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

6,600
Open access books available

177,000
International authors and editors

195M
Downloads

154
Countries delivered to

TOP 1%
Our authors are among the 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

Cultivation and Conservation of African Medicinal Plants for Pharmaceutical Research and Socio-Economic Development

Emmanuel Mshelia Halilu

Abstract

Medicinal plants are a huge reservoir of therapeutic agents for the treatment of human and other animals’ diseases. This paper highlights the potential of African medicinal plants for pharmaceutical research and socio-economic development. The paper also provides an insight on the role of medicinal plants in boosting the economy of African countries. Furthermore, the need for the government and private individuals to invest in the cultivation and conservation of medicinal plants has been discussed. Most importantly, the need to encourage collaboration among African countries towards pharmaceutical research into medicinal plants with the view of developing new drugs for the present and future pandemics have been stated. Therefore, the deliberate research into African medicinal plants may be the saving grace of the African continent against dreaded diseases, for cures yet to be discovered lie mainly in the medicinal plants.

Keywords: conservation, cultivation, COVID-19, drugs, economy and traditional medicine

1. Introduction

A medicinal plant contains either in all or some of its parts or organs substances that can be used for therapeutic purposes or as starting material for the synthesis of pharmaceutically active drugs [1]. In Africa, medicinal plants are the main ingredients used for the preparation of medicaments by the traditional healer. Therefore, due to the frequent utilization of medicinal plants, African Traditional Medicine has played a key role in socio-economic and socio-cultural heritage that services more than 80% of the African populations [2]. Several Africans especially the rural dweller earn their living from the medicinal plant trade [3]. Medicinal plants have formed the basis for the treatment of various diseases in ancient medical practice especially from the recorded history of the Sumerians and Akkadians; and also in Egypt, China, India and Greece [4, 5].
The first recorded history that depicted the importance of the cultivation and conservation of plants is found in the Bible. God created the garden of Eden and carefully put selected plants for specific purposes (Genesis 2:8-9). This story demonstrates the importance of the cultivation of plants; God himself placed our ancestor (Adam) to take care of the garden and there his needs for medicine, food and shelter can be met (Genesis 1:29; 2:8-9).

The cultivation of medicinal plants for pharmaceutical research and development is an area that has received little or no attention from African countries. Medicinal plants are endowed with chemicals substances that have been used and are still in use today for the development of new drugs. Nature has provided mankind with the reservoir of millions of complex/simple bioactive compounds from plants; mainly the secondary metabolites that can be used for therapeutic purposes [6–8]. Therefore, it is evident that cures yet to be discovered (e.g., COVID-19) lie largely in the medicinal plants [9].

Medicinal plants are mainly sourced from the wild. This is no longer sustainable and reliable due to over-harvesting and over-exploitation by the plant collectors and herb sellers [10]. Today, many medicinal plants have gone extinct or are very scarce to find. Therefore, speedy investment in the cultivation of medicinal plants for pharmaceutical research and development beyond the COVID-19 is needed. Cultivation of medicinal plants also provides numerous advantages over wild sources in many ways. The export of cultivated medicinal plants may add to the economy of many African countries [11].

The African continent is enriched with biodiverse varieties of plants which are reservoirs of chemical diversities for the development of new drugs. The African medicinal plants are mainly found in the wild and it has been estimated that there exist about 40,000 to 45,000 plant species on the African continent and out of this; 5000 plant species are thought to have some therapeutic benefits [12]. In Nigeria, there are over 4600 plant species identified, ranking it 11th in Africa for diversity [13]. Therefore, medicinal plants may serve as a huge raw material reservoir, which if harnessed will serve as the driving force towards the revolution of pharmaceutical research and development of the African pharmaceutical industries.

2. The need for cultivation and conservation of African medicinal plants for pharmaceutical research

The emergence of the COVID-19 pandemic has demonstrated that the African continent has made no adequate preparation for the prevention of present and future diseases through systematic advanced biomedical research. Therefore, to prevent future emergencies, there is a need for rapid investment into agro-medicinal plant cultivation. The medicinal plants may provide the following categories of medicinal agents:

a. They provide raw materials for the pharmaceutical industries.

b. They provide compounds that are extremely difficult to be synthesized in the laboratory.

c. They provide some basic compounds whose structures can be modified to become potent drugs.
d. They provide prototype compounds that can be synthesized in the laboratory.

e. The cultivation of medicinal plants provides a constant and genuine source of medicinal plants for the pharmaceutical industries.

In the recent past, there is a growing difficulty in obtaining some medicinal plant species from the wild source due to extinction, scarcity and over-exploitation. Therefore, where there is difficulty in obtaining a medicinal plant; then cultivation of medicinal plants seems to be the best and the most reliable alternative for their conservation. Botanical gardens are important agencies for ensuring their conservation [9].

According to Osemeobo [14] who observed, since the medicinal plants on regular trade are on the decline, stakeholder’s participation is required in plant species rehabilitation in the forests. This can be achieved through the establishment of ex situ gardens which may sustain the medicinal plant trade.

The continued commercial exploitation of these plants has resulted in receding the population of many plant species in their natural habitat. It is therefore, necessary to initiate systematic cultivation of medicinal plants to conserve biodiversity and to protect endangered species [15].

Medicinal plants harvested from the wild are of immense importance for the well-being of millions of people around the world. They continue to provide both reliefs from illness and a source of income. The loss of habitat, combined with over-harvesting, threatens the survival of many of these plant species.

Furthermore, the rapid extinction of medicinal plants from the wild threatens drug discovery [8]. The more the medicinal plants become extinct, the more difficult it becomes to get these plant species for pharmaceutical research and drug development [8]. The medicinal plants used by the pharmaceutical industries are mostly harvested from the wild [15].

Plants play a pivotal role for the survival of man and other animals [9]. They are the primary producers that sustain all other life forms, regulate air and water qualities, shape ecosystems and control the climate [15]. They provide food, medicine, clothes, shelter and the raw materials from which other products are made. These benefits are widely recognized but poorly understood [9]. Thus, plants are both a vital part of the world’s biological diversity and plants are an essential economic resource for human existence [9].

Medicinal plants have been used by mankind for millennia; their use is as old as humanity itself. The range of plant species used for healing purposes is vast. Belinda [9] asserted that “cures as yet undiscovered may exist in plants as yet undescribed”. It has been reported by the WHO that over 80% of the World’s population depends mainly on plants and plant extracts for health care [16]. It has been estimated that in developed countries like the United States (US), plant drugs constitute about 25% of total drugs. In China and India, they constitute about 80%. It has been estimated that over 250,000 higher plant species occur on earth, with more than 80,000 species reported to have some medicinal values while around 5000 species have specific therapeutic values [15].

Medicinal plants can be classified according to the part used (as a whole plant, root, bark, stem, leaf, fruit, flower and seed), habit (as grasses, sedges, herbs, shrubs, climbers and trees), habitat (as tropical, sub-tropical and temperate) and therapeutic value (as antimalarial, anticancer and anti-inflammatory, antibacterial) [15].
3. Evidence of the need for investment in the cultivation of medicinal plants from the African perspective

The COVID-19 pandemic commenced and most nations of the world swung into action for the search for the cure of the viral infection through several means which include: synthesizing of new drugs, testing already existing drugs and search of new drugs from natural sources. Although, the African countries could not go on to search for cures from other sources; it looked at what is readily available on her continent and made a giant stride towards the utilization of medicinal plants to combat the ravaging COVID-19 pandemic. This effort is evidenced by Madagascar’s research institute who developed the Covid-Organics (medicinal plant preparation) derived mainly from *Artemisia annua* and other plants indigenous to Madagascar. Many other African countries including Nigeria have made effort in that regard. As demonstrated from the above, this calls for aggressive pharmaceutical research as it has demonstrated the therapeutic potentials of the medicinal plants of African origin towards the fight against the deadly viral disease (COVID-19). Africa needs to invest in the cultivation of medicinal plants for pharmaceutical research towards the development of drugs. Medicinal plants may be the latent savior for the Africans against present and future pandemics. Africa needs to prepare a head and not wait for other pandemics before it starts searching for a cure. This shows Africa’s late response to COVID-19 because it was not prepared. Africa has a great advantage as it houses huge varieties of medicinal plants resources and it is in best position to search for the cure of the future diseases from medicinal plants. Professor Albert Rakoto Ratsimamanga the pioneer of Science in Madagascar stated and declared that “we (Africa) must move forward at our own pace, we must above all have confidence in ourselves and in the therapeutic virtues of nature. For nature and man are one” [17].

4. Boosting African economies through medicinal plant cultivation and biodiversity conservation

The cultivation and commercialisation of medicinal plants provide an economic resource for Africa’s pharmaceutical industries, which opens business and investment opportunities. There is a need for strong collaboration between the pharmaceutical industry and the academia/research institute to promote sustainable economic growth through the utilization of medicinal plant resources in Africa for drug development and commerce [18].

Several Africans are living in abject poverty who needs to be fed, clothed, housed and employed. The commercialisation of African medicinal plants can be seen as an opportunity to benefit the people on the continent. The industry will create work for the rural and peri-urban unemployed people [18]. This will help the poor to secure a regular income, which in turn helps them to maintain a healthy living condition. Commercial laboratories also play a role in creating, among their employees, an awareness of Africa’s rich biodiversity [18]. Cultivation of medicinal plants reduces the pressure on plants in the wild, thereby protecting the diverse flora. Techniques for commercialisation of medicinal plants requires advanced technology and this will encourage collaboration and sharing of ideas in science and technology programmes among African countries. Street and Prinsloo [11] stated that around 80% of South Africans depend on traditional medicine for their primary healthcare needs. They however stated that only a few of the South African medicinal plants have been
exploited for their full potential in terms of commercialization. They stated that the exploitation of the South African medicinal plants for the development of new pharmaceutical remains untapped. Marula et al. [3] also reported 78 South African medicinal plants belonging to different plant families currently sold in informal markets which serves as a major source of income to the vulnerable groups living in peri-urban, rural, and marginalized areas. Medicinal plant cultivation if properly harnessed could serve as a major source of income to many Africans.

In Nigeria, in the year 1990, the estimated monetary value of benefits realized from conservation was put at well over $6 billion. In the year 2002, due increase in bio-prospecting and bio-discovery activities and the growth in biotechnology-related industries that utilize indigenous genetic materials as feedstock, the year 2002 estimated benefits of biodiversity to Nigeria was over $8 billion per annum [19]. According to Ibrahim et al. [20], the expected annual profit from the production of 840 liters of eucalyptus oil per annum was N2,273,508.00 and profit after tax of N1,818,806.40 at 20%. This figure indicates how viable medicinal plants can boast the African economy if carefully exploited.

In Ghana, an estimated 951 tons of crude herbal medicine were sold at Ghana's herbal markets in 2010, with a total value of around US$ 7.8 million [21]. In Africa, about 75% of people living with HIV/AIDS patronize Complementary and Alternative Medicine [22]. Cumulatively, the yearly market value of herbal drug products is nearly, USD 43 billion which is far above the total annual budget of several African countries [22]. According to Ndhlala et al. [23], the production of herbal mixtures from medicinal plants has resulted in the growing herbal medicine industry with about 50 to 100 private entrepreneurs in the informal market and has also contributed to the creation of numerous jobs in South Africa. Eziacka et al. [24] reported that the value of the traded medicinal plants has been estimated to be US$300,000 in Johannesburg; US$7.8 m in Ghana; US$1.5 in Gabon and Kenya was US$25,900 [25, 26]. In Tanzania, at Kariakoo Market in Dares Salaam, the value was estimated to US$200,000 [27].

Evidence from outside Africa has shown that medicinal plant can be a huge source of income. In the USA, more than 1500 herbal drugs worth billions USD were sold yearly. In the UK, the yearly expenditure on Complementary and Alternative Medicine was 2.3 billion US dollars [2]. Furthermore, over USD 2.4 billion Traditional Chinese Medicines (TCM) have been sold and USD 400 million worth of TCM have been exported out of China in 1993 [2]. Also, about USD 60 million was realized from the sale of herbs in 1996 in Malaysia and in Europe, North America [22, 28].

5. Impact of medicinal plants on the pharmaceutical industries in relation to economic growth

Medicinal plants have played and are still playing an important role in the pharmaceutical industry. Medicinal plants have contributed immensely to the economic growth of many countries through the sales and production of pharmaceutical products. Paul-Marie [29] reported that the annual global sales of drugs were about 300 billion USD. This includes natural product-derived, semi-synthetic and synthetic drugs. Paul-Marie [29] also reported that the global sale of drugs from natural origin varies but as of 1976 it was estimated to be around 5 billion USD and some years later, it was estimated to be around 20 billion USD. This underscores the contribution of medicinal plants and plant-derived drugs to the economic growth of many countries.
6. The importance of medicinal plants used in traditional medicine in the development of orthodox drugs

Historical experiences with plants as therapeutic tools have helped to introduce single chemical entities in modern medicine. Plants, especially those with ethnomedical uses, have been the primary sources of medicines for early drug discovery. A recent analysis by showed that the uses of 80% of 122 plant-derived drugs were related to their original ethnopharmacological purposes. Current drug discovery from terrestrial plants has mainly relied on bioactivity-guided isolation methods, which, for example, have led to discoveries of the important anticancer agents, paclitaxel from *Taxus brevifolia* and camptothecin from *Camptotheca acuminata* [30]. Plants contain thousands of constituents and are a valuable source of new and biologically active molecules [31].

About 25% of all prescriptions sold in the United States are from natural products, while another 25% are as a result of structural modifications of natural products constituents [6]. Furthermore, Farnsworth [6] claims that 119 characterized drugs are still obtained commercially from higher plants with 74% of them sourced from ethnobotanical information.

One of the most important areas of application of natural products is in the treatment of human and veterinary ailments. Currently, at least 119 chemical substances, derived from 90 plant species, can be considered important drugs that are in use in one or more countries [32]. Although, the use of natural products as medicinal agents presumably predates the first recorded history, as the earliest humans used various but specific plants to treat illness, the treatment of diseases with pure pharmaceutical agents is a relatively modern phenomenon [32]. Nevertheless, the role of traditional medicine in the discovery of potent chemicals is quite crucial. Among some of the earliest successes in developing drugs from natural products, are the reports of isolation of the antimalarial agents such as quinine, quinidine, cinchonine and cinchonidine from *Cinchona succirubra*. Currently, the hydroxychloroquine which is the derivative of quinine under investigation as a potential cure for COVID-19 [33]. Pain relievers such as the morphine from *Papaver somniferum* and acetylsalicylic acid from *Salix alba* [34, 35]. More recently, the vinca alkaloids: vinblastine and vincristine were isolated as antineoplastic agents from the Madagascan periwinkle (*Catharanthus roseus*), and subsequently derivatized to vinorelbine and vindesine, the drugs currently used for cancer treatment [32].

Similarly, a potent antimalarial drug, a sesquiterpenoid endoperoxide, artemisinin was isolated from *Artemisia annua* and is used as a remedy against the multidrug-resistant strains of Plasmodium. This followed the long use of this plant as an antimalarial drug in traditional Chinese medicine. Using the basic structure of artemisinin, semisynthetic compounds such as artesether and dihydroartemisinin were synthesized as potent antimalarial agents with the aim of optimizing the pharmacology of artemisinin. These are now in widespread use around the world [32].

Other drugs that were developed on ethnomedical information include reserpine, an antihypertensive agent from *Rauwolfia serpentina*, Atropine, an anticholinergic from *Atropa belladonna*, digoxin, a cardiotonic from *Digitalis lanata*, Physostigmine, a cholinesterase inhibitor from *Physostigma venenosum* and Ephedrine, a sympathomimetic from *Ephedra sinica* [36].
These few accounts give not only the potential of plants as a source of drugs or as the solid link between folk medicine and drug development but also the necessity of research into medicinal plants [37].

7. Orthodox drugs developed from medicinal plants indigenous to Africa

About 52% of the drugs approved in the U.S. between 1981 and 2002 were from natural products mainly plants [6]. From these drugs, African medicinal plants have provided the drug vincristine (I) and vinblastine (II) from Madagascar periwinkle, combretastatin (III) obtained from the South African bush willow in the 1950 and maytansine (IV) from *Maytenus serrata* isolated in the early 1970s from the Ethiopian plant. This illustrates that, medicinal plants native to Africa are huge potential for the development of therapeutic agents. These drugs are potent anticancer drugs and some

![Figure 1. Some bioactive compounds from medicinal plants native to Africa.](image)

<table>
<thead>
<tr>
<th>Drug Plants source</th>
<th>Plant source</th>
<th>Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vincristine</td>
<td><em>Catharanthus roseus</em> (L.) G. Don</td>
<td>Apocynaceae</td>
</tr>
<tr>
<td>Vinblastine</td>
<td><em>Catharanthus roseus</em> (L.) G. Don</td>
<td>Apocynaceae</td>
</tr>
<tr>
<td>Combretastatin</td>
<td><em>Combretum caffrum</em> (Eckl. &amp; Zeyh.) Kuntze</td>
<td>Combretaceae</td>
</tr>
<tr>
<td>Maytansine</td>
<td><em>Maytenus serrata</em> (Hochst.ex A.Rich.) Wilczek</td>
<td>Celastraceae</td>
</tr>
</tbody>
</table>

Table 1. *Plants used for the development of drugs native to African countries.*
are still in use today all over the world in different forms as effective anticancer agents (Figure 1 and Table 1) [8].

8. Utilization of African medicinal plants for pharmaceutical research and drug development for the present and the future pandemics

Niprisan is a drug for the treatment of Sickle cell anemia was developed from herbs in Nigeria based on Yoruba Traditional Medicine [38]. Nigeria is home to the largest population of sickle cell anemia patients, estimated to have around 4 million patients with more than 150,000 children born annually with the disease. Despite decades of research, only one FDA-approved drug, hydroxyurea, is available for use in sickle cell anemia [39, 40]. In the late 1980s, in an effort to advance research of traditional herbal medicines, Nigeria's Ministry of Science and Technology established the National Institute for Pharmaceutical Research and Development (NIPRD)—a research body dedicated to identifying, characterizing, developing, and documenting the use of traditional herbal medicines in Nigeria. In May, 2011, three antisickling herbs (Entandrophragma utile, Chenopodium ambrosioides, and Petiveria alliacea) based on Yoruba Traditional Medicine were used at NIPRD to develop Niprisan. At present, three other recipes are currently awaiting development [38]. The Madagascar's research institutes have in the past in collaboration with the National Cancer Institute (NCI) have identified Ipomoea squamosa and Macaranga alnifolia respectively in the 1990’s [41]. More recently the Madagascar development of Covid-Organics formulated from Artemisia annua and other plants by the Malagasy Institute of Applied (IMRA) and the National Pharmacology Research Centre underscore the urgent need for the utilization of African medicinal plants for the research and development of new drugs. These efforts have demonstrated that African medicinal plants can be utilized for the development of many drugs for the treatment of various diseases.

9. Some economically viable medicinal plants of the African origin

Some economically important medicinal plants indigenous to Africa are presented. Street & Prinsloo [11] have reported ten (10) commercially important medicinal plants of South Africa to include: Agathosma betulina, Aloe ferox, Aspalathus linearis, Harpagophytum procumbens, Hypoxis hemerocallidea, Merwilla natalensis, Pelargonium sidoides, Sclerocarya birrea, Siphonochilus aethiopicus and Sutherlandia frutescens. Mahomoodally [12] has also reported ten potent African medicinal plants with the potentials to be developed as phytopharmaceuticals to treat infectious diseases. These plants include: Acacia senegal, Aloe ferox, Artemisia herba-alba, Aspalathus linearis, Cantella asiatica, Catharanthus roseus, Cyclopia genistoides, Harpagophytum procumbens, Momordica charantia and Pelargonium sidoides. Other plants of economic value include: Xylopia aethiopica, Monodora myristica, Aframomum melegueta, Khaya senegalensis, Pteleopsis suberosa, Griffonia simplicifolia, Voacanga africana and Fadogia agrestis [21]. According to [41, 42] the most traded species were of plants in Tanzania include: Zanthoxylum chalybaeum, Albizia antheniintica, Zanha Africana, Warburgia stuhlmannii and Vachellia nilotica.
In Nigeria, according to [19] the economic viable plants which if harnessed for their fixed can generate a huge amount of revenue include: *Sesame indicum*, *Adansonia digitata*, *Vitellaria paradoxa* and *Persia americana*.

10. Recommendations

a. Government should invest in the cultivation and conservation of medicinal plants with the view of effective utilization in pharmaceutical research and development of African pharmaceutical industries.

b. There should be an effective collaboration between established African established research laboratories for rapid screening of medicinal plant extracts with reported ethnopharmacological claims on the treatment of viral infections and other diseases.

c. Farmers should be encouraged to cultivate agro-medicinal which can be a good source of revenue, employment and entrepreneurship to the vast majority of African youths.

11. Conclusion

African medicinal plants are a huge reservoir of medicinal agents for pharmaceutical research and development. Cures yet undiscovered lies in the medicinal plants. Our quest for the development of new drugs of African origin may come from the African medicinal plants if concerted effort and commitment from the African heads of government are put towards searching and screening of medicinal plants extracts with established ethnomedicinal claims. The medicinal plants are largely obtained from wild sources where there is no guarantee of constant supply due to over-harvesting, over-exploitation and extintion. Therefore, there is a need for their cultivation and conservation.

Author details

Emmanuel Mshelia Halilu¹,²

¹Faculty of Pharmacy, Cyprus International University, Nicosia, Turkey

²Faculty of Pharmaceutical Sciences, Department of Pharmacognosy and Ethnomedicine, Usmanu Danfodiyo University, Sokoto, Nigeria

*Address all correspondence to: emshelia2002@gmail.com*
References


