and sold in Ghana, as a way of enhancing medicinal plant use in the Country.
- To identify some challenges associated with plant medicine practice in Ghana.

A review approach was therefore adopted to compile available information on medicinal plants use in Ghana. A detailed literature search, via electronic database such as Google Scholar, PubMed, Science direct, SciFinder and other relevant websites, as well as books and reports, was the main method employed to gather the information in this article.

## 2. History of Medicinal Plant Use and Herbal Medicine Practice in Ghana

Medicinal plant use and herbal medicine practice in Ghana can be traced to the

very beginning of Ghanaian homes as an integral part of their livelihood since time immemorial. Ghanaians in ancient days relied solely on plant medicine for treatment, until colonialism came in with formal education and Christianity and greatly affected this holistic practice [5]. It all started as an indigenous practice where herbalist employed various medicinal plants, and in some cases, in addition to supernatural and divine understanding to heal all kinds of diseases [7].

Even though this traditional health system and medicinal plants use played vital roles in the health needs and wellbeing of individuals of olden days, it had some setbacks that might have contributed to its non-recognition during the colonial era. The herbalist and individuals attached superstitions to almost all kinds of diseases, even to illness that were hygiene related. They again overemphasized the efficacy of herbal medicines, claiming a single plant can heal a whole lot of disease conditions. High Illiteracy rate of herbalist was also a great setback which made them handicapped in terms of understanding the physiology, anatomy, pathogenesis and diagnosis of diseases. Failure to co-operate and come together as an association to be registered and recognized by government also made their practices somehow not acknowledged. Moreover, lack of cooperation between herbal and conventional medicine practitioners, where the traditional health system was seen as primitive and unscientific was a huge drawback. Unspecified dosages and large volumes of herbal medicines given to patients, as well as unhygienic ways of preparation discouraged a lot of people from patronizing it [8] [9].

### **3. Advancement in the Use of Traditional Medicine in Ghana**

Even though colonialism and some setbacks seemed to overthrow medicinal plant use and herbal traditional practices, the government of Ghana right after independence in 1957 saw the need and importance of plant medicine and started to put in place measures to support and intensify its use. All subsequent governments have also done their part to improve plant medicine use, with the hope of transforming traditional medicine practice to an equivalent level as that of conventional medicine practice [10]. Such interventions and improvements in plant medicine practice over the years have contributed to a lot of Ghanaians showing much interest in herbal medicine in recent times. Some of these developments and interventions are discussed in the subsequent sections.

#### **3.1. Establishment of Associations, Institutions and Organizations**

The government of Ghana in 1961, formed the Ghana Psychic and Traditional healers Association under the Ministry of health to bring all traditional medicine practitioners together to promote and protect the best psychic and traditional healing in the country. However, internal power struggles among members could not allow the association to survive.

The Centre for Scientific Research into Plant medicine, now Centre for Plant Medicine Research (CPMR), was also established in 1975 under an ACT of gov-

ernment to conduct and promote scientific research related to plant medicine, ensure purity of plant medicines, co-operate with the Ghana Psychic and Traditional Healers' Association, research institutions and commercial organizations on matters of plants medicine, collaborate in the collation, publication and the dissemination of the results of research and other useful technical information, as well as establish where necessary, botanical gardens for medicinal plants, among other functions as the government may assign to it [11].

Also Traditional and Alternative Medicine Directorate (TAMD) was established in 1991 under the ministry of health to enhance the growth and sustainability of traditional medicine in Ghana, by ensuring development and integration of traditional and alternative medicine as a distinctive medical practice within the national health care system, formulating policies on traditional and alternative medicine, mobilizing resources to support traditional and alternative medicine and ensuring mechanisms exist to patenting of herbal formulations among others.

The Food and Drugs Board now the Food and Drug Authority (FDA) was also established under the ministry of health as a regulatory body to implement the food and drug law (PNDCL 305B). As part of its mandate, it regulates the manufacture, importation, exportation, distribution, use and advertisement of food, drug, cosmetics, medical devices and chemicals, by ensuring their safety, wholesomeness, quality and efficacy. The FDA again gives approval and ensures the registration of vaccines and medicines (conventional and herbal) [12].

Ghana Federation of Traditional Medicine Practitioners Associations (GHAFTRAM), was formed in 1999 as a national umbrella organization for all traditional healers in Ghana to ensure cooperation and unity among them.

Furthermore, the Traditional Medicine Practice Council (TMPC) was formed by an Act of Parliament, Traditional Medicine Practice Act-2000 (Act 575) in 2011, to regulate the practice in Ghana. The TMPC is mandated to register and issue certificates to qualified practitioners and give permit to places of practice, enforce code of ethics of the practice recognized by the Ministry of Health as referred in its Act as an Association, advice the Minister on matters relating to and affecting the practice of traditional medicine as well as promote and support training in traditional medicine [13].

### **3.2. Policies and Regulations**

The Government of Ghana in 2005 brought together almost all the relevant traditional medicine institutions and organizations to develop the Traditional Medicine Policy, with representatives from Ministry of Health (MOH), Ghana Health Service (GHS), Food and Drugs Authority (FDA), Ghana National Drugs Programme, Centre for Plant Medicine Research (CPMR), Centre for Scientific and Industrial Research (CSIR), Ghana Federation of Traditional Medicine Practitioners Associations (GHAFTRAM), Ghana Medical Association, Nurses and Midwives Council, Pharmacy Council, World Health Organization (WHO)

and DANIDA, Sociology and Biochemistry Departments of the University of Ghana and the Faculty of Pharmacy and Pharmaceutical Sciences of the Kwame Nkrumah University of Science and Technology.

The objective of the policy document is to provide general policy direction or framework within which government's short to long term plans on traditional medicine would be based. It is the policy of government to continue to research and develop Traditional Medicine with the aim of integrating the products and returns into the health care delivery system of the country, and focuses on areas such as, Practice of traditional medicine and regulatory legislation; Re-organization and management of traditional medicine associations; Intellectual Property Rights Protection; Professionalization of TM/CAM through formal training; Research and Product Development; Public I.E & C on Rational use of Traditional Medicine; Standardization, quality assurance and large scale production; Documentation, information exchange and baseline data collection; Biodiversity conservation and sustainable harvesting; Global Networking and Collaboration; Technology transfer and commercialization of best products and practices; Integration of TM/CAM into national health systems and commercialization [14].

The TAMD with the core aim to coordinate policy initiation and implementation rely greatly on the Traditional Medicine Policy to work effectively. The Directorate has three units which all help in one way or the other to implement the policies of Government to see to the growth and sustainability of traditional medicine use in the country. The Traditional and Alternative Medicine Policy and Regulation Unit is responsible for reviewing and developing policies for TAMD. It also designs and develops Traditional and Alternative Medicine regulatory and licensing schemes, systems, plans, strategies, mechanisms and standards to manage activities within the sub-sector. The Research Unit is responsible for creating and reviewing research data for the development of policies, monitoring and evaluation of the activities of Traditional and Alternative Medicine industries. Finally, the Information and Communication Unit is also responsible for the development and reviewing of information and communication strategies, creation of platforms for policy discussions, sensitization and education on alternative medicines and health care systems in Ghana.

In terms of regulations, the TMPC is to regulate all traditional medicine practices in the country. There are regional offices all over the country to help register and issue licenses to practitioners, inspect and give permit to premises of operation (herbal clinics, herbal shops) as well as organize qualifying examinations for students to become professionals.

The Food and Drug Authority also regulate herbal medicines as part of their mandate. All herbal products to be sold on the Ghanaian market are expected to be registered by the FDA before they go onto the market. There is currently Herbal Medicine Unit at the FDA which scrutinize and conduct safety and quality assessment on herbal medicines submitted for registration before issuing license for public patronage. All such products certified by the FDA can be identified with a unique FDA Registration number to help track unregistered products.

### 3.3. Education and Training

Knowledge on medicinal plants use has been widely known to be inherited or transferred orally through informal education over the years, however, currently in Ghana, formal training in the area of herbal medicine is offered by a number of tertiary schools and institutions to help train herbal medicine professionals.

The Kwame Nkrumah University of Science and Technology in 2001 introduced a 4-year Bachelor of Science degree in Herbal Medicine under the faculty of Pharmacy and Pharmaceutical Sciences, to produce Medical Herbalist who diagnose and prescribe herbal medicine for treatment of various ailments. Under this curriculum, students gain knowledge on medicinal plants and are trained on how to develop, formulate, standardize and evaluate herbal medicine, in addition to how to diagnose disease conditions and treat them solely with herbal medicine. After graduating, they undergo a 2-year internship program where they are attached to health related institutions which provides herbal medicine services. During the second year they spend 6 months at CPMR and 6 months at the Tetteh Quashie Memorial hospital all at Mampong-Akuapem, after which they write a professional qualification exam. On passing, they are registered and certified to be able to practice as Medical Herbalist in the country. All this training is to ensure that, the graduates are trained enough to provide quality primary healthcare to Ghanaians.

Also the Department of Pharmacognosy and Herbal medicine at the University of Ghana (Legon) runs a Bachelor of Science degree program in herbal medicine related fields. The University of Cape Coast (UCC) offers a certificate program in Traditional medicine for traditional medicine practitioners and others who have interest in traditional medicine. The college of integrated Medicine also has a certificate program in Complementary Health Care.

In addition, the Catholic University College of Ghana, Faculty of Public Health and Allied Sciences at Fiapre, in 2008 introduced a course on Complementary and Alternative Medicine at the final year, as part of the BSc Public Health degree program. The Endpoint Homeopathic Training Institution runs Diploma and Degree programs in alternative Medicine as well. The Nyarkotey College of Holistic Medicine, a science based premier holistic medicine Private University, is accredited by the Traditional and Alternative Medicine Practice Council (TMPC) of the Ministry of Health to run Diploma, Bachelor of Science (BSc), Master of Science (MSc) and Doctor of Philosophy (PhD) degrees in Homeopathy, Naturopathy and Holistic Medicine.

Moreover, some institutions and associations like the CPMR, TAMD and GHAFTRAM periodically collaborate and organize trainings for practitioners in various regions of the country on safety, microbial quality, preservation and general good manufacturing processes of herbal product to help equip them with some formal knowledge on their practices.

### 3.4. Research

Plant medicine has taken a new level where scientific research and analysis is in-

roduced to confirm its folkloric use and efficacy, as well as determine its safety and quality to improve their healing capacities. A wide range of medicinal plants used in Ghana have been researched by a number of researchers in the country to scientifically prove their efficacy and confirm their traditional uses (**Table 1**).

In Ghana, as part of the government's effort to promote the use of herbal medicine in the country, the Centre for Plant Medicine Research was established with the core aim of researching plants medicine. Currently the Centre has a number of research Departments, which include Pharmacology and Toxicology, Phytochemistry, Microbiology, Pharmaceutics, Plant Development, Production and Clinic. All these Departments conduct various researches and scientific analysis into plant medicines.

For instance, the Pharmacology and Toxicology Department has an Animal Experimentation Unit attached to it which enables it to conduct *in-vivo* research of pharmacological bases in search of anti-inflammatory, anti-malaria, anti-diabetic, anti-hypertensive, etc plant agents. The Department again undertakes toxicological studies (acute, sub-acute and chronic) on medicinal plants and herbal products. The Microbiology Department is also engaged in the search of antimicrobial medicinal plants employing both *in-vitro* and *in-vivo* assays and contributes to the microbial quality assessment of herbal products to be submitted to FDA for registration. The Phytochemistry Department also conducts research into plant medicines, screening them for phyto-constituents present and isolating active compounds for identification and characterization. The Plant Development Department is into research of plant conservation and sustainability, ethnobotany, cultivation trials to determine optimum conditions for the growth of specific medicinal plants species and systematics using the medicinal plants herbarium in the department. The Pharmaceutics and Production Departments are much involved in research leading to product development, through formulation and reformulation of herbal products out of medicinal plants with confirmed efficacy and safety. The clinic as a research Department leads in clinical studies of herbal products upon approval from the FDA.

There are other Research Institutions, like Noguchi Memorial Institute for Medical Research (NMIMR), Centre for Scientific and Industrial Research (CSIR), Ghana Atomic Energy, as well as Tertiary education Institutions all over the country which conduct various researches into plant medicine.

### **3.5. Product Development and Formulations**

Preparations of herbal medicine in the country has advanced greatly from mostly being boiled in individuals' kitchen and taking any quantity of choice to a well-prepared, preserved and packaged products with specified doses per kilogram body weight. A lot of potent herbal products of different dosage forms (decoctions, tablets, capsules, powders, teas, ointments, eye/nasal drops, etc.) have been formulated and well labeled for use in the country. Some researchers

**Table 1.** Some medicinal plants used in Ghana with reported biological/pharmacological activities.

Plant Name/Family	Local Name	Growth Form	Part (s) Used	Traditional Uses in Ghana	Compounds Isolated or Detected	Biological Activity Reported by Researchers in Ghana
<i>Adenia cissampeloides</i> (Planch, ex Benth.) Harms Passifloraceae	Hamakyem (Twi)	Climber	Leaves Stem Root Vine	Fever, Malaria, Wounds, Gastro-intestinal disease, Numbness, Hypertension, Wound [20] [21]	phytol, $\alpha$ -linolenic acid, n-hexadecanoic acid, hexahydrofarnesyl acetone, (13S)-8,13-epoxy-labd-14-ene, kaur-16-ene, guaial, $\alpha$ -gurjunene, and $\alpha$ -elemene [22]	Anti-hypertensive [23] Anticoagulant [24] Antiplasmodial [25]
<i>Aframomum melegueta</i> (Roscoe) K. Schum. Zingiberaceae	Fam wisa (Twi)	Herb	Seed	Convulsion, Hypertension, Aphrodisiac, Measles, Infertility [26] [27] [28]	6-Parado, 6-Shagao, 6-Gingerol, Oleonic acid [29]	Antimicrobial [30]
<i>Amaranthus cruentus</i> L. Amaranthaceae	Aleefu (Twi)	Herb	Leaf	Blood tonic [31]	linoleic acid and oleic acid [32]	Antioxidant [33]
<i>Anchomanes difformis</i> (Bl.) Engl. Araceae	Ope (Twi)	Herb	Leaves Stem	Snake bites, burns [34]	12-heptadecenoic acid, hexadecanoic acid and $\beta$ -stigmaterol [35]	Antimicrobial and Anti-inflammatory [36]
<i>Azadirachta indica</i> A. Juss. Meliaceae	Nyeedua (Twi)	Tree	Leaves Fruit stem bark, Root	Malaria, Tuberculosis, Cancer, Worm infections, Wounds, Boil [21] [37] [38] [39] [40]	Azadirachtin, tirucallol, meliantriol, azadirone, salannolide, margosinolide, nimbin and salannin [41]	Antiplasmodial [42] [43] Anthelmintic [44] Antioxidant [45] Anti-schistosomal [46]
<i>Bambusa vulgaris</i> Schrad. ex J.C. Wendl. Poaceae	Mpampro (Twi)	Shrub	Leaves	Malaria, Hypertension, Cancer [37] [39] [47]	-	Antiplasmodial [48]
<i>Baphia nitida</i> Lodd. Fabaceae	Odwono (Twi)	Shrub	Leaves Stem Root	Waist pains, wounds, Asthma, Anxiety, Haemorrhage, Jaundice, Rheumatism, Ringworm [28] [49] [50]	[Kaempferol 3-O-b-D-xylopyranosyl (1 $\rightarrow$ 3)-(4-O-E-pcoumaroyl-a-L-rhamnopyranosyl (1 $\rightarrow$ 2))][b-Dglucopyranosyl (1 $\rightarrow$ 6)]-b-D-galactopyranoside-7-O-a-Lrhamnopyranoside and [Kaempferol 3-O-b-D-xylopyranosyl (1 $\rightarrow$ 3)-(4-O-Z-pcoumaroyl-a-L-rhamnopyranosyl(1 $\rightarrow$ 2))][b-Dglucopyranosyl (1 $\rightarrow$ 6)]-b-D-galactopyranoside-7-O-a-Lrhamnopyranosid] [51]	Anti-inflammatory and Anti-infective [52]
<i>Capparis erythrocarpos</i> Inert. Cappariaceae	Pitipiti (Twi)	Shrub	Leaves Root	Piles, Back Pain, Inflammatory conditions, Aphrodisiac, Arthritis, Piles [21] [50] [53]	isocodonocarpine, 14-Nacetylisocodonocarpine, 15-N-acetylcap-parisine [54] [55]	Anti-dyslipidemic [56] Anti-Inflammatory and Analgesic [57] Anti-prostate cancer [58]. Anti-arthritic [53] [59] Antinociceptive effect [60]
<i>Carica papaya</i> Linn. Cariaceae	Brofer3 (Twi)	Tree	Seed leaves	Malaria, Worm infections, hypertension, Cancer, Jaundice, skin ulcer, cough, Abortion, Headache [21] [27] [28] [31] [39] [44] [47]	Carpaine [61], 1,2,3,4-tetrahydropyridin-3-yl octanoate [62] caricaphenyl triol, papayaglyceride, glyceryl-1-oleyl-2,3-dilinoleiate, glyceryl-1-oleyl-2,3-diarachidate, glyceryl-1-linoleyl-2,3-distearate, glyceryl-1,2-dipalmitate, glyceryl trimyristate, glyceryl tristearate, glyceryl-1,2-dipalmityl-3-myristate, glyceryl-1-oleyl-2,3-dimyristate, b-sitosterol glucoside, glyceryl-1-oleyl-3-phosphate, glyceryl-1-oleyl-2-lauryl-3-phosphate and glyceryl-1,2-distearyl-3-phosphate [63]	Antiplasmodial [43] Antimicrobial, Antioxidant, [64] Anti-prostate cancer [65] Anthelmintic [66]



## Continued

<i>Cassia sieberiana</i> DC Caesalpiniaceae	Nkokowu (Twi)	Small Tree or Shrub	Root, Root bark	Stomach ache, Aphrodisiac, Apoplexy, Appetizer, dizziness [21] [31]	Cassiberianol A, Piceatannol, Quercetin, Kaempferol, Dihydrokaempferol, Islandicin, Chrysophanol, Physcion, Emodin, Chrysophanol-10,10-bianthrone, Lupeol, Betulinic acid, Stigmasterol, Galanthamine. [67]	Antimicrobial [68] Anti-ulcer [69] Antioxidant [70] Anti-inflammatory and Anti-nociceptive [71] [72] [73]
<i>Clausena anisate</i> Willd. Hook. f. ex Benth. Rutaceae	Sesadua/ Samanobere/ Sa- mandua/ Duawonsi/ Eduasin. (Twi)	Shrub	Leaf Stem bark	Arthritis, Asthma, Cough, Dermatitis, Diabetes mellitus Dysentery, Earache, Fever; Fracture, Headache, Helminthiasis, Herpes zoster; Mosquito and tick bites, Rheumatic pains; Snakebite; Stomachache, Schistosomiasis, Toothache [49] [74]	girinimbine, murrayamine-A, ekeberginine, aurantiamide acetate, N-benzoyl-L-phenylalaninyl-N- benzoyl-L-phenylalaninate, sitosterol and stigmasterol [75]	Antimicrobial [76] [77] Antioxidant and Wound healing [78] Anti-inflammatory and analgesic [79] Anti-HIV [80]
<i>Clerodendrum splendens</i> G Don Lamiaceae		Shrub	Leaves	Malaria, Coughs, Gonorrhoea, Syphilis, Skin diseases, Ulcers, Rheumatism, Asthma, Fibroid [81] [82]	Triancontanol, [(22E, 24S)-Stigmasta-5, 22, 25-trien-3 $\beta$ -ol] and [3-O-D-glucopyranoside of (22E, 24S)-Stigmasta-5,22,25-trien-3 $\beta$ -ol (3)] [83]	Antimicrobial and Anti-inflammatory [84] Wound healing [85]
<i>Colocasia esculenta</i> (L.) Schott Araceae	Kooko/Brobe	Herb	Leaves Stem bark	Wounds, Stings/bites [34] [40]	tryptophan, orientin, isoorientin, vitexin, isovitexin, luteolin-7-O-glucoside, luteolin-7-O-rutinoside, rosmarinic acid, 1-O-feruloyl-D-glucoside and 1-O-caffeoyl-D-glucoside [86]	Antimicrobial, Antioxidant and Anti-inflammatory [36]
<i>Combretum mucronatum</i> Schum. & Thonn. Combretaceae	Ohwirem/ Hwiremu (Twi); Geza (Hausa)	Liana	Leaves Root	Worm infection, Ascites, Boils, Catarrh, Chest pain, Chronic cystitis, Dracontiasis, Fever, Fresh cuts and wounds, Gonorrhoea, Guinea worm, Malaria, Rheumatism, Thrush [44] [49]	Epicatechin, Epiatzelechin-(4 $\beta$ →8)-epicatechin, Procyanidin C 1, [Epicate- chin-(4 $\beta$ →6)-epicatechin-(4 $\beta$ →8)-epicatechin], [Epicatechin-(4 $\beta$ →8)-epicatechin- (4 $\beta$ →6)-epicatechin], [Epicatechin-(6'→8)-epicatechin], cinnamtannin A2, Pentameric Procyanidin and Isovitexin [87]	Anthelmintic [44] Wound healing [88] Mycobactericidal, [89]
<i>Corchorus olitorius</i> L. (Jute) Tiliaceae	Ayoyo (Twi) Ademe (Ga)	Herb	Leaves	Wound [40]	oleanolic acid, 2-hydroxyethyl benzoate, chlorophyll, phytol fatty acid, esters, $\beta$ -sitosterol fatty acid esters, $\beta$ -sitosterol and stigmasterol [90]	Antimicrobial [91] Anti-oxidant [33] [92]
<i>Croton membranaceus</i> Müll.Arg. Euphorbiaceae	Bukoe	Shrub	Root Stem	Prostate diseases, Urinary retention problems, Diabetes, Measles [93]	[12-oxo-15,16-epoxy-3,13(16), 14-clerodatrien-17,18-dioic acid dimethyl ester], julocrotine, $\beta$ -sitosterol, $\beta$ -sitosterol-3-O glucoside, gomojoside H, and DL-butane1,2,3,4-tetraol [94]	Antimicrobial [95] Anti-Prostate enlargement [96] [97] Anti-cancer [98] Anti-hyperglycaemic and antioxidant [99]
<i>Elaeis guineensis</i> Jacq. Palmae	Abe	Tree	Root Fruit Fronds/ Leaves	Malaria, Cancer, wounds, Stroke [28] [37] [39] [40]	3,4 hydroxybenzaldehyde, p-hydroxybenzoic acid, vanillic acid, syringic acid and ferulic acid [100]	Antiplasmodial [25]
<i>Entandrophragma angolense</i> (Welw) Meliaceae	Edinam	Tree	Bark	Cancer, Pain-killers, Arthritis, Rheumatism, Eye treatments Ear treatments, Stomach troubles, Kidneys, Diuretics [31] [39]	Methyl Angolensate [101], [3,23-dioxotirucalla-7,24-dien-21-al], [3,4-secotirucalla-23-oxo-4(28), 7,24-trien-21-al-3-oic acid] and [3,4-secotirucalla-23-oxo-4(28),7,24-trien-3, 21-dioic acid (21-methyl ester)] [102].	Antimicrobial [103]
<i>Funtumia elastic</i> (Preuss) Stapf Apocynacea	Ofuntum	Tree	Root	Abortion, Edema, Urine flow [27] [31] [104]	holarrhetine, conessine, holarrhesine and isoconessimine [105]	Antimicrobial, Anti-inflammatory [106] Antioxidant [107] Fibroblast stimulation [108]

## Continued

<i>Hibiscus sabdariffa</i> L. Malvaceae	Sobolo (Twi)	Herb	Flowers	Hypertension, Liver disorders, Antiseptic, Aphrodisiac, Digestive problems, Diuretic [49] [82]	Hydroxycitric acid, Hibiscic acid, Chlorogenic acid, Chlorogenic acid, Myricetin 3-arabinogalactose, Quercetin 3-sambubioside, 5-O-Caffeoylshikimic acid, Quercetin 3-rutinoside, Quercetin 3-glucoside, Kaempferol 3-O-rutinoside, N-Feruloyltyramine, Kaempferol 3-(p-coumarylglucoside), Quercetin, 7-Hydroxycoumarin, Delphinidin 3-sambubioside, Cyanidin 3-sambubioside, Hibiscus acid hydroxyethyl ester, Hibiscus acid dimethylester, 2-O-trans-caffeoyl-hydroxycitric acid, Methyl epigallocatechin, Ethylchlorogenate, 2-O-trans-feruloyl-hydroxycitric acid, hydroxy ethyl dimethyl ester, Coumaroylquinic acid, Cryptochlorogenic acid, Methyl digallate [109]	Antimicrobial, Anti-oxidant [33] [110] [111] Anti-hypertensive [112]
<i>Hillieria latifolia</i> H. Watt. Phytolaccaceae	Anafranaku (Twi)	Herb	Leaves	Wounds, boils, Jaundice, Guinea worms, Urethral discharges, rheumatism [34] [113] [114]	-	Antinociceptive [115] Anxiolytic and Antidepressant [116] Anti-inflammatory and Antioxidant [117] [118] Antimicrobial [119] Wound healing [120]
<i>Justicia flava</i> (Vahl) Vahl Acanthaceae	Afema	Herb	Leaves	Wounds, Malaria, Diarrhoea, Piles, Boils, Burns, Stomach ulcer, Reproduction [28] [34] [40] [121]	campesterol, stigmasterol, sitosterol, and sitosterol-D-glucoside [122]	Antimicrobial [123] Antioxidant and Wound healing [124]
<i>Kigelia africana</i> (Lam.) Benth. Bignoniaceae	Nufuten (Twi)	Tree	Stem bark Root Leaves Fruit Flowers	Stomach ache, Hypertension, Abortifacient, Flow of Milk, Boils, Psoriasis, Eczema, Leprosy, Syphilis, Cancer [28] [125]	[3-(2'-hydroxyethyl)-5-(2"-hydroxypropyl)-dihydrofuran-2(3H)-one], 7-hydroxy viteoid II, 7-hydroxy eucommic acid, 7-hydroxy-10-deoxyeucommiol, 10-deoxyeucommiol, jiofuran, jiojglutolide, 1-dehydroxy-3,4-dihydroaucubigenin, des-p-hydroxybenzoyl kisasagenol B, ajugol, verminoside and 6-transcaffeoyl ajugol [126]	Antimicrobial, Antioxidant, Wound healing [106]
<i>Lannea welwitschia</i> (Hiern) Engl. Anacardiaceae	Kumnin (Twi)	Tree	Leaves, Stem back	Child fever, Aseram, wounds, stomach ulcer [28] [34]	Lanneaquinol and 2'-hydroxylanneaquinol [127]	Antimicrobial, Antioxidant and Wound healing [124] Anti-allergic, Anti-inflammatory and Analgesic [128]
<i>Laportea aestuans</i> (Linn) Chev. (Syn. <i>Fluerya aestuans</i> ) Urticaceae	Honhon (Twi)	Herb	Leaves	Heartburns, Correct acidity in pregnant women [129] [130]	Methylcyclohexane, [isodecyl octyl 1,2-benzenedicarboxylate], di-n-octyl phthalate, [bis(7-methyloctyl)phthalate], toluene, [butyl 8-methylnonyl-1,2-benzenedicarboxylate], [8-decyloxy-3-phenyl-2,4,7-trioxabicyclo[4.4.0]dec-9-ene], [dicyclohexyl-1,2-benzene dicarboxylate], didodecyl phthalate, [butyl-8-methylnonyl-1,2-benzenedicarboxylate] [di-n-octyl phthalate], [butyldecyl-1,2-benzenedicarboxylate], [bis(2-ethylhexyl) hexanedioate], [butyl-2-ethylhexyl-1,2-benzenedicarboxylate], [bis(2-ethylbutyl)-1,2-benzenedicarboxylate] [131]	Anti-oxidant [33]

## Continued

<i>Laportea ovalifolia</i> (Schumach.) Chew Urticaceae	Akyekyenwonsa (Twi)	Herb	Leaves	Wounds, poison antidote, Control menstrual bleeding [34] [132] [133]	laportomide A and laportoside A [134]	Antimicrobial [119] Antioxidant and Anti-inflammatory [118] Wound healing [120]
<i>Lippia multiflora</i> Moldenke. Verbanaceae	Sareso nunu (Twi)	Shrub	Leaves	Malaria [37]	Nuomioside A, isonuomioside A, samioside, verbascoside, isoverbascoside, alyssonoside and leucoseptoside A and geniposide [135]	Antioxidant [136] Antihypertensive [137]
<i>Mallotus oppositifolius</i> (Geiseler) Müll.Arg Euphorbiaceae	Anyanforowa (Twi)	Shrub	Whole plant	Malaria, Dysentery, Parasitic infection [37] [50] [138]	Methylene-bis-aspidinol AB, mallopposinol, aspidinol B, methylene-bis-aspidinol, (+)- $\alpha$ -tocopherol, lupeol, stigmasterol, phytol, bergenin, squalene and methyl gallate [139]	Antimicrobial, Anti-oxidant [91] Wound healing [140] Antinociceptive [141] Antidepressant [142]
<i>Mangifera indica</i> L. Anacardiaceae	Amango (Twi)	Tree	Leaves	Hypertension, Cough, Bedwetting, Low sperm count, Diabetes Malaria, Fever [28] [37] [47] [143] [144]	friedelin, friedelan-3b-ol, $\alpha$ -amyirin, $\beta$ -amyirin, and cycloartenol. Sterols include $\beta$ -sitosterol, protocatechuic acid, catechin, mangiferin, benzoic acid, kainic acid, gallic acid, shikimic acid, stearic acid, eicosanoic acid, linoleic, linolenic, oleic acid, arachidonic acid, and palmitic acid [145]	Antimicrobial [146] [147] Antioxidant [148] Antiplasmodial [43] [147]
<i>Momordica charantia</i> L. Cucurbitaceae	Nyanya (Twi)	Liana	Whole Plant	Abdominal pains, fever, measles, Gonorrhoea, headache, snakebite, Malaria, Diabetes, Detoxification, Diarrhoea, Dysentery, Febrifuge [28] [37] [49]	[3 $\beta$ ,25-dihydroxy-7 $\beta$ -methoxycucurbita 5,23 I-diene], [3 $\beta$ -hydroxy-7 $\beta$ ,25-dimethoxycucurbita-5,23I-diene], [3 $\beta$ ,7 $\beta$ ,25-trihydroxycucurbita-5,23 I-dien-19-al], [3-O- $\beta$ -D-allopyranosyl, 7 $\beta$ ,25-dihydroxycucurbita-5,23I-dien-19-al] [149]	Antimicrobial [123] Antioxidant, Wound healing [140] Anti-lipidaemic [150]
<i>Morinda lucida</i> Benth Rubiaceae	Konkroma (Twi)	Tree	Root	Haemorrhoids, stomach ulcer, Malaria, Typhoid, Bone fracture, High blood pressure, Rheumatism, Candidiasis, Gonorrhoea [34] [37] [143] [151]	Oleanolic acid, ursolic acid [152] Molucidin, Oruwacin [153]	Antiplasmodial [154] Anti-Schistosomal [46] Antiproliferative, Antioxidant [155] Antiprotozoan [156] Anti-inflammatory [157] Anti-infective [158] [159]
<i>Moringa oleifera</i> Lam. Moringaceae	Moringa (Twi)	Tree	Leaves Seeds	Hypertension, Ulcer, Fever, Malaria, Typhoid, Blood tonic, Urine retention, Bilharzia, Diarrhoea [28] [37] [47] [151]	Niazirin, niazirin, 4-[(4'-O-acetylalpha-L-rhamnosyloxy) benzyl]isothiocyanate, niaziminin A, and niaziminin [160]	Antiplasmodial [147,161], Antioxidant, Anti-prostate cancer [65] Anthelmintic [162]
<i>Myrianthus arboreus</i> P. Beauv. Moraceae	Nyankama (Twi)	Tree	Leaves Stem bark	Kidney pain, Reproduction, Diabetes [121] [163] [164]	Epicatechin, Epigallocatechin, Dulcisflavan, Euscaphic acid, Tormentonic acid, Sitosterol-3-O- $\beta$ -d-glucopyranoside, Arjunolic acid [165]	Antimicrobial [123] Wound healing, Antioxidant [166] Anti-Hyperglycaemia [165] Antidiabetic [167]
<i>Myristica fragrans</i> Houtt Myristiaceae	Nutmeg	Tree	Seeds	Carminative, Rheumatism, Postpartum medication, Stomach disorders, Nausea, Flatulence, Indigestion, and Diarrhea, secondary to thyroid medullary carcinoma [168]	$\alpha$ -pinenes, camphene, $\gamma$ -terpinene, $\beta$ -phellandrene, p-cymene, phenylpropane [169] [170] $\beta$ -caryophyllene, safrole, $\beta$ -phellandrene, eugenol, isoeugenol [171] (Z)-p-menth-2-en-1-ol, (E)-p-menth-2-en-1-ol [172]	Antimicrobial [173] [174]

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<i>Paullinia pinnata</i> L. Sapindaceae	Tuoatini (Twi)	Liana	Bark Root Leaves, Stem	Worm infection, Waist pain, Ulcer, Sexual weakness, Piles, Rheumatism, Bone Fracture, Impotency, Fatigue, Fever, Stroke, HIV/AIDS [44] [151] [175]	2-O-methyl-L-chiro-inositol, $\beta$ -sitosterol, friedelin (Lunga <i>et al.</i> , 2014) and 6 $\alpha$ -(3'-methoxy-4'-hydroxybenzoyl)- lup-20(29)-ene-3-one [176]	Antibacterial and Antioxidant [177] Anti-cancer [178] Anthelmintic [44] Wound healing [179]
<i>Phyllanthus amarus</i> Schumach. & Thonn Phyllanthaceae	Ombatoatshi (Ga)	Herb	Whole plant	Diabetes, Dysentery and Painful spasms in intestines [129] [180]	Isobubbialine, epibubbialine, phyllanthine, securinine and norsecurinine [94]	Antibacterial [181] [182] Antioxidant and Anti-prostate cancer [65] Anti-schistosomal [46] Antiplasmodial [161] [183]
<i>Phyllanthus fraternus</i> G. L. Webster Phyllanthaceae	Bo mma gu w'akyi (Twi) Kpavideme (Dangbe)	Herb	Bark	Tuberculosis, Cancer, wound, Dropsy, Dysentery [38] [39] [129]	(+)-allonorsecurinine, ent-norsecurinine, nirurine, bubbialine, epibubbialine and phyllanthin [184]	Antioxidant and Anticoagulant [185] Antiplasmodial [48] [186] Anti-inflammatory [187]
<i>Phyllanthus muellerianus</i> (Kuntze.) Exell Euphorbiaceae	Awobe (Twi)	Climbing shrub	Whole plant	Wounds, menstrual disorders, fevers, pain and inflammation [28] [34]	Geraniin 1 $\beta$ ,22 $\beta$ -Dihydroxyfriedelin, 22 $\beta$ -Hydroxyfriedel-1-ene, 3-Friedelanone, Caffeic acid and Isoquercitrin [188] [189] [190]	Anti-infective [191] Anti-inflammatory [192] Wound healing [193] Anti-Nociceptive [194] Anti-leishmanial [195]
<i>Piper guineense</i> Schumach. & Thonn. Piperaceae	Soro wisa (Twi)	Liana	Seeds	Malaria, cancers, excipient [129] [151] [196]	[N-Isobutyl-11-(3,4-methylenedioxyphenyl)- 2E,4E,]OE-undecatrienamide], [N-Pyrrolidyl-12-(3,4-methylenedioxyphenyl)- 2E,4E,9E,]IZ-dodecatetraenamide], [N-Isobutyl-2E,4E-decadienamide], [N-Isobutyl-2E,4E_dodecadienamide] and [N-Isobutyl-13-(3,4-methylenedioxyphenyl)- 2E,4E,12E-tridecatrienamide] [197]	Antimicrobial [30]
<i>Polyalthia longifolia</i> (Sonn.) Thwaites Annonaceae	Bronyadua (Twi)	Tree	Leaves, Stem bark	Malaria, Ulcer [16] [49] [198]	quercetin, quercetin-3-O- $\beta$ -glucopyranoside, kaempferol-3-O- $\alpha$ -rhamnopyranosyl- (1 $\rightarrow$ 6)- $\beta$ -galactopyranoside, kaempferol-3-O- $\alpha$ -rhamnopyranosyl- (1 $\rightarrow$ 6)- $\beta$ -glucopyranoside, rutin and allantoin [199]	Antiplasmodial [147] [200] [201] [202] Antipyretic [203]
<i>Portulaca oleracea</i> Linn. Portulacaceae	Adwere (Twi)	Creepers	Whole Plant	Cancer, Expel roundworms, Earache, Carious teeth, Demulcent, Diuretic, and slightly Astringent [39] [49]	oleracone F, p-hydroxy ethyl cinnamate, 4-hydroxy-3-methoxy ethyl cinnamate, salicylic acid, $\beta$ -carboline-3-carboxylic acid, aurantiamide, and portulacaneone A, B and C [204]	Antimicrobial, Antioxidant, Anti-inflammatory [205]
<i>Pterygota macrocarpa</i> K. Schum. Malvaceae	Kyere/kyereye/ Koto (Twi)	Tree	Leaves, Bark	Stomachache, Pains, Disorders of digestion, Gonorrhoea, Urinary tract infections, haemorrhoids, Dropsy, Swellings, Edema, Gout, Leprosy [82] [206]	-	Antimicrobial, Anti-inflammatory [207]
<i>Pupalia lappacea</i> (L.) A Juss. Amaranthaceae	Apsɔmpɔ (Twi)	Tree	Leaves	Boils, Diarrhoea [28] [129]	1-docosanol, stearic acid, stigmaterol, $\beta$ -sitosterol, saropeptate (N-benzoyl-1-phenylalaninol acetate), $\beta$ -sitosterol-3-O-d-glucopyranoside, stigmaterol-3-O- $\beta$ -d-glucopyranoside, and 20-hydroxyecdysone [208]	Wound healing, Antioxidant [209] Anti-leishmanial [195]

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<i>Rauvolfia vomitoria</i> (Afzel) Apocynaceae	Kakapenpen (Twi)	Shrub	Root	Arthritic, Cancer, Heart problems, Ulcer, Diarrhoea, Rheumatism, Jaundice, Psychiatric conditions Hypertension, Bradycardia, Insomnia; Arrhythmia, Angina, Schizophrenia, Skin diseases Constipatio, Lumbago, Infectious diseases; Yaws; Malaria; snakebite; Diabetes, wounds [34] [49] [210] [211]	reserpine, tetrahydroalstonine, isosandwicine, methyl reserpate, ajmaline, sandwicine, isorauhimbine, perakine, $\alpha$ -yohimbine, yohimbine, mitoridine, tetraphyllicine, harman, mauiesine, and 12-hydroxymauiesine [212]	Anthelmintic [213] Antibacterial [214] Anti-parasitic [215]
<i>Senna siamea</i> (Lam.) H. S. Irwin & Barneby Fabaceae	Zangara tsi (Dangbe)	Tree	Stem back, Leaves	Malaria [37]	beta-sitosterol, sucrose, n-octacosanol, [2-methyl-5-(2'-hydroxypropyl)-7-hydroxy-chromone-2'-O- $\beta$ -D-glucopyranoside], piceatannol, Emodin and lupeol [216]	Antiplasmodial [48] [154]
<i>Solanum macrocarpon</i> L. Solanaceae	Gboma (Twi)	Shrub	Leaves, Fruit	Asthma, Diabetes, Typhoid, Malaria, Anemia [144]	$\beta$ -carotene, lutein and zeaxanthin [217]	Anti-oxidant [33] [92]
<i>Solanum torvum</i> Sw. Solanaceae	Kwaonsusua/ Abedru (Twi)	Shrub	Leaves, Fruits	Tuberculosis, Blood tonic, Cough, Asthma, Bronchitis, Wounds, Skin diseases, Reproductive disorders, Fever, Arterial Hypertension, Diabetes [28] [37] [38]	Methyl caffeate [218], neochlorogenin 6-O- $\beta$ -D-quinovopyranoside, neochlorogenin 6-O- $\beta$ -D-xylopyranosyl-(1 $\rightarrow$ 3)- $\beta$ -D-quinovopyranoside, neochlorogenin 6-O- $\alpha$ -L-rhamnopyranosyl-(1 $\rightarrow$ 3)- $\beta$ -D-quinovopyranoside, solagenin 6-O- $\beta$ -D-quinovopyranoside, solagenin 6-O- $\alpha$ -L-rhamnopyranosyl-(1 $\rightarrow$ 3)- $\beta$ -D-quinovopyranoside, isoquercetin, rutin, kaempferol and quercetin [219]	Anti-mycobacterial [220] Immunomodulatory and Erythropoietic effects [221]
<i>Strophanthus hispidus</i> DC. Apocynaceae	Maatwa (Twi)	Liana	Root	Syphilis ulcers, Bony syphilis, Guinea-worm sores Wounds [34]	-	Antimicrobial, Antioxidant, Wound healing [106]
<i>Synedrella nodiflora</i> (L) Gaertn Asteraceae	Tutummerika kohwe epo/ Mamponfo-apow (Twi)	Herb	Whole plant	Convulsion, Epilepsy, Pain [222] [223]	stigmast-4-ene-3-one and gamma-sitosterol [224]	Anti-Nociceptive [223] Anti-lipid Peroxidative [225] Anticonvulsant [222] Analgesic [226] Antipsychotic [227] Antidepressant [228] Anti-Hyperglycaemic [229] Antioxidant and Anti-Proliferative [230] Seizure suppression [231]
<i>Talinum triangulare</i> (Jacq.) Willd. Portulacaceae	Bokoboko (Twi)	Herb	Whole plant	Diabetes [144]	(+)-Catechin, Resveratrol, Quercetin, Galocatechin, Ellagic acid 4-Hydroxybenzaldehyde, 4-Hydroxybenzoic acid, 4-Hydroxybenzoic acid, methyl ester, Vanillic acid, Gallic acid, Ferulic acid, 2-Allyl-5-ethoxy-4-methoxyphenol, $\beta$ -Cryptoxanthin, Lycopene, Carotene, Cholesterol, Cholestanol, Theobromine, Theophylline, Epoxy-3,7-dimethoxyocrinane-11-one, $\alpha$ -Pinene and $\beta$ -Pinene [232]	Anti-oxidant [33]
<i>Tectona grandis</i> Verbanaceae	Teak (Twi)	Tree	Leaves	Malaria [37] [233]	5-hydroxylapachol, 1-hydroxy-2-methylanthraquinone, tectoquinone, pachybasin, dehydrotectol, tectol, lapachol, dehydro- $\alpha$ -lapachone, 2-methylquinizarin, deoxylapachol, $\beta$ -sitosterol, obtusifolin, squalene and betulinic acid [234]	Antiplasmodial [48]

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<i>Terminalia ivorensis</i> A. Chev. Combretaceae	Framire/Emeri (Twi)	Tree	Leaves, stem bark	Piles, Strengthening Pregnancy, Anemia, Cancer, Malaria [16] [28] [39] [235]	ivorengenin A and B, arjungenin, arjunic acid, betulinic acid, sericic acid, and oleanolic acid [236]	Antiplasmodial [25] [48]
<i>Tetrapleura tetraptera</i> (Schum & Thonn.) Mimosaceae	Prekese (Twi)	Tree	Fruit	Convulsion, Leprosy Oedema, Rheumatic Pains, Asthma, Female Sterility, Inflammation [49]	7-Hydroxy-6-methoxy coumarin, N-acetylglucosides, echinocystic acid-3-O sodium sulphate, chalcones-butein and isoliquiritigenin [237]	Antioxidant, Antimicrobial [238] Anti-trypanosomal, Anthelmintic [239]
<i>Thonningia sanguinea</i> Vahl Balanophoraceae	Kwabedwea (Twi)	Herb	Whole plant	Haemorrhoids, Bronchial asthma, Prophylaxis Torticollis, Dysentery, Sore throat, Skin infections, Abscesses, Dental caries, Gingivitis, Fever, Malaria, Heart disease, Rickets, Rheumatism [240] [241] [242] [243]	$\beta$ -sitosteryl-3 $\beta$ -D-glucopyranoside-O-fatty acid methyl esters molecular species, $\beta$ -sitosterol-3 $\beta$ -D-glucopyranoside-60 -O-palmitate, $\beta$ -sitosterol, $\beta$ -sitosterol-3 $\beta$ -D-glucopyranoside, $\beta$ -stigmaterol, $\beta$ -stigmaterol-3 $\beta$ -D-glucopyranoside, cholesterol and betulinic acid [244]	Antioxidant [241] [245] Anticancer [98] Anti-anaphylactic [246]
<i>Xylopiya aethiopica</i> (Dunal) A. Rich. Annonaceae	Hwenetia (Twi)	Tree	Seed, Fruit	Chicken Pox, Stomachache, Bladder Trouble, Strengthening Pregnancy, Diabetes mellitus, Asthma, Convulsions, Leprosy, Mental illness, Inflammation, Arthritis [49] [237] [247]	oxoglucaine, O-methylmoschatoline, and lysicamine, Oxophoebine, Liriodenine, 10-Methoxyliriodenine and 10-Hydroxyliriodenine [248]	Antimicrobial [30] [249] Antioxidant [250] Anti-allodynic and Anti-hyperalgesic [251] Anti-Inflammatory [252]
<i>Zingiber officinale</i> Roscoe Zingiberaceae	Kakaduro (Twi)	Herb	Rhizome	Tuberculosis, Circulatory and Digestive problems, Diabetes Cough, Diarrhoea, Wounds [28] [38] [49] [144]	[4]-gingerol, [6]-gingerol, [8]-gingerol, [10]-gingerol; [6]-paradol, [4]-shogaol, [6]-shogaol, 1-dehydro-[10]-gingerdione, [10]-gingerdione, hexahydrocurcumin, tetrahydrocurcumin, gingerenone A, 1,7-bis-(4' hydroxyl-3' methoxyphenyl)-5-methoxyheptan-3-one, and methoxy-[10]-gingero [253]	Antimicrobial [30] Anti-mycobacterial [220]

have surveyed and reported a number of finished herbal product on the Ghanaian market for treating various disease conditions [15] [16]. The CPMR alone has over thirty (30) different herbal products of different dosage forms used at the clinic for treating various ailments. Individual herbalists and herbal medicine manufacturing companies have also come out with a wide range of products which are been sold on the Ghanaian market (Table 2).

### 3.6. Integration of Herbal Medicine in Ghana's Healthcare System

Even though an Alternative Medicine Bill is yet to be passed by the Ghanaian parliament, Policies are being implemented to help integrate plant medicine into the health care system. Plant medicine practice is already recognized as an alternative and complementary to the existing conventional health care system by a lot of Ghanaians.

There are private herbal clinics all over the country which provide herbal remedies for various disease conditions. The Ministry of Health, in addition to the CPMR clinic, has also introduced Herbal Units in some Government Hospitals as an alternative health care and by way of integrating herbal medicine in the

**Table 2.** Some common herbal products on the Ghanaian market.

HERBAL PRODUCTS	INDICATIONS
Adom Koo Mixture and Capsule	Piles
Adu-Ayaa Herbal Tonic	Anaemia
Adu-Ayaa Malamix	Malaria
Adutwumwaa Bitters	Malaria
Agbeve A1 Herbamix	Malaria
Agetum	Infertility
Agye Me Herbal Mixture	Malaria, Loss of appetite
Akoma Herbal Mixture	Improves circulation
Alafia Mixture	Malaria
Angel Cream	Skin conditions
Angel Natural Capsule	Male vitality
Ango Powder Capsules	Male vitality
Antiaris	Nervous system disorders
Aphro Powder	Aphrodisia
Aphro Root	Aphrodisia
Applex Herbal Mixture	General well being
Asena	Arthritis
Blighia Powder	Bleeding piles/haemorrhoids & diarrhoea
Boafo) Ointment	Musculoskeletal pain
Boafo) Soap	Skin infection
Bridelia Tea	Diabetes
Chardica Powder	Anticancer
Chocho Cream	Skin infection
Chocho Tea	General well being
Coa Mixture	General well being
Cough Mixture	Cough
Dannemal Herbal Mixture	Malaria
Dannetone Herbal Mixture	Loss of appetite
Daprof Immune Booster	Immune booster
Dominion Herbal Powder	General well being
Dudo Malamix	Malaria
Dyspepsia	Heartburn/nausea
Empire G Capsules	Male vitality
Empire Garlic Bitters	Cholesterol management
Empire Kooko	Piles

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Enterica	Typhiod fever
Fefe Powder	Palpitation of the heart
Femi Cure Capsules	Female General well being
Forever Aloe Beny Nectar	UTI/STD
Forever Aloe Vera Gel	Skin Infection
Forever Antic Gel	Improves urine flow
Forever Garcina Plus	Female well being
Forever Garlic Thyme	Improves circulation
Franko Herbal Mixture	Malaria
Garibe Ointment	Skin infections
Gita P Caps	Haemorrhoids
Givers Herbal Mixture	Malaria
Givers Koo Capsule	Pile
G-P1 Herbal Mixture	Immune booster
Greenlife Ashcure Tea	Detoxification
Greenlife Men Formula	Male vitality
Greenlife ST Formula	Male vitality
Habibi Herbal Tea	Immune booster
Halima Antimalaria	Malaria
Himalaya Ayur Slim Capsule	Slimming
Imboost Herbal Mixture	Immune booster
Joy Daddy Bitters	General well being
Joy Ointment	Skin infections
Joy Soap	Skin infections
Joy Twede3 Bitters	Male vitality
K BA	Antibiotic
K Herb.	Antibiotic
Kandimix Herbal Mixture	Malaria
Kenoch Baktafight Mixture	Malaria, loss of appetite
Kin Tablet	General well being
Kingdom Ginseng Power Capsule	Male vitality
Kof-Care Herbal Mixture	Cough
Krowaa Cinnamon Balm	Skin infection
Lako Herbal Mixture	Malaria
Laud STD Capsules	STD'S
Lawson Mixture	Malaria
Lippia Tea	Blood pressure

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Living Bitters Tonic	Detoxification and General well being
Lucky Herbal Bitters	Malaria fever
Mars Capsules	Male vitality
MIST Campa T	Waist pains/sexual weakness
Mist Diodia	Diuretic
Mist Jaundica	Jaundice
Mist Membrana	Benign prostatic hyperplasia /urine retention
Mist Modium	Asthma
Mist Morazia	Sickle cell
Mist Sodenia	Numbness
Mist Tonica	Anaemia/ loss of appetite
Mona Soap	Skin Infection
Moringa Leaf Powder	Diabetes Mellitus
Mr Q Herbal Capsule	Male vitality
Nibima	Malaria
Ninger	Dysmenorrhoea/infertility
Nku Dread Cream	Dandruff
Npk 500 Capsules	Natural pain killer
Olax Powder	Severe waist pains
Pawa 02	STDs
Pile C Ointment	Piles/haemorrhoids
Pile Mixture	Piles/haemorrhoid
Reform Koo Mixture	Piles
Reform Mixture	Malaria
Rheubalm J. Ointment	Joint and muscular pain
Rockman Capsules	Male vitality
Rooter Life Mixture	Flat tummy
Sahara Mixture	Malaria
Sibi Herbal Soap	Skin infection
Sibi Malacure	Malaria
Sibi Men	Male vitality
Sibi Women	Female vitality
Sirrapac Powder	Arthritis
Soafa Herbal Soap	Skin infection
Soafa Herbal Tea	General well being
Solak Herbal Mixture	General well being
Taabea Herbal Mixture	Malaria

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**Continued**

Time Herbal Mixture	Malaria
Tina A. Powder	Asthma
Tinattet BE4 BE4	Premature ejaculation
Tinattet Be4 Be4 Instant	Erectile dysfunction
Tinattet Memory Aid	Improves brain function
Tinattet Venicare	Dysmenorrhea
Tinattet W And P	Waist pain
Top Bintang Mixture/Capsules	Gastroenteritis
Top Cough Mixtures	Cough treatment
Top Fever Syrup/Capsules	Malaria
Top Laxative Bitters	Purgative
Top Mpeeh Capsules	Male vitality
Top Tico Balm	Musculo-skeletal pain
Top Tico/Capsules	Anaemia
Top Waagah Mixture/Caps	Dysmenorrhea
Uro 500 Capsules	Benign prostatic hyperplasia
Vigpower Capsules	Male vitality
X & Y Granules	General well being
Zahara Gee Herbal Capsules	General well being
Zipman Capsule	Male vitality

country's health system. These herbal clinics engage the services of qualified Medical Herbalists who diagnose based on laboratory test results and prescribe appropriate herbal medicines for treatment of various disease conditions. They prescribe solely plant medicine which are known to be efficacious through research and have been registered by the FDA.

The Ministry of health is currently compiling a list of herbal medicines to be part of the essential medicine list to be captured and absorbed under the National Health Insurance Scheme, as part of efforts to integrate plant medicine in the health care system.

### 3.7. Conservation of Medicinal Plants

Even though plant medicine practice started by sourcing medicinal plants from only the wild, efforts have been made to get institutions and individuals to cultivate medicinal plants domestically for use to prevent plants from going extinct. The CPMR has about 150 acres of farm lands at different locations in the Eastern regions of Ghana, which is managed by the Plant Development Department (PDD) for conservation and cultivation of medicinal plants which are mostly used by the Center in producing herbal products and for research. The CPMR again identifies individuals with interest in medicinal plants farming and engage

them in its medicinal plants out-grower programs, where seedling are often supplied to them for cultivation. The PDD has established a nursery to raise seedlings for supply to their medicinal plant farms and out-growers.

Tissue culture technology is also employed by researchers of some institutions to generate seedlings of plants which are difficult to raise through the natural methods of using their propagation parts. This technology helps to conserve plants by producing challenging plant which are likely to go on extinction much easier and faster, with increased plant yield and improved secondary metabolites [17] which can support the plant medicine industry.

The Government of Ghana by way of conserving medicinal plants and plant diversity at large, has established Botanical Gardens, Forest Reserves and National Parks to preserve some important plant species for educational, recreational and tourism purposes. Some of these botanical gardens and forest reserves also have nurseries where seedlings are raised for medicinal plant farmers to purchase and cultivate on their private gardens and farms [18] [19].

## **4. Challenges with Plant Medicine Use/Practice in Ghana**

### **4.1. Lack of Recognition, Acceptance and Co-Operation**

Even though plant medicine practice is well advanced in the country and majority of Ghanaians have been exposed to the use of medicinal plants in the treatment of various diseases and the important role plant medicine plays in the health care delivery system has been established, there is still a section of the population who consider the whole idea as superstitious and hence are yet to welcome the practice.

Most allopathic practitioners despise the use of herbal medicines and will never encourage their patients to patronize them [254]. Others are often quick to attribute most organ damage cases like kidneys and liver dysfunction to the use of plant medicines, even when they do not have enough evidence to back it. Interestingly, traditional herbalists who receive such comments normally get agitated and furious but unfortunately, they are not able to disprove the claims of the allopathic practitioners due to the huge uncertainties associated with their practices. This has created enmity between the two groups of practitioners and hence, retarded the development of herbal medicine and for that matter medicinal plants usage in Ghana.

### **4.2. Lack of Financial Support**

The herbal medicine industry like any other industry requires huge capital investment for large scale production of quality products. However, most herbalists are indigenous people with little or no money to go into research and large scale production even though they have all the knowledge and ability to produce great and efficacious herbal medicines. Most of such great herbal products only stay with the herbalist in their respective homes and communities without reaching other parts of the country. With a little financial support to conduct

research and produce on a large scale well packaged and registered herbal medicines, patronage among Ghanaians will be increased and it will lead to acceptance on the international market.

There is currently no government subsidy on the purchase of plant medicines. Patients who choose to go for herbal treatment in government hospitals pay for full amounts for their herbal prescriptions unlike patients who choose the orthodox and enjoy being served free medications through the National Health Insurance Scheme (NHIS) which caters for most orthodox health services, replacing the cash and carry system [255]. This alone discourages a lot of Ghanaians from assessing and patronizing plant medicine.

### **4.3. Contaminations**

In Ghana and neighboring countries in West Africa, human activities predispose the environment to contaminants such as pesticides, heavy metals, microbial contaminants and mycotoxins. Plants are mostly affected by environmental pollution which tends to accumulate levels of the contaminants and pass them onto other organisms due to their position in the food chain.

#### **4.3.1. Pesticide Contaminations**

Pesticides such as insecticides, fungicides and herbicides are introduced into the environment mainly through unstandardized agricultural practices in Ghana. The pesticides residues, metabolites or degraded products get accumulated in plants, animals, soil and water bodies. It is however notable that these residues are part of the major sources of contaminations for medicinal plants and herbal medicines for that matter. For instance, organochlorine pesticides (OCP), including benzene hexachlorides (BHC), dichloro-diphenyl-trichloroethane (DDT) and pentachloronitrobenzene (PCNB) were frequently detected in medicinal plants and products [256]. Even though their use has been banned in many countries including Ghana, their slow degradation makes them persist in the environment especially in soils and river bodies and hence accumulate in the food chain. Ghana has a well-developed policy on pesticide registration and licensing and only allows relatively safer pesticides into the country, but the problem is the inadequate education to the farmers on its use.

#### **4.3.2. Heavy Metal Contamination**

Another challenge of the use of medicinal plant is the problem of heavy metal contamination. The most toxic heavy metals often detected in medicinal plants are mercury, arsenic and lead [257] [258] [259]. Others may include cadmium, copper and thallium. Heavy metals are introduced into the environment by poorly unregulated mining activities known in the Ghanaian parlance as “galamsey”. They get both the soil and water bodies contaminated which are absorbed by plants.

#### **4.3.3. Microbial and Mycotoxins Contaminations**

A common challenge of herbal medicine in Ghana is microbial and mycological

contaminations [259]. These challenges may arise due to poor handling, storage and processing of plant materials. Freshly collected plant materials must be washed thoroughly under running water, well dried and stored under cool, dry and air-tight conditions. Failure to do so may lead to the growth of pathogenic microbes like enterobacter, enterococcus, shigella and streptococcus. Under humid conditions and favorable temperatures, mycotoxins such as aflatoxins, fusarial toxin, ochratoxin, citreoviridin, penicillic acid, etc may grow on the plant material. These toxins are highly poisonous and render the affected material unsafe for use. Microbial and mycotoxin contaminations have been a difficult challenge to deal with in Ghana because of the climatic conditions in the tropical and sub-tropical regions. The high temperatures and humidity support the growth of these organisms and their toxins.

#### **4.4. Misidentification of Plant Species**

The identification and authentication of the right medicinal plant is a basic requirement that borders on toxicity and efficacy. Due to the increasing number of closely related species of medicinal plants with similar phenotypes, it is easy to mistake one plant for another, for example, *Taraxacum officinale* and *Emilia sonchifolia*. On the other hand, the same species of plant may also show differences morphologically under different environments. This poses a huge challenge to herbalists and end users, since there have been cases of people who developed complications and died all because of the wrong identification and hence the wrong use of plant materials in preparations.

#### **4.5. Adulterations**

Adulteration of medicinal plants and products can be classified into three; addition of orthodox drugs to the herbal medicine, substitution of material and addition of foreign materials. Adulteration is targeted at enhancing efficacy or maximizing profit but it should also be noted that, safety is compromised in most cases.

##### **4.5.1. Addition of Orthodox Drugs**

There have been instances where some pharmaceuticals have been detected in herbal products. The most frequently observed cases are addition of sildenafil (Viagra) to herbal products indicated for the treatment of sexual dysfunction, acetaminophen (paracetamol) to products for treating pains and inflammation and antibiotics are added to herbal products for infections [258] [260]. This is not acceptable in Ghana but due to facility and financial constraints on the part of the regulatory institutions, such analysis to detect other foreign compounds are only insisted on with just suspected cases.

##### **4.5.2. Substitution of Material**

This problem is mostly encountered when the plant part requested is not available or is limited in quantity. For example, in a case where the root bark of the

medicinal plant is the most active, some manufacturers rather substitute it with the stem bark because of the challenge of digging for roots and quest of conservation. It may also arise due to mislabeling of the parts during collection and processing of the material. Even though it may be the same plant, the active constituents may vary in the different parts, which has a tendency of affecting the efficacy and toxicity.

#### **4.5.3. Addition of Foreign Materials**

This includes the deliberate addition of other plant materials, and other unacceptable substances to the processed products in order to maximize profit. The addition may also be accidental where other plant materials which are not of interest are introduced during collection and processing of the medicinal plants.

#### **4.6. Individualism and Secrecy among Herbalist**

Majority of herbal medicine practitioners in Ghana are extremely individualistic and secretive, thus the practice is shrouded in secrecy and fading off gradually [5]. They mostly are suspicious of colleague herbalist and especially plant medicine research institutions, claiming their medicinal plants and formula for producing will be stolen. This attitude impedes research, documentation and transfer of knowledge on plant medicine, and Ghana is gradually losing vital information on traditional uses of plants in treatment of diseases since the herbalists, a repository of these information, are fading out.

#### **4.7. Lack of Approval and Quality Assessment**

Lots of efforts are being made by the government and FDA to regulate traditional medicine, however, there are still a lot of products on the market which have not gone through the required quality assessment and registration. Herbalists with no licenses, with product without FDA approval are all over information centers and market places making ambiguous claims on such products. This may be as a result of inadequate enforcement of regulations and leads to loss of interest in herbal medicine by a lot of Ghanaians.

#### **4.8. Standardization**

Standardization has become a focal point in ensuring the safer use of medicinal plants. This is because it ensures that batch to batch productions contain the same or similar levels of phyto-constituents. However, this has been quite challenging in the country due to lack of defined regulations, lack of marker compounds and challenges with the identification of the active principle(s) in the plant or the product [261]. Aside from the challenges with identification and isolation of the active constituents especially in poly-herbal formulations, the whole concept of standardization and the need to standardize limits the understanding of the scientific community to herbal medicine. This is because, the concept of synergy can easily be excluded since the active constituents may not be acting in isolation, but may require other naturally occurring compounds to

be more active. That is, there are cases where the whole crude extract from the medicinal plant has greater therapeutic activity than the sum of the activity of the active constituent alone [262].

## 5. Conclusion

Plant medicine practice in Ghana has come a long way and keeps advancing over the years through the efforts of subsequent government right after independence. The advancements in policies, research, training and education, safety and quality, diagnosis and treatment, product development and packaging have led to an increased patronage in the use of plant medicine and its practice entirely. A wide range of medicinal plants were also found through literature search to have been researched by a number of researchers in Ghana, to confirm their traditional uses and help boost the confidence of users in their potencies to heal specific diseases. There is still however more room for improving the practice in the country, since it faces a lot of challenges currently.

## 6. Recommendations

The authors recommend the Government of Ghana speeds up the process to pass the Traditional Medicine Bill, since it will go a long way to give much recognition and support to the practice. More researches towards product development are highly encouraged to help produce quality and potent herbal products which can complement the orthodox system of health care delivery in the country. Also the regulatory bodies must be much stricter with their implementation so as to ensure the right thing is done to help boost individuals' confidence in the practice.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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