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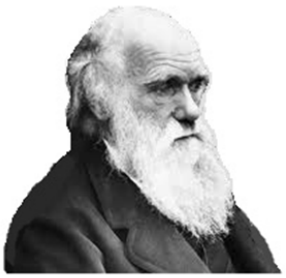

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Medicinal Based Plants: A Call to Nature

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ABSTRACT

Herbal plants play an unprecedented role in preventing and treating of human diseases. For many years, people have been using medicinal plants in traditional medicine. Human civilization around the world have been associated with plants, however, plants are known as a rich source of phytochemical compounds that enable it to have a medicinal value. In the development of herbal and conventional drugs, medicinal plants are potential sources. In the 21st century, medicinal plants have been considered due to its pharmacological effects as a promising drug for the management of diverse health implication. The resurgence of interest to discover medicinal plants as a potential source of new drug has become imperative. Even though synthetic drugs are gaining ground in the healthcare system all over the world, however, available evidences suggest that nature will be a pointer for drug discovery. Hence, there is a need to understand and discover the knowledge of medicinal plants as a rich source of herbal drugs knowing fully well its active compositions.

***Keywords*:** Medicinal Plants, Nature, Herbal medicine, Drug, Phytotherapy, Traditional medicine

1. INTRODUCTION

Nature has endowed us with different medicinal plants. Man, from the beginning of existence has familiarized himself with medicinal plants and make use of them in different ways throughout the ethnic groups. In the search for foods, man has successfully distinguished plants suitable for different medicinal purpose from other due to the observation of those with biological and pharmacological effects. The growth of knowledge incurred by man has grown

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and many plants can now be used as medicine to cure diseases and to develop new plant drugs. Medicinal plants usually come with some specific potentials such as maintaining health whether in modern medicine or in traditional medicine. Plants being a very vital source of medicine play a major role in world health [1]. The Food and Agriculture Organizations estimated in 2002 that over 50,000 herbal plants are used across the world. Medicinal plants are considered a store house of many types of active compounds having different therapeutic potentials. The therapeutic properties of medicinal plants over a long period of time has been well explored [2].

2. HERBAL MEDICINE

Herbal Medicine is called "Botanical or Phytotherapy," and it refers to making use of the plants leaves, root, bark, seeds, flowers and berries for therapeutic and medicinal purposes for treating diseases and managing human health. A botanical is a plant or plant part valued for its medicinal or therapeutic properties. Herbal products, botanic product and phyto-medicine are all products that are made from botanicals that are mainly used in the treatment and improvement of health. 80% of the world's population which corresponds to about 4 billion people usually make use of medicinal plant for some aspect of primary healthcare as reported by the World Health Organization (WHO) [3]. Thus, WHO has recognized herbal medicine as an essential components of primary health care which is about 11% of the 252 drugs are derived from medicinal plants [4]. Herbal medicine is effective, lesser side effect, and affordable than the medicines bought from an allopathic medicine. Herbal medicines include herbs, herbal materials, herbal preparations, and herbal products that contain different parts of plants or other plant materials as active ingredients. India, China, Pakistan, Japan, Thailand and Sri Lanka all practices traditional medicine; 40% of the people in China consume traditional medicine. In the United States of America for instance, in early 90s, $2.5 Billion was estimated as the revenue from the sale of herbal medicine. Also in Japan, there is high demand for herbal products over pharmaceutical products.

In Germany, 1500 plant species of 200 families have been processed into medicinal products. In South Africa, over 500 species of natural product are commercialized while countries like Germany, Poland and Bulgaria are known as major exporters of medicinal plant product [5]. Phytochemicals (Phyto from Greek word - meaning 'plant') also known as plant secondary metabolites are active compounds that protect plants against a wide range of diseases and infections. The active compounds possess therapeutic potentials that are considered as a drug or medicine usually sold in form of tablets, capsules, teas, powders, extract and dried or fresh plants. Human beings use herbal medicine because of the pharmacological effects it contains to improve and maintain their health. The active compounds can be classified into primary and secondary metabolites. Primary metabolites are organic compounds like protein, fats, nucleic acid, glucose, polysaccharide and starch which are usually beneficial for the nutritional development of human body. Plant secondary metabolites includes alkaloids, saponin, tannins, flavonoids, cardiac glycosides, steroids, terpenoids, volatile oils.

The medicinal and therapeutic efficacy of plants can be ascribed to these secondary metabolites for curing diverse nature of diseases. The role of these phytochemicals are well documented. Alkaloids are known to possess an antimalarial, antispasmodic, analgesic and diuretic properties. Terpenoids possess antibacterial, antiviral, anticancer, antimalarial, anti-inflammatory and anthelminthic properties. Flavonoids and Phenol are reported to possess

antioxidant, antibacterial and anti-allergic properties. Saponin possess anti-inflammatory and antiviral and plant defence activities while Glycosides also have antibacterial and antifungal properties [6,7].

2. 1. Benefits of Herbal medicine

- Natural healing
- More affordable than conventional medicine
- They are safe
- Help in building the immune system
- Fewer/little side effects
- Easily accessible
- Stabilizes hormones and metabolism
- Often times, we can use poly-herbal (Combinations of herbs) preparations, which is always more effective

3. TRADITIONAL MEDICINE (TM)

Traditional medicine is the combination of the total knowledge, skills, and practices based on the beliefs, theories and experiences indigenous to different cultures which are used to maintain and improve health, as well as to treat, prevent, diagnose, or examine physical and mental illnesses [8]. Different ethnic groups historically developed diverse healing methods to fight against varieties of health and life threatening diseases. TM commonly known as complementary and alternative medicine (CAM) or complementary and ethnic medicine plays major role in so many countries till date [9,10].

TM usually adopted by other persons outside the indigenous culture is termed complementary or alternative medicine [8,11]. The developed and developing countries of the world have really shown rapid increase in the utilization of herbal remedies and CAM [12].

Some 20 year ago, the pharmacopoeias of developed and developing countries of the world through a thorough investigation and the reason behind the research was to evaluate whether TM had really inspired modern drug discoveries and to correlate between the use of the isolated active compounds and their application in TM. The research focused on the different compounds isolated from different plants that is used to produced drugs in different countries of the world and the findings established the fact that TM had played a major role in developing new herbal drugs that is very effective.

The findings focused on about 122 compounds of which 80% was found to be pharmaceutically effective in folk medicine, and the 122 compounds originated from 94 plant species [3].

3. 1. Development of natural drug from herbal plant

For ages, there has been a total turn around by people from orthodox to natural remedies to cure common diseases such as stomach upset, toothaches, colds, allergies etc. A shift has in the universal trend from synthetic to herbal medicine which we can call “Return to Nature” for the prevention and treatment of diseases. From time immemorial, nature has always been the

only source of medicinal plants. Human civilization has converted the plants to food, economic advantage, medicine, clothing and shelter.

Herbal plants have a lot of pharmacological and medicinal advantage such as been used as an antioxidant, antiviral, anticancer, antimicrobial, antifungal and antiparasitic. Plants have free radical scavenging molecules, including flavonoids, phenolics, anthocyanins and vitamins, which show antioxidant like activity [7]. It has been reported that the antioxidant property of phytochemicals may be mitigated by the oxidative stress in the biological system.

Presence of phytochemicals in plants have lowered the risk of various human diseases such as cancer, malaria, cardio-vascular diseases, diabetes, neurodegenerative disorders. It has been well documented that herbal plants and their derivatives play critical roles in modern drug development. Medicinal plants are the natural resources in developing of new drugs [8,13,14]. However, many herbal medicine are usually directly or indirectly derived from plants that are normally considered as a very potent medicine used for the treatment of various human diseases [15,16]. Once the medicinal plant is chosen for a single drug molecule based on a research survey and known phytochemical relationships, the next step is its collection and botanical identification. The plant material is subjected to drying at a cool temperature ambient temperature in a shady place or in an oven with a controlled airflow and temperature.

The dried or stabilized plant material should then be powdered to give a suitable mesh size and subjected to a suitable extraction process as per standard operating procedures. For bioactive studies, some extracts are prepared and subjected to a preliminary screening programme. The extracts are subjected to standard chromatographic techniques of fractionation and isolation of bioactive molecules [17]. A number of medicinal plants have been subjected to detailed chemical investigations for isolation of pure bioactive molecules which have been pharmacologically evaluated.

This has led to the discovery of new drugs. At the beginning of the nineteenth century, the era of “modern” drugs began. In 1805, the first pharmacologically-active compound morphine was isolated by a young German pharmacist, Friedrich Sertürner, from the opium plant [18,19]. Subsequently, countless active compounds have been separated from natural products. Some type of medicines, such as anticancer, antihypertensive, and antimigraine medication, have benefited greatly from natural products [18,20]. Over the past dozen years, increasing attention has accordingly been paid to natural products in the search for novel drugs in combination with new technology, such as high-throughput selection [21,22].

Natural products, which have evolved over millions of years, have a unique chemical diversity, which results in diversity in their biological activities and drug-like properties. Those products have become one of the most important resources for developing new lead compounds. Natural products will undergo continual use toward meeting the urgent need to develop effective drugs, and they will play a leading role in the discovery of drugs for treating human diseases, especially critical diseases [23]. The drug discovery process from plants is a laborious and time consuming process.

The classical examples of drug discovery like morphine, quinine, digoxin, etc which replaced the extracts of their respective plants were mostly responsible for harbouring the idea that a single active ingredient must have been responsible for the bioactivity [24]. The discovery of artemisinin can be traced back to the 1960s, when tropical malaria was a serious problem during the Vietnam War. North Vietnam requested China to help tackle the malaria problem. The Chinese government approved a project for malaria control and drug research in 1967.

The research group made its investigations and carried out a large-scale search of the literature on the subject. As part of the phytochemical and pharmacological research effort, a lot of Chinese herbal medicines were screened and investigated with respect to their toxicity or efficacy. Eventually artemisinin was derived from *Artemisia annua* L. in 1972 [25-27]. Artemisinin is quite different from previously-used antimalarial drugs, such as chloroquine, in that it has a novel structure, with a sesquiterpene lactone bearing a peroxy group, and it does not contain nitrogen heterocycles. Compared with previous antimalarial drugs, artemisinin has the merit of high efficiency, quick effect, and low toxicity.

Artemisinin is effective in treating various forms of malaria, such as falciparum and cerebral malaria, which are resistant to chloroquine, and its mechanism of action is different from traditional antimalarial drugs. The discovery of artemisinin was a great success for TCM at a special period in China's history, and it was achieved through a well-organized team of hundreds of researchers [27]. 'Arteether', introduced in 2000, as Artemotil is derived also from 'Artemisinin' [28].

'Grandisine A' and 'Grandisine B' are two indole alkaloids which were isolated from the leaves of the Australian rainforest tree, *Elaeocarpus grandis*. 'Grandisine A' contains a unique tetracyclic skeleton, while 'Grandisine B' possesses an unusual combination of isoquinuclidinone and indolizidine ring systems. Both 'Grandisine A'and 'Grandisine B' exhibit binding affinity for the human δ-opioid receptor and are potential leads for analgesic agents [29].

'Galantamine hydrobromide' is an Amaryllidaceae alkaloid obtained from the plant *Galanthus nivalis* and has been used traditionally used in Turkey and Bulgaria for neurological conditions and is used for the treatment of Alzheimer's disease [30,31].

'Apomorphine' is a derivative of 'Morphine' isolated from the poppy (*P. somniferum*) and is a short-acting dopamine D1 and D2 receptor agonist, as well as a potent dopamine agonist, used to treat Parkinson's disease [32]. 'Tubocaurarine' isolated from the climbing plant, *Chondrodendron tomentosum* (Menispermaceae) is one of the active constituents used as a muscle relaxant in surgical operations, reducing the need for deep anesthesia [33]. It is estimated that 60 % of anti-tumour and antiinfectious drugs already on the market or undergoing clinical trials are of natural origin [34].

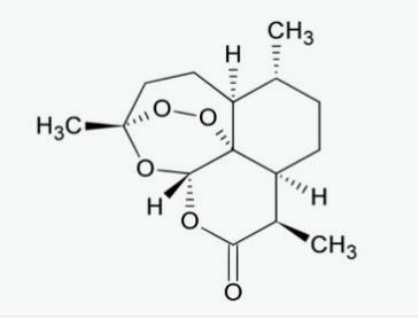
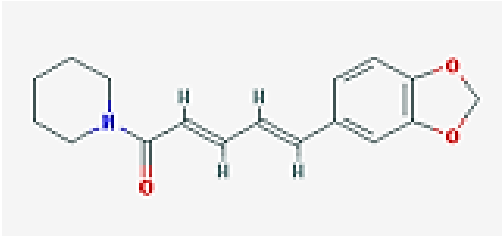
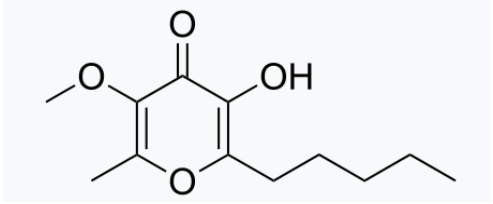
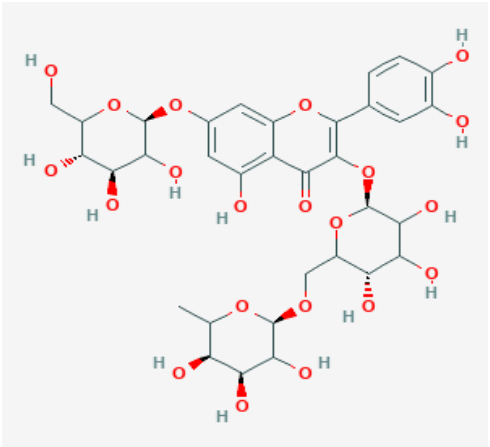
The most widely used breast cancer drug 'Paclitaxel' (Taxol®) is isolated from the bark of *Taxus brevifolia* (Pacific Yew). The bark from about three mature 100-year-old trees is required to provide 1 gram of Taxol® given that a course of treatment may need 2 grams of the drug. Taxol® is present in limited quantities from natural sources, its synthesis (though challenging and expensive) has been achieved [35].

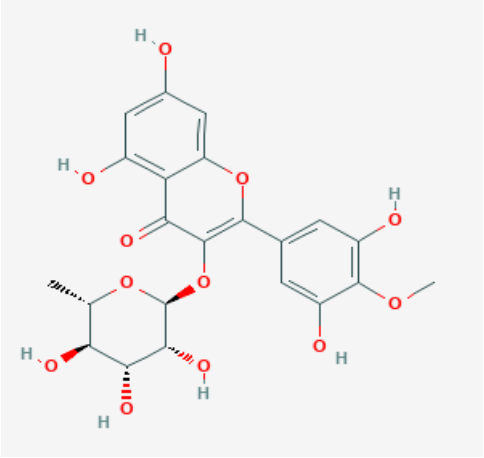
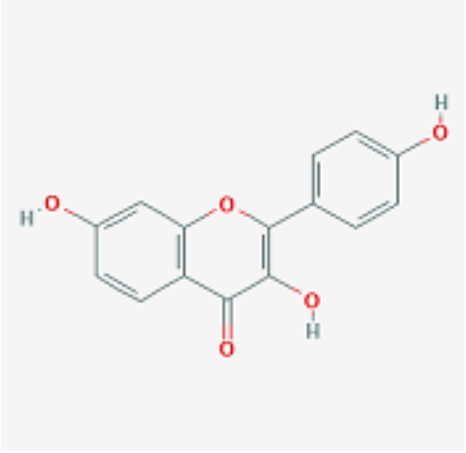
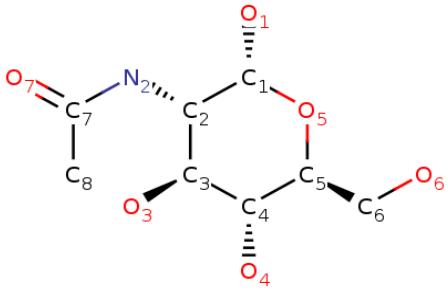
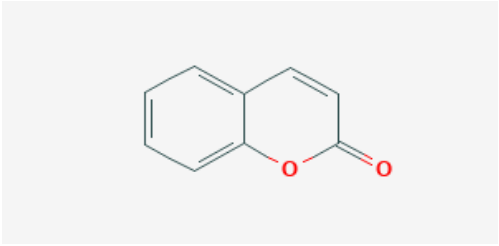
Baccatin III present in much higher quantities and readily available from the needles of *T. brevifolia* and associated derivatives is an example of a structural analogue that can be efficiently transformed into Taxol® [33]. Other examples of antitumor compounds currently in clinical trials include 'Ingenol 3-*O*-angelate' a derivative of the Polyhydroxy diterpenoid ingenol isolated from the sap of *Euphorbia peplus* (known as "*petty spurge*" or "*radium weed*") which is a potential chemotherapeutic agent for skin cancer [36,37].

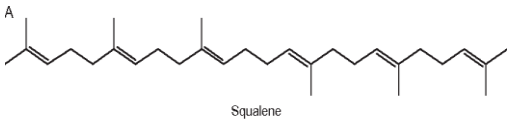
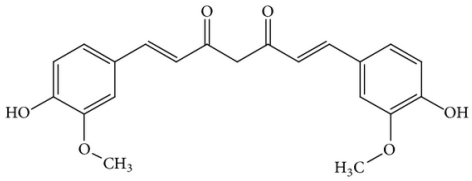
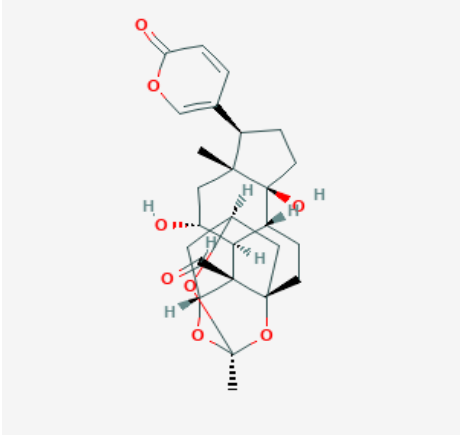
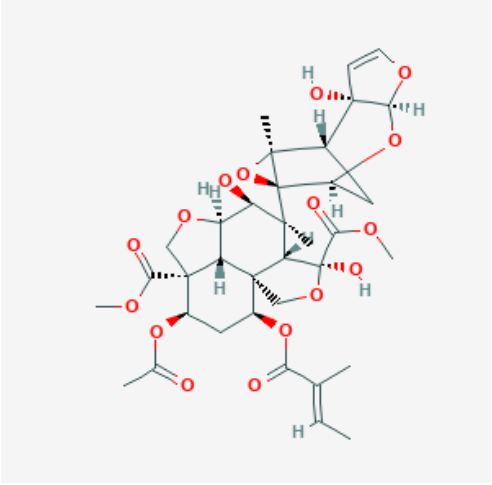
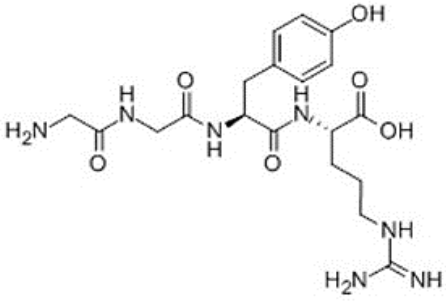
'PG490-88' (14- succinyl triptolide sodium salt), a semisynthetic analogue of triptolide is a diterpene-diepoxide isolated from *Tripterygium wilfordii* which is used for autoimmune and inflammatory diseases in the People's Republic of China [38,39]. 'Combretastatin A-4 phosphate' a stilbene derivative from the South African Bush Willow, *Combretum caffrum* acts as an anti-angiogenic agent causing vascular shutdowns in tumors [40,41].

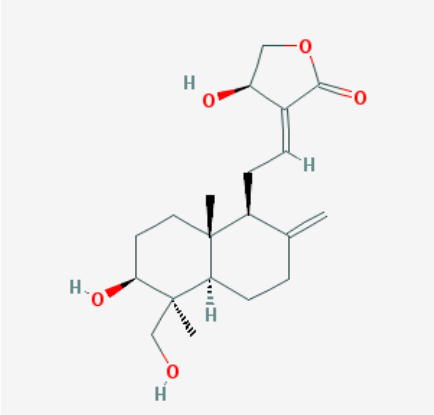
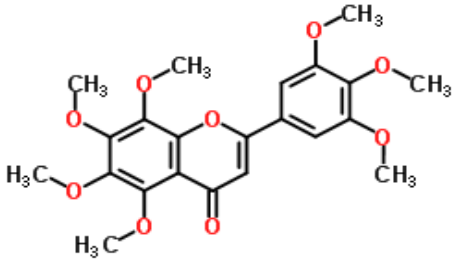
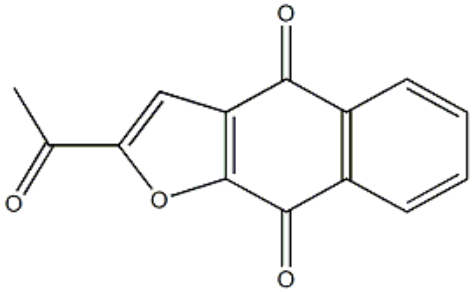
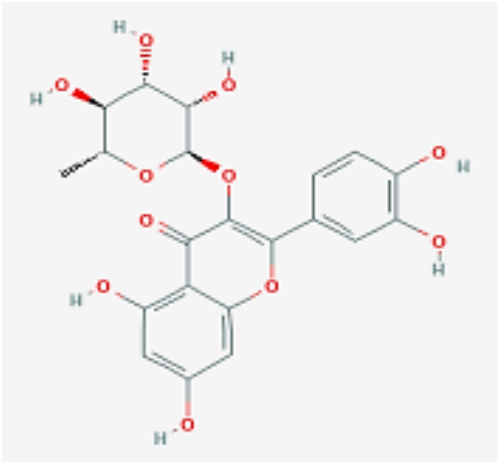
Natural products can be predicted to remain an essential component in the development of new, safe and economical medications [42].

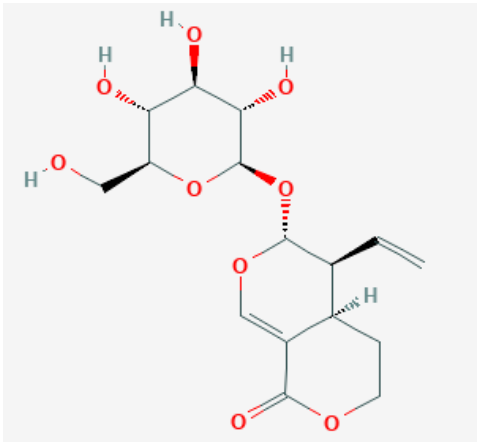
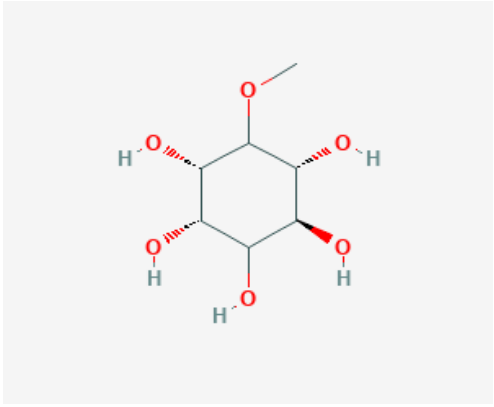
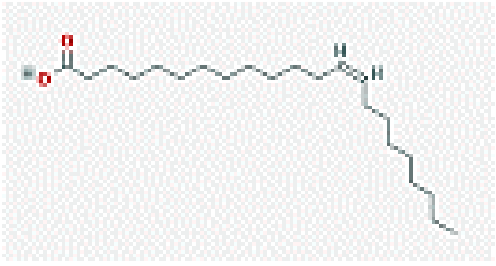
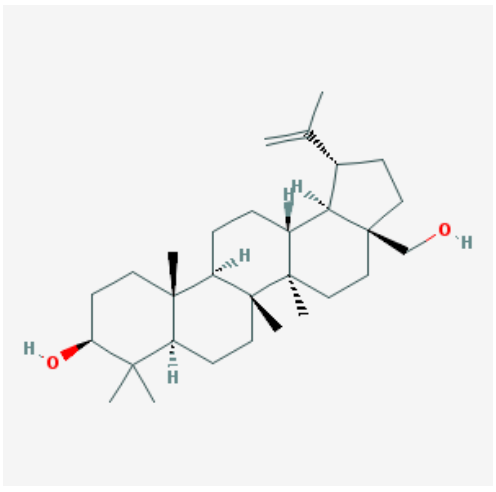
Table 1. Some active chemical compounds isolated from natural products (medicinal plants)

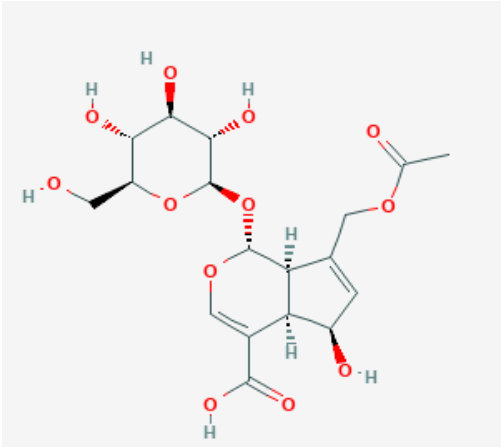
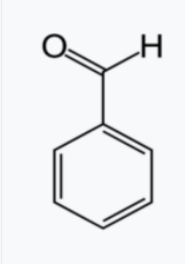
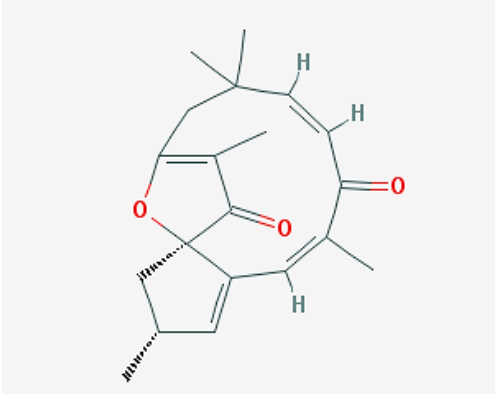
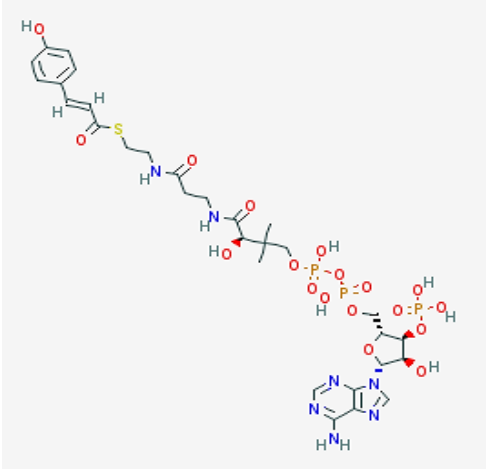
Plants Species/Family	Active compounds	Chemical structures	Common Name	Local Name	Authority
Artemisia annua (Asteraceae)	Artemisinin		Sweet wormwood	Nil	[26]
Piper guineense (PIPERACEAE)	Piperine, Piperidine, dehydropipernonaline		Ashanti Pepper, Black pepper	Iyere	[43]
Allium sativum (ALLIACEAE)	Allixin		Garlic	Ayuu	[44]
Cissus polpulea (VITACEAE)	Quercetin 3-rutinoside-7-glucoside		Tree bine	Afato	[45]

Leea guineensis (Leeaceae)	Mearnsitrin		Leea	Sasamura, Maboyunku	[46]
Albizia zygia (Leguminosae)	3', 4',7 – Trihydroflavone		Senegal rose wood	Ayinre were	[47]
Abrus precatorius (LEGUMINOSAE-PAPILIONNOIDEAE)	Abrin		Rosary Pea	Omisinmisin, Oju Ologbo	[48]
Parkia biglobosa (FABACEAE)	Coumarin		African locust bean	Iru	[49]

Cnestis ferruginea (CONNARACEAE)	Squalene		Short pod, Alum plant	Omu aja	[50]
Curcuma longa (ZINGIBERACEAE)	Curcumin		Turmeric	Ata Ile	[51]
Bryophyllum pinnatum (CRASSULACEAE)	Bryophyllin A		Resurrection plant	Ewe Abamoda	[52]
Azadirachta indica (MELIACEAE)	Azadirachtin		Neem	Dongoyaro	[53]
Carica papaya (CARICACEAE)	Papain		Pawpaw	Ibepe	[54]

Andrographis paniculata (ACANTHACEAE)	Andrographolide (Plant) Andrographine (Root)		King of Bitters	Meje Meje	[55]
Agerantum conyzoide (ASTERACEAE)	5,6,7,8,3',4',5'-heptamethoxyflavone		Billy Goat Weed	Imi Esu	[56]
Newbouldia laevis (BIGNONIACEAE)	2-acetylfuro-1,4-naphthoquinone		Boundary Tree	Akoko	[57]
Secamone afzelli (ASCLEPIADACEAE)	Quercitrin		Secamone	Ailu	[58]

Anthocleista djalonensis (LOGANIACEAE)	Sweroside		Cabbage tree	Sapo	[59]
Paulina pinnata (SAPINDACEAE)	Methylinosito		Sweet gum	Obi Omode, Isu – omode	[60]
Icacina trichanta (ICACINACEAE)	**Erucic acid**		Icacina	Gbegbe	[61]
Aerva lanata (AMARANTHACEAE)	Betulin		Mountain Knot grass	Ewe Aje, Sese efun	[62]

Morinda lucida (RUBIACEAE)	Asperulosidic Acid		Brimstone tree (Nigeria Olier)	Oruwo	[63]
Petiveria alliaceae (PETIVERIACEAE)	Benzaldehyde, Benzoic acid, Coumarin, isoarborinol.		Guinea Henweed	Awogba	[64]
Jatropha gossypifolia (EUPHORBIACEAE)	Jatrophone		Black physic nut,	Lapalapa pupa, Botuje pupa	[65]
Spondias mombin (ANACARDIACEAE)	Coumaroyl		Yellow mombin	Iyeye	[66]

4. PROBLEMS FACING THE USAGE OF MEDICINAL PLANTS

In spite of the wide acceptance and usage given to medicinal plants especially in the developing countries, there are still a number of challenges facing the utilization of this nature's gift. One of the problems facing the usage of herbs comes from the prescription challenges; often, herbs may be used together because the combination is more effective and may have fewer side effects. However, various studies have highlighted their possible side effects, if taken irregularly, in excessive amounts or in combination with some medicines [67]. Interaction between drugs and herbs can also cause undesired effects. Despite the success of drug development research from medicinal plants in the past decades, some of the shortcomings in the applications include but not limited to the quality of an herbal product is questioned and the standardization of raw material emerges as a major issue for herbal industry [68,69]. Herbal plants can be easily contaminated during growth, processing and collection. Adulteration and heavy metal contamination are the two major problems reported in Herbal medicines. Therefore, it is necessary to improve the quality and quantity of bioactive compounds for developing new herbal drug and keep pace with other drug discovery efforts [70,71]. Also, it has been observed that some plants are not safe for health because they contain some toxic compounds which show adverse effects in the body [72]. Many people believe that products labeled "natural" are always safe and good for them. This is not necessarily true. Herbal medicines do not have to go through the testing that drugs do. Some herbs, such as comfrey and ephedra, can cause serious harm. Some herbs can interact with prescription or over-the-counter medicines.

4. 1. Future of Herbal Medicine

While still not widely accepted, herbal medicine is being taught more in medical schools and pharmacy schools. In 2019, University of Medical Science (UNIMED) Ondo state, Nigeria was planning to commence the study of herbal medicine which was to be accredited by the National University Commission (NUC). If approved, it will afford the university opportunity to research more into herbs and run undergraduate study in herbal medicine. More healthcare providers are learning about the positive and potentially negative effects of using herbal medicines to help treat health conditions. Some healthcare providers, including doctors and pharmacists, are trained in herbal medicine. They can help people create treatment plans that use herbs, conventional medications, and lifestyle changes to promote health [73]. To gain public trust and to bring herbal product into mainstream of today's healthcare system, clinical trials should be applied by the researchers, manufacturers, and the regulatory agencies to ensure the quality and consistency of the traditional herbal products. Using modern technologies, the quality and consistency of the heterogeneous herbal products can be monitored. A well-designed clinical trial is the method of choice to prove the safety and effectiveness of a therapeutic product. Basic uses of plants in medicine will continue in the future, as a source of therapeutic agents and as raw material base for the extraction of semi-synthetic chemical compounds such as cosmetics, perfumes, and food industries. In the dual role as a source of health care and income, medicinal plants make an important contribution to the larger development process [74]. It is a major responsibility of the regulatory authorities to ensure that the consumers get the medication, which guarantee with purity, safety, potency, and efficacy. The quality control of crude drugs and herbal formulations is of paramount importance in justifying their acceptability in modern system of medicine.

5. CONCLUSION

In the next few decades, herbal medicine may become a new era of medical system for the management of human diseases. Even though synthetic drugs are gaining ground in the healthcare system all over the world, however, available evidences suggest that nature will continue to be a pointer for drug discovery. There is a need to advance search for the development and characterization of new natural drugs with the aid of better screening methods from plants and other natural sources. As science advanced, it becomes imperative to solve the new challenges of modern healthcare system using medicinal plants.

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