We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

185,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Chapter 2

Phytochemicals—God's Endowment of Curative Power in Plants

Olayinka Temitayo Ogunmefun

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.77423

Abstract

Phytochemicals—God's Endowment of Curative Power in Plants tried to review the link between the knowledge of God's pronouncement on plants as man's source of food and drugs in the Holy Bible to the scientific proofs of the availability of phytochemicals in different species of plants. The abundance of plants in the world as vegetables, spices, fruits, etc. of which more than 80% of their chemical compositions have not been discovered emphasizes the reasons for the search of these phytochemicals as alternative drug sources which are safer and relatively cheaper. Literature is reviewed on different phytochemicals such as alkaloids, saponins, tannins, anthraquinones, and glycosides in the form of cardiac and cyanogenetic glycosides, flavonoids, carotenoids, and phenols considering their chemical properties and their usefulness to man. This review confirmed the outburst that said "the world is too much with us; late and soon, getting and spending, we lay waste our powers: Little we see in nature that is ours." Therefore, there is an urgent need to search for these various phytochemicals in plants so that we can utilize the potentials in these free gifts from God and not lay waste the curative power endowed on them purposely for man's health benefits.

Keywords: alternative drug, curative power, endowment, God, phytochemicals, plants

1. Introduction

God created plants for the use of mankind and ordered man to make use of these herbs and trees for food and for medicine as reflected in His words recorded in the Holy Bible in the books of *Genesis* and *Revelation*. The book of *Genesis* Chapter 1 verse 29 reported and God said "Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in which is the fruit of a tree yielding seed; to you it shall be for meat." The book

IntechOpen

© 2018 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. CC BY

of *Revelation* Chapter 22 verse 1 also declared "And he showed me a pure river of water of life, clear as crystal, proceeding out of the throne of God and of the Lamb." Also, in *Revelation* Chapter 22 verse 2, it was written "In the midst of the street of it, and on either side of the river, was there the tree of life, which bare twelve manner of fruits, and yielded her fruit every month: and the leaves of the tree were for the healing of the nation" [1].

From the work of creation, God made light on the first day followed by water on the second day and afterward created plants on the third day in the categories of grass, herb yielding seed, and tree yielding fruit, whose seed was in itself, that is, seed enclosed in fruit. This order was a divine one which no one can fathom as God is all-knowing and His understanding is unsearchable. God knew what the requirements for the growth of all these plants would be, and He ordered their creation after those requirements were met so that they could survive.

He created man lastly on the sixth day after all other things (creatures) had been made so that man could have dominion over them. He ordered man to use the herbs and tree bearing fruits for meat, that is, food, and for treating their illnesses as He understood the frailty of man. He knew all the requirements that man needed to survive and made provisions for them.

God created plants to serve man and put into these plants certain powers that are capable of healing and which in the modern times are now known as "phytochemicals." These phytochemicals are of different types according to their specificity in curing various diseases. Many individual plants were endowed with varieties of these chemical constituents, and the synergistic effects of these constituents also termed secondary metabolites endow on them their curative abilities. The healing properties of most plants are becoming more recognizable and preferable as most are associated with little or no side effect which is a common problem with the administration of most synthetic drugs (orthodox medicines) and the realization of the fact that many natural remedies carry their cures along with them [2]. Never are we reminded of Wordsworth's outburst: "The world is too much with us; late and soon, getting and spending, we lay waste our powers. Little we see in nature that is ours" [2].

1.1. Objectives of the study

- To acknowledge the curative powers in plants as God's gift and perfect plan for man's well-being
- To review the study of plants in relation to their medicinal properties
- To review some plants used in the treatment of certain diseases

1.1.1. The history of botany in relation to medicine

Botanical science in a pure sense is the study of plants, and botany is the applied science which has in its interest the study of human use of plants. The studies that are mostly obvious in applied botany are agriculture, forestry, horticulture, pharmacognosy, weed science, economic botany, plant pathology, and ethnobotany that fall outside of modern botany courses [3].

The knowledge of plants especially in uses for food and medicine increased during the Neolithic Revolution. Protobotany which was the first prescientific written record of plants

did not begin with food but was born out of the medicinal literature of China, Egypt, India, and Mesopotamia [4]. It was observed by botanical historian, Alan Morton, that agriculture was the occupation of the poor and uneducated, while medicine was the profession of the socially influential shamans, priests, magicians, physicians, and apothecians who were more likely to put their knowledge in record for posterity [3].

1.1.2. The relevance of botany in medicine

Lists of different plants and herb concoctions for pharmaceutical purposes were dated back to 481 BC–221 BC in ancient China. Over the centuries, the written knowledge of herbal pharmaceuticals was contributed to by many Chinese writers [5]. The study of medicinal plants was not being neglected, and a full synthesis of ancient Greek pharmacology was compiled in *De Materia Medica* c. 60 AD by Pedanius Dioscorides (c. 40–90 AD) who was a Greek physician with the Roman army [6]. The lives of the European middle ages were based on agriculture in the fifteenth and sixteenth centuries until when printing came into limelight which did not publish dissertations on agriculture but rather preferred the lists of medicinal plants with descriptions of their attributes and inherent power (efficacy). Records had it in most ancient history that *Herbal* which was the first series of books written on plants indicated botany to form a part of medicine [3]. People who contributed to *Herbal* were mostly university gardens' curators [7], and compilations of classic texts in *Herbal* were mostly derived from *De Materia Medica*.

1.2. Separation of botany from medicine

The need for accurate and detailed plant descriptions meant that some herbals were more botanical than medicinal. Herbals made contributions to botany by initiating the science of plant description, classification, and botanical illustrations. Botany and medicine were the same up to the seventeenth century, but those books that emphasized medicinal aspects omitted the plant lore and eventually became the modern pharmacopeias; those that omitted medicine became more botanical which evolved into the modern plant description compilations called *Floras* and are often backed by specimens deposited in a herbarium (a collection of dried plants that verified the plant descriptions given in the *Floras*). The transition from *Herbal* to *Floras* marked the final separation of botany from medicine [8].

1.2.1. Relevance of medicinal plants

Medicinal plants are gaining popularity in usage due to a large number of people in search of health remedies with little or no side effect which is the problem of most chemically synthesized drugs. Considerable attention is presently given to the use of eco-friendly and bio-friendly products from plant origin for the prevention and cure of human and animal health challenges (diseases) [9, 10]. This problem of side effects of most chemically based drugs has spurred the Western world to looking into natural products that are safe, effective, and affordable. It has been documented that 80% of the world's population has a strong belief in traditional medicine, especially drugs from plant origin for their primary health care [9, 10]. Medicinal plants, for example, neem leaves and stem bark (*Azadirachta indica*), pawpaw leaves (*Carica papaya*), mango leaves and stem bark (*Mangifera indica*), and Cinchona bark have been

in use in one form or the other traditionally. No doubt, the plant kingdom is rich in diverse array of plants whose medicinal attributes (potencies) are yet to be unraveled [9, 10]. The various uses of some common medicinal plants from Nigeria used for treating various diseases highlighting the parts of the plants used are represented in **Table 1**.

1.3. Harvest of medicinal plants

Medicinal plants should be harvested at the appropriate seasons as their medicinal properties vary with respect to different seasons. The medicinal properties may be located and restricted to a particular part of the plant, and the medicinal attributes is also affected by the age of the plant. A medicinal plant of a particular age for drug processing should therefore be harvested at the correct season of the year to prevent loss or changes in its phytochemical constituents. The period of storage in shade or sun and the geographical locations of the medicinal plants also play important roles in the medicinal properties of the plant [11].

1.4. Identification and standardization of active principles in medicinal plants

Medicinal plants are very rich in chemical compounds which they produce for their own defense and are known as secondary metabolites (phytochemicals) and their medicinal potencies are attributed to these chemical compounds [11]. A medicinal plant may contain a mixture of different phytochemicals, for example, saponins, which have ability to lower cholesterol; alkaloids which are rich in nitrogenous compounds and are stimulants; tannins which are natural antibiotics; anthraquinones used as laxative and dye; cardiac glycosides which are good cardiovascular drugs; and phenols and flavonoids which are rich in antioxidants. The ability to identify these biologically active compounds in a medicinal plant serves as a guide in its quality control and dose determination. Most medicinal plants in Nigeria have not been screened for their complete phytochemical compositions, and this would help in their dose determination and standardization. The entire world has more than 250,000 species of higher plants gathered from conservative studies, and only an insignificant percentage has been exhaustively studied for their potentials as drug sources [11].

1.5. Plant-based drugs

In the ancient times, plants served humankind as the source of all drugs with most therapeutic agents provided by the higher plants. The World Health Organization estimated that about 3.5–4 billion people in the world depend on traditional medicine as sources of drugs for their primary health care (80% of people in the developing countries and 85% of traditional medicine rely on plant extracts) [12]. Plant-derived drugs represent 25% of the prescription of drugs in the market in the United States of America [13], and from 1983 to 1994, 39% of the new approved drugs were of natural origin; this included original natural products, semisynthetically derived products from natural origin and synthetic products based on models from natural products [14]. From 87 approved anticancer drugs, a survey revealed that 62% were of natural origin or is derived from modeling of the natural product parents [14]. Paclitaxel, vincristine, podophyllotoxin (a natural product precursor), and camptothecin (a natural precursor for water-soluble derivatives) are among those clinically useful drugs.

	Botanical (species) name	Family name	Local name(s)	Common names	Parts used	Medicinal use(s)
1	*Abelmoschus esculentus*	Malvaceae	Ila, okweje, kubewa	Okra, lady's finger	Fruit, seeds	Fevers, dysentery, catarrhal, antispasmodic, tonic, gonorrhea
2	*Acalypha fimbriata*	Euphorbiaceae	Jinwinini, kandiri	Acalypha	Leaves	Syphilis, ulcers, asthma, anthelmintic, antimicrobial
3	*Adansonia digitata*	Bombacaceae	Igi-ose, kukaa, ose, kulambali	Baobab	Leaves, fruit, pulp, bark	Malaria, skin diseases, caries, asthma, diarrhea, bladder diseases, antimicrobial
4	*Aframomum melegueta*	Zingiberaceae	Atare, ata-ire, itaye, citta, ose oji, gyandamaryaji	Alligator pepper, grains of paradise	Leaves, seeds	Anemia, wounds, stimulant, coughs, malaria, rheumatism, anthelmintics, smallpox, chicken pox
5	*Alafia barteri*	Apocynaceae	Agbari etu	Alafia chewing stick, guinea fowl's crest	Roots, leaves	Eye infections, toothache, sickle cell anemia, rheumatic pains
6	*Allium cepa*	Liliaceae	Alubosa, albasa, yabase, albasa gudaji	Onion	Bulb, leaves	Skin diseases, throat infection, tumor, weak erection, cough, antidiuretic, anthelmintic, rubefacient
7	*Allium sativum*	Liliaceae	Aayu	Garlic	Bulb	Asthma, anthelmintic, antibiotic, blood tonic, malaria, ringworm, antimicrobials, emmenagogue, flatulence
8	*Aloe vera*	Liliaceae	Ahon erin	Barbados aloe	Leaves' juice	Purgative, guinea worms, hair care, skin diseases, amenorrhea, immune booster, diabetes, breast cancer
9	*Azadirachta indica*	Meliaceae	Dongo-yaro, eke-oyibo	Neem tree	Leaves, stem bark, seeds	Malaria, syphilis, jaundice, eczema, laxative, ringworm, skin disease, sore throat, anthelmintic
10	*Bambusa vulgaris*	Poaceae	Oparun, atosi	Bamboo	Leaves, young shoots	Gonorrhea, abortifacient, skin rashes of HIV/AIDS, emmenagogue, anthelmintic
11	*Buchholzia coriacea*	Sterculiaceae	Uworo, obi-ata	Wonderful kola	Fruit, bark	Antimicrobials, anthelminthic, ulcer, fibroid, dysmenorrhea, chest pains, respiratory disorders

http://dx.doi.org/10.5772/intechopen.77423

	Botanical (species) name	Family name	Local name(s)	Common names	Parts used	Medicinal use(s)
12	*Butyrospermum paradoxum* (*Vitellaria paradoxa*)	Sapotaceae	Emi-emi, emi, osisi, ka'danya	Shea butter tree	Seeds	Nasal decongestion, anthelmintic, hypertension, diuretic
13	*Cannabis sativa*	Cannabaceae	Igbo	Indian hemp	Leaves, female inflorescence, seeds, stem, twigs	Diarrhea, sores, dandruff, sedative, gonorrhea, whooping cough, migraine, dyspepsia
14	*Carica papaya*	Caricaceae	Ibepe, ojo, gwanda	Pawpaw	Leaves, seeds, fruits	Amoebic dysentery, syphilis, gonorrhea, abortifacient, diabetes, roundworms, convulsion, malaria, mental disorder, papain enzyme as meat tenderizer
15	*Catharanthus roseus*	Apocynaceae	Apabida pupa	Rose periwinkle	Leaves, whole plant	Diabetes, antileukemic properties, dysentery, hypertension, menorrhagia, antitumor
16	*Ceiba pentandra*	Bombacaceae	Araba	White silk cotton tree	Flowers, leaves, bark, exudate	Fever, syphilis, gonorrhea, diabetes, emetic, astringent, asthma, menorrhagia, emollient, demulcent
17	*Citrus aurantifolia*	Rutaceae	Osan-wewe, dankabuya, afotanta, epe nkirisi	Lime, swing	Leaves, stem, root, fruit	Fever, hypertensive recipe, jaundice, gonorrhea, measles, abdominal ulcer, flavoring agent, cough, scurvy, toothache, anthelmintic
18	*Cocos nucifera*	Palmae	Agbon	Coconut palm	Bark, root, nuts	Bronchitis, migraine, dysentery, antiseptic, toothache, hair loss, uterine disease, emollient, diuretic, laxative, anthelmintic, liver ailment
19	*Daniellia oliveri*	Leguminosae	Iya	African copaiba, balsam tree	Gum, bark	Toothache, astringent, diarrhea, dysentery, urinary infection
20	*Datura metel*	Solanaceae	Ajegun-eegun	Devil's trumpet, hairy thorn apple	Leaves	Asthma, convulsion, venereal diseases
21	*Elaeis guineensis*	Palmae	Igi-ope, ope	Red oil palm	Root, bark, kernels, palm oil	Diarrhea, asthma, measles, mental disorders, malaria

	Botanical (species) name	Family name	Local name(s)	Common names	Parts used	Medicinal use(s)
22	*Entandrophragma cylindricum*	Meliaceae	Ijebo, jebo	Cedar mahogany	Stem bark	Stimulant, gastrointestinal disorders, cough, diabetes, fever, black tongue
23	*Euphorbia hirta*	Euphorbiaceae	Emi-ile, iroko-iju, oro-elewe	Asthma weed	Whole plant, exudate	Asthma, catarrh, cough, hay fever, conjunctivitis, anthelmintic, amoebic dysentery, increased lactation and breast shape, antispasmodic, hypertension
24	*Funtumia elastica*	Apocynaceae	Ire	Silk rubber tree, wild rubber	Stem, twigs, latex	Piles, jaundice, impotence, antipyretics
25	*Garcinia kola*	Guttiferae	Orogbo	Bitter kola	Seeds, roots, fruits, stem bark	Antimicrobial, bronchitis, cough, dysentery, toothache, fever, throat and respiratory ailments, liver disorders, evacuant, headache, anticancer
26	*Hibiscus rosa-sinensis*	Malvaceae	Kekeke	Garden hibiscus	Leaves, stem, flower buds	Influenza, appendicitis, hypertension, asthma, stomach upset, antipyretic, oligospermia
27	*Ipomoea batatas*	Convolvulaceae	Anamo, odukun, kunkundukun, dankali, ekomako, jioyibo	Sweet potato	Leaves, tuber	Boils, diabetes, wounds, bronchial asthma, antimicrobials, purgative, breast swelling
28	*Irvingia gabonensis*	Irvingiaceae	Oro (ogbono)	Wild mango, bread tree	Fruits, seeds (kernel), leaves	Weight loss, antiulcer, spleen infection
29	*Jatropha curcas*	Euphorbiaceae	Lapalapa, botuje, zugu, oluluidu	Physic nut	Seed, stem, leaves, roots, sap	Eczema, ringworm, scabies, whitlow, fever, guinea worm, herpes, irregular menstruation, smallpox, convulsion
30	*Khaya ivorensis*	Meliaceae	Oganwo, ono, madachi	African mahogany	Stem, root, barks	Malaria, anemia, skin diseases, jaundice, arthritis, anthelmintic, emmenagogue
31	*Kigelia africana*	Bignoniaceae	Pandoro, iyan, rawuya, uturubein	Sausage tree	Leaves, stem, root, bark, fruits,	Kidney disorders, rheumatism, cough, malaria, spleen infection, dysentery, gonorrhea, astringent, leucorrhoea
32	*Lagenaria breviflorus*	Cucurbitaceae	Tagiri, eso-itagiri, eso-ito	Pseudocolocynth	Root, fruit	Anthelmintic, diabetes, purgative, small pox, abortifacient, chicken pox, lumbago, cathartic

	Botanical (species) name	Family name	Local name(s)	Common names	Parts used	Medicinal use(s)
33	*Lawsonia inermis*	Lythraceae	Laali, lali	Henna plant	Leaves, bark, flowers	Spermatorrhea, malaria, astringent, gonorrhea, ulcers, jaundice, skin diseases, menorrhagia
34	*Mentha piperita*	Lamiaceae	Mintii	Peppermint	Whole plant	Mouth wash, stomach ache, respiratory infections, chest pains
35	*Morinda lucida*	Rubiaceae	Oruwo, eruwo, eze ogu, njisi	Brimstone tree	Leaves, stem bark, root bark	Anticancer, malaria, heart diseases, jaundice, flatulence, diuretic, emetic
36	*Newbouldia laevis*	Bignoniaceae	Akoko, ogirisi, aduruku	Tree of life, fertility tree	Leaves, bark, root	Infertility, hernia, elephantiasis, yellow fever, migraine, roundworms, cough, dysentery, earache, stomachache
37	*Ocimum gratissimum*	Lamiaceae	Efinrin-nla, efinrin-aja, oromoba, saidoya, nchanwu	Tea bush, balsam, basil	Leaves, whole plant	Antimicrobials, bronchitis, diarrhea, insect repellant, piles, cold, cough, diabetes, anthelmintic, hypertension, colic, fever, convulsions
38	*Parkia biglobosa*	Leguminosae	Igba, igi-iru, dadawa, ogirili, dorowa	West African locust bean, Dadawa tree	Leaves, bark, fruits, seeds, pulp	Antitumor, diabetes, high blood pressure, malaria, tonic, wounds, mental disorder, intestinal disorder, obesity, astringent
39	*Talinum triangulare*	Portulacaceae	Gbure, ofe bake, ntu oka	Water lettuce, Ceylon spinach, fame flower, Surinam purslane	Roots, leaves	Anemia, scabies, schistosomiasis, fresh cuts, high blood pressure
40	*Zingiber officinale*	Zingiberaceae	Atale, jinja	Ginger	Rhizome	Asthma, rheumatism, piles, hepatitis, diuretic, headache, cold, stimulant, cough, anthelmintic, typhoid fever, obesity, malaria

[40, 52, 53].

Table 1. Some common medicinal plants from Nigeria used for treating various diseases.

These substances contain properties which are essential as new chemotherapeutic agents useful for treatment in the hospitals. There are some new approaches to drug discovery, such as combinatorial chemistry and computer-based molecular modeling design, and none of them can replace the role of natural products in drug discovery and development. Examples of plant-based drugs are artemisinin, gingerosome, and quinine.

1.6. Synergy in relation to pharmacological action of phytomedicine

Most herbs exhibit their effects on a variety of constituents, and the idea of synergy within and between them is gaining acceptance [15]. Most herbal medicines are not well documented to prove whether they are acting truly in a synergistic way or by additive effects. It is usually difficult to clinically evaluate herbal preparations without the knowledge of their synergistic effects. Biological activity may be absent in the crude drugs but may contain some components that can enhance their active components' potency. One of such examples is St. John's wort (*Hypericum perforatum*, family Hypericaceae), a clinically proven herb which has efficacy as an antidepressant. Hypericins responsible for its activity was found to be very weak, and impurities in the fraction used gave the additional results which suggest multiple (polyvalent) and synergistic effects. St. John's wort thus represents a good example of an herb which may exhibit synergism and polyvalent action [16]. The use of combinations of herbs can also result in synergism or enhancement of activity of herbal drugs. In case of multiple herb extracts, some of the herbs enhance the potency of the real effective herb, and in some cases, their constituents could reduce the toxic effects of the main herb, resulting in a safe herbal combination tolerable for consumption by the human system [17].

1.7. Phytoconstituents in medicinal plants

Phytochemicals are chemicals found in plants that protect plants against bacteria, viruses, and fungi. Eating large amount of brightly colored fruits and vegetables, whole grains/cereals, and beans containing phytochemicals may decrease the risk of developing certain cancers as well as diabetes, hypertension, and heart disease. The actions of phytochemicals vary by the type of the food and the color. They may act as antioxidants or nutrient protectors or prevent carcinogens from forming. The term phytochemical refers to a wide variety of compounds made by plants but is mainly used to describe those compounds that may affect human health. Scientists have identified thousands of phytochemicals, although only a small fraction has been studied closely. Some common examples of phytochemicals include beta-carotene (with other carotenoids), vitamin C, vitamin E, and folic acid [18]. Phytochemicals have shown various physiological actions [19, 20]. Among the numerous phytochemicals in existence are the following with their usefulness:

1.8. Alkaloids

These are the largest group of secondary metabolites made of ammonia compounds comprising basically nitrogen bases synthesized from amino acid building blocks having various radicals substituting one or more of the hydrogen atoms in the peptide ring, containing mostly

oxygen [21]. The compounds have basic properties and are alkaline in reaction, turning red litmus paper blue. In fact, one or more nitrogen atoms that are present in an alkaloid, typically as 1°, 2°, or 3° amines, contribute to the basicity of the alkaloid. The degree of basicity varies considerably, depending on the structure of the molecule, presence, and location of the functional groups [22]. They react with acids to form crystalline salts without the production of water [21]. Alkaloids exist majorly in solid states as atropine, liquids containing carbon, hydrogen, and nitrogen.

Alkaloids are mostly readily soluble in alcohol but are sparingly soluble in water though their salts are usually soluble in water. Their solutions are usually very bitter; alkaloids defend plants against herbivores and pathogens and are used widely as stimulants, narcotics, pharmaceuticals, and poisons because of their biological potencies [23]. Alkaloids, in nature, are found in large quantities in the seeds and roots of plants and mostly in combination with vegetable acids. Alkaloids are useful as central nervous system (CNS) stimulants and anesthetics in pharmacological applications [23].

Alkaloids also find its usefulness as pain relievers [24]. Atropine is an alkaloid used widely in medicine as an antidote to organophosphate poisoning, while caffeine stimulates CNS and respiratory systems. Caffeine also serves as an antidote to barbiturate and morphine poisoning, while emetine (from *Cephaelis ipecacuanha*) root is useful in the treatment of protozoal infections, for example, amoebic dysentery.

1.9. Tannins

The tannin compounds are found mainly in many plant species which help to confer on them protection from predators and probably pesticides; they also help in regulating plant growth [25]. The dry and puckery feeling in the mouth after eating unripe fruits or red wine is attributed to the astringency from the tannins [26]. The destruction or modification of tannins with time in like manner plays an important role in the ripening of fruit and the aging of wine. They are acidic in reaction, and this is attributed to the presence of phenolics or carboxylic group [27]. They form complexes with proteins, carbohydrates, gelatin, and alkaloids.

Tannins are divided into hydrolysable tannins and condensed tannins. Hydrolysable tannins, when hydrolyzed, produce gallic acid and ellagic acid, and depending on the type of acid produced, the hydrolysable tannins are called gallotannins or ellagitannins; when tannins are heated, they form pyrogallic acid [25]. The presence of phenolic group in tannins confers on them their usefulness as an antiseptic [27]. Common examples of hydrolysable tannins include the aflavins (from tea), daidzein, genistein, and glycitein.

Plants that contain tannins have been reported to be astringent in nature and are useful in treating intestinal disorders like diarrhea and dysentery. This means that tannins possess antimicrobial activity [28, 29]. The antimicrobial activities possessed by these plants could support their use in West Africa for treating gastrointestinal disorders [30]. Tannins are also potent antioxidants [31, 32].

1.10. Saponins

Saponins are a class of phytochemicals present in abundance in numerous species of plants. They are specifically amphipathic glycosides and are grouped phenomenologically by their production of soap-like foaming when shaken in aqueous solutions (phenomenology—study of structures of consciousness as experienced from the first-person point of view). They are grouped structurally by possession of one or more hydrophilic glycoside moieties combined with a lipophilic triterpene derivative [33].

Two major groups of saponins exist which are steroid and triterpene saponins. Saponins are insoluble in ether but soluble in water, and on hydrolysis, they give aglycones like glycosides. They cause hemolysis of blood and cattle poisoning as they are known to be extremely poisonous (27). Apart from causing irritation to mucous membranes, they have a bitter and acrid taste. They are soluble in alcohol and water but insoluble in solvents like benzene and n-hexane that are organic and nonpolar; therefore, they are mostly amorphous in nature. Saponins are therapeutically important because they lower bad fats in the body (hypolipidemic) and have anticancer potentials. Saponins work in synergy with the cardiac glycosides [22].

Saponins are known to produce inhibitory effect on inflammation [34]. Saponins help in lowering cholesterol which will subsequently reduce the risk of cardiovascular diseases such as hypertension which usually leads to stroke [35].

1.11. Anthraquinones

Anthraquinones are phenolic and glycosidic compound derivatives and are solely derived from anthracene leading to the production of variable oxidized derivatives like anthrones and anthranols [36, 21]. Industrially, anthraquinones are used for washing of bowels (laxatives) and in dye production [37].

1.12. Glycosides

Glycosides are the condensation products of sugars (polysaccharides inclusive) with different varieties of organic hydroxyl (occasionally thiol) compounds. Glycosides are colorless, crystalline water-soluble plant constituents found in the cell sap. Glycosides chemically contain a carbohydrate (glucose) and a noncarbohydrate part (aglycones or genin) [27, 21]. Glycosides can be readily hydrolyzed into its components with mineral acids as they are neutral in reaction and are purely bitter principles commonly found in plants of the family Genitiaceae. The action of the bitters on the gustatory nerves results in increased flow of saliva and gastric juices [27, 21]. Some of the bitter principles due to the presence of tannic acid are either used in restricting flow of blood (as astringents), function in the reduction of thyroxin, and thereby regulate cell metabolism and growth or as antiprotozoal. Examples of glycosides include cardiac glycosides which act on the heart and anthracene glycosides act as purgative and for treatment of skin diseases, while chalcone glycosides are used as anticancer agents [22]. The extracts of plants containing cyanogenetic glycosides have been reported to be useful as

flavoring agents in many pharmaceutical formulations. Amygdalin has been used in the treatment of cancer [hydrogen cyanide (HCN) liberated in stomach kills malignant cells] and also as a cough suppressant in various preparations. Intake of cyanogenetic glycosides in excess quantities can be dangerous [22].

1.13. Cardiac glycosides

Plants long used as arrow poisons (e.g., *Strophanthus*) or as heart drugs, for example, *digitalis*, contain cardiac cardiotonic glycosides [38]. Cardiac glycosides help in the treatment of congestive heart (cardiac) failure; that is, they help a weakened heart to be strengthened and function more efficiently [39].

1.14. Cyanogenetic glycosides

Cyanogenetic glycosides are a group of materials derived majorly from plants which on hydrolysis liberate hydrocyanic acid (HCN). They therefore call for attention and an object of concern because of their ability in causing damage by poisoning that are natural toxicants. Cassava, an example of a food plant (*Manihot esculenta*), produces cyanogenetic glycosides which require prolonged hydrolysis and boiling in preparation of the starchy tuberous roots to release and evaporate off the HCN before consumption [40].

1.15. Flavonoids

Flavonoids belong to a group of important polyphenols which are widely distributed among plants. They have more than one benzene ring in its structure and are used as antioxidants or free radical scavengers [27]. Flavans are parent compounds from which they are derived. Out of over 4,000 flavonoids that exist, some are found as pigments in higher plants. About 70% of plants contain common flavonoids such as quercetin, kaempferol, and quercitrin. Among other groups of flavonoids in existence are flavones, flavans, anthocyanidins, dihydroflavons, flavonols, chalcones, and catechin [27]. Flavonoids function to reduce the risk of coronary heart diseases [41] and possess anticoagulant, anti-inflammatory, and aphrodisiac properties [42].

1.16. Phenols

Phenols contribute to the prevention of various degenerative diseases that act as an antioxidant [41]. Phenols, phenolics, or polyphenolics are chemical constituents that are commonly present as natural color pigments giving fruits of plants their colors. The action of phenylalanine ammonia lyses (PAL) on phenylalanine leads to the synthesis of phenolics in plants. Among the various functions of phenols is in plant defense against pathogens and predators of herbivores and therefore used in the control of human infections caused by pathogens [43]. The most common of phenolic compounds widespread in plants is caffeic acid which is followed by chlorogenic acid, the causal agent of excessively sensitive inflammation of the skin (dermatitis) among humans [27]. Phenolics are natural antioxidants functioning as nutraceuticals and available in red wine, apples, and green tea. They serve as anticancer and anti-inflammatory agents as well as prevent heart diseases.

1.17. Steroids

Plant steroids also known as cardiac or steroid glycosides are one of the most naturally occurring plant phytoconstituents that are applied therapeutically as cardiac drugs or arrow poisons [21]. The cardiac glycosides are majorly steroids having a natural ability to exert specific and powerful action on the cardiac muscle mainly when injected into animal or man. Steroids (anabolic steroids) have the ability to promote nitrogen retention in osteoporosis (a disease following menopause in women causing bones to be porous and subjected to fracture) and in animals with wasting illness [36, 23]. Steroids have the ability to exhibit activities such as antifungal, antiviral, antileukemic, hypnotic, antipyretic, and muscle-relaxant activities and are found in large quantities in many plants [44].

1.18. Carotenoids

Carotenoids are coloring pigments in plants especially fruits and vegetables; these act as antioxidants to protect the body against the activities of free radicals [45].

1.18.1. Mechanism of action of phytochemicals

Phytochemicals may inhibit microorganisms, may interfere with some metabolic processes, or may modulate gene expression and signal transduction pathways [46–48]. Among the many uses, phytochemicals may either be used as chemotherapeutic or chemopreventive agents. Chemoprevention refers to the use of agents to inhibit, reverse, or retard tumorigenesis. In this sense chemopreventive phytochemicals are applicable to cancer therapy, and molecular mechanisms may be common to both chemoprevention and cancer therapy [49, 50].

The mechanism of action of phytochemicals in general is attributed to proton-motive force disruption, active transport, cytoplasmic membrane disturbance, electron flow, and cell contents' coagulation [51]. There are different modes of action of phytoconstituents which could be anticancer, anti-inflammatory, antioxidant, anti-ulcer, antidiabetic and may be a multifunctional target.

2. Conclusion

God is the creator of all things that are in existence of which plants which are in abundance and of various diversities are among. He put plants in place to serve man especially for food and medicine to heal their diseases. It is therefore imperative to search more into medicinal plants for phytochemicals which can provide a clue in terms of lead (active) compound discovery for the cure of many so-called incurable diseases like cancer, diabetes, hypertension, ulcer, and other degenerative diseases that are just being managed by medical practitioners till the patient passes on. It is realized that many natural remedies carry their cures along with them; therefore, it could be concluded that botanists (plant scientists), pharmacists, pharmacognosists, pharmacologists, chemists, biochemists, and all other fields related to the science of drug discovery should rise up to these challenges of sourcing from plant alternative medicines which God had placed into our hands only left to be discovered.

Author details

Olayinka Temitayo Ogunmefun

Address all correspondence to: yinkatayo_08@yahoo.com

Department of Biological Sciences, Afe Babalola University, Ado-Ekiti, Nigeria

References

[1] Version KJ. Life Application Study Bible (the Holy Bible). Carol Stream: Illinois: Tyndale House Publishers, Inc.; 2004. 2143p

[2] Thomson WAR. Herbs that Heal. London: A and C Black; 1976. 184p

[3] Morton AG. History of Botanical Science: An Account of the Development of Botany from Ancient Times to the Present Day. London: Academic Press; 1981. 474p

[4] Reed HS. A Short History of the Plant Sciences. New York: Ronald Press Company; 1942. 330p

[5] Needham J, Lu G-d, Huang H-T. Science and Civilisation in China Vol. 6; Part 1 Botany. Cambridge: Cambridge University Press; 1986

[6] Singer C. Herbals. The Edinburgh Review. 1923;**237**:95-112

[7] Sachs J. History of Botany (1530-1860). Translated by Garnsey, H.E.F., revised by Balfour, I.B. Oxford University Press: London; 1890. Retrieved 13 December, 2015

[8] Oliver FW. Makers of British Botany. Cambridge: Cambridge University Press; 1913. pp. 146-246 Retrieved 2010-01-12

[9] Gijtenbeek JMM, Vanden Bent MJ, Vent CJ. Cyclosporine neurotoxicity. Journal of Neurology 1999;**246**:339-346

[10] Johnson WC, William OW. Warfarin toxicity. Journal of Vascular Surgery. 2002;**35**:413-421

[11] Dubey NK, Kumar R, Tripathi P. Global promotion of herbal medicine: India's opportunity. *Current Science*. 2004;**86**(1):37-41

[12] Farnsworth NR. In: Wilson EO, editor. Biodiversity. Washington DC: National Academy Press; 1988. 419p

[13] Pezzuto JM. Plant-derived anticancer agents. Biochemical Pharmacology. 1997;**53**(2):121-133

[14] Cragg GM, Newman DJ, Snader KM. Natural products in drug discovery and development. Journal of Natural Products. 1997;**60**:52-60

[15] Duke JA, Bogenschutz-Godwin MJ. Natural Products from Plants. Boca Raton, FI, USA: CRC Press; 1999. 632p

[16] Whitley D. In: Evans WC, editor. CNS Drugs in: Trease and Evans Pharmacognosy. Edinburgh, London: W.B. Saunders; 2002. p. 52

[17] Miaorong P, Jing L. Proceedings of the 40th Annual Conference on Chinese Medicine. Beijing University; 1996. pp. 28-30

[18] Glaser TS, Doss LE, Shih G, et al. The Association of Dietary Lutein plus Zeaxanthin and B vitamins with cataracts in the age-related eye disease study AREDS report no.37. Ophtalmology. 2015;**122**(7):1471-1479

[19] Edeoga HO, Okwu DE, Mbaebie BO. Phytochemical constituents of some Nigerian medicinal plants. African Journal of Biotechnology. 2005;**4**(7):685-688

[20] Peteros NP, Uy MM. Antioxidant and Cytotoxic activities and Phytochemical screening of four Philippine medicinal plants. Journal of Medicinal Plants Research. 2010;**4**:407-414

[21] Firn R. Nature's Chemicals. Oxford: Oxford University Press; 2010. pp. 74-75

[22] Sarker SD, Nahar L. Chemistry for Pharmacy Students General, Organic and Natural Product Chemistry. England: John Wiley and Sons; 2007. 396p

[23] Madziga HA, Sanni S, Sandabe UK. Phytochemical and elemental analysis of Acalypha wilkesiana leaf. Journal of American Science. 2010;**6**(11):510-514

[24] Kokate P, Purohit AP, Gokhale SB. Pharmacognosy. 20th ed. India: Nirali Publication; 2002. pp. 1-14

[25] Kathie E, Ferrelli T, Richard W. Squirrels; The Animal Answer Guide. Baltimore: Johns Hopkins University press; 2006. 91p

[26] McGee H. On Food and Cooking? The Science and Lore of the Kitchen. NewYork: Scribner; 2004. 714p

[27] Kar A. Pharmaocgnosy and Pharmacobiotechnology (Revised-Expanded Second Edition). New Delhi, India: New Age International Limted Publishers; 2007. 898p

[28] Scalbert A. Antimicrobial properties of tannin. Phytochemistry. 1991;**30**(12):3875-3883

[29] Dharmananda S. Gall nuts and the uses of tannins in Chinese medicine. In: Proceedings of Institute for Traditional Medicine. Portland, Oregon; 2003. p. 26

[30] Burkill HM. The Useful Plants of West Tropical Africa. 2nd ed. Royal Botanic Gardens: Kew, UK; 1985. 960p. http://plants.jstor.org/upwta/2_580

[31] Harborne JB. Phytochemical Methods – A Guide to Modern Techniques of Plant Analysis. London: Chapman and Hall; 1998. pp. 182-190

[32] Trease GE, Evans WC. A Text Book of Pharmacognosy. 16th ed. London: Saunders Ltd; 2009. 616p

[33] Hostettmann K, Marson A. Chemistry and Pharmacology of Natural Products: Saponins. Cambridge: Cambridge University press; 2008. 562p

[34] Just MJ, Recsio MG, Gner RM, Cuellar MJ, Marez S, Bilia AR, Rios J. Anti-inflammatory activity of unusual lupine saponins from Bupleurum fruiticescens. Planta Medica. 1998;**64**(5):404-407

[35] Francis G, Kerem Z, Makkar HP, Becker K. The biological action of saponins in animal systems: A review. British Journal of Nutrition. 2002;**88**(6):587-605. DOI: 10.1079/BJN2002725

[36] Maurya R, Singh G, Yadav PP. Antiosteoporotic agents from natural sources. In: Rahman A-u, editor. Studies in Natural Products Chemistry. Vol. 35. Elsevier Publication; 2008. pp. 517-545

[37] Bien HS, Stawitz J, Wunderlich K. Anthraquinone dyes and intermediates in: Ullmann's Encyclopedia of Industrial Chemistry. Weinheim: Wiley-VCH; 2005; 2745. DOI:10.1002/14356007.a02_355

[38] Dewick PM. Medicinal Natural Products: A Biosynthetic Approach. 2nd ed. England: John Willey & Sons Limited; 2002. 241-244, 455-456

[39] Colin B, Shelia J. Cardiac glycosides. The Oxford Companion to the Body. Encyclopedia.com. 2001. http://www.encyclopedia.com

[40] Odugbemi T. A Textbook of Medicinal Plants from Nigeria. Akoka, Yaba – Lagos, Nigeria: © Tolu Odugbemi University of Lagos Press; 2008. 628p

[41] Rice-Evans CA, Miller NJ, Paganga G. Structure–antioxidant activity relationships of flavonoids and phenolic acids. Free Radical Biology and Medicine. 1996;**20**(7):933-938

[42] Houghton PJ, Hylands PJ, Mensah AY, Hensel A, Deters AM. *In vitro* tests and ethnopharmacological investigations: Wound healing as an example. Journal of Ethnopharmacology. 2005;**100**:100-107

[43] Puupponen-Pimiä R, Nohynek L, Alakomi H, Oksman-Caldentey K. The action of berry Phenolics against human intestinal pathogens. BioFactors. 2008;**23**(4):243-251

[44] Kokpol U, Chittawong V, Mills HD. Chemical constituents of the roots of *Acanthus illicifolius*. Journal of Natural Product. 1984;**49**:355-356

[45] Sims J, Odle T. Carotenoids. Gale Encyclopedia of Alternative Medicine. Encyclopedia.com. 2005. http://www.encyclopedia.com

[46] Kris-Etherton PM, Hecker KD, Bonanome A, Coval SM, Binkoski AE, Hilpert KF, Griel AE, Etherton TD. Bioactive compounds in foods: Their role in the prevention of cardiovascular disease and Cancer. American Journal of Medicine. 2002;**113**:71S-88S

[47] Manson MM. Cancer prevention – The potential for diet to modulate molecular Signalling. Trends in Molecular Medicine. 2003;**9**:11-18

[48] Surh YJ. Cancer chemoprevention with dietary Phytochemicals. Natural Reviews in Cancer. 2003;**3**:768-780

[49] D'Incalci M, Steward WP, Gescher AJ. Use of Cancer Chemopreventive Phytochemicals as Antineoplastic agents. Lancet Oncology. 2005;**6**:899-904

[50] Sarkar FH, Liu Y. Using Chemopreventive agents to enhance the efficacy of Cancer therapy. Cancer Research. 2006;**66**:3347-3350

[51] Kotzekidou P, Giannakidis P, Boulamatsis A. Antimicrobial activity of some plant extracts and essential oils against food borne pathogens in vitro and on the fate of inoculated pathogens in chocolate. LWT Food Science and Technology Journal. 2008;**41**:119-127

[52] Ngondi JL, Oben JE, Minka SR. The effect of *Irvingia gabonensis* seeds on body weight and blood lipids of obese subjects in Cameroon. Lipids in Health and Disease. 2005;**4**:12

[53] Ngondi JL, Etoundi BC, Nyangono CB, Mbofung CM, Oben JE. IGOB 131, a novel seed extract of the west African plant *Irvingia gabonensis* significantly reduces body weight and improves metabolic parameters in overweight humans in a randomized double – Blind placebo controlled investigation. Lipids in Health and Disease. 2009;**8**:7

IntechOpen

IntechOpen