

Standard Review

Biodiversity and conservation of medicinal and aromatic plants in Africa

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Medicinal and aromatic plants (MAPS) represent a consistent part of the natural biodiversity endowment of many countries in Africa. The role and contributions of medicinal plants to healthcare, local economies, cultural integrity and ultimately the well-being of people, particularly the rural poor, have been increasingly acknowledged over the last decade. The demands of the majority of the populace for medicinal plants have been met by indiscriminate harvesting of spontaneous flora, including those in forests. This has resulted in severe loss of habitat and genetic diversity. The utilization of medicinal and aromatic plants (MAPs) as a source of fuel, building material, food, fodder, and fibre, in African countries has, however, led to a resurgence of natural product-based industries and pharmaceutical products. This had been spurred by the interests of the developed countries for traditional medicine and natural products. Furthermore, many African medicinal plants are well-known in the international markets, e.g. *Ancistrocladus abbreviatus*, a Cameroun plant with anti-HIV potential. Therefore, sustainable management and conservation of these endangered medicinal plant species are important not only because of their value as potential therapeutics, but also due to worldwide reliance on traditional medicinal plants for health. Effective conservation strategies for medicinal plant should take place within four main areas: *in-situ* and *ex-situ* conservation, education and research. Saving Africa's medicinal plant resources from extinction calls for intensive management and conservation, more research and increased level of public awareness about our vanishing heritage.

Key words: African, health care delivery, medicine, harvesting.

INTRODUCTION

Medicinal and aromatic plants represent a consistent part of the natural biodiversity endowment of many countries in Africa, as well as the world at large. Medicinal plants are plants containing inherent active ingredients tending or used to cure disease or relieve pain. Aromatic plants on the other hand, have strong characteristic smell or fragrance (King, 1992). Plants represent a huge storehouse of drugs: they produce more than 10,000 different compounds to protect themselves from predators. These compounds could be potential drugs (King, 1992; Izuakor, 2005).

Biodiversity is the variety and variability of living organisms and biological communities in which they live, plus the ecological and evolutionary processes that keep

them functioning. It is often a variational measure of the health of biological systems indicating the degree to which the aggregate of historic species are viable versus extinct (UNESCO, 1994a). Conservation, on the other hand, involves a careful preservation and protection of something, especially planned management of a natural resource to prevent neglect, over-exploitation or even destruction.

Historically, plant medicines were discovered by trial and error. Just as people learnt to exploit plants for food, so they learnt to use plants as medicine (UNESCO, 1994a). For example, our ancestors noticed that aches and pains went away when they drank tea made from the bark of a willow tree, *Salix* sp. Later, scientists discovered that willow bark contains salicylic acid, the active ingredient in aspirin. Other plant medicines such as *Cinchona*, *Opium*, *Belladonna*, and *Aloe* were selected for use based on empirical evidence as gathered by traditional

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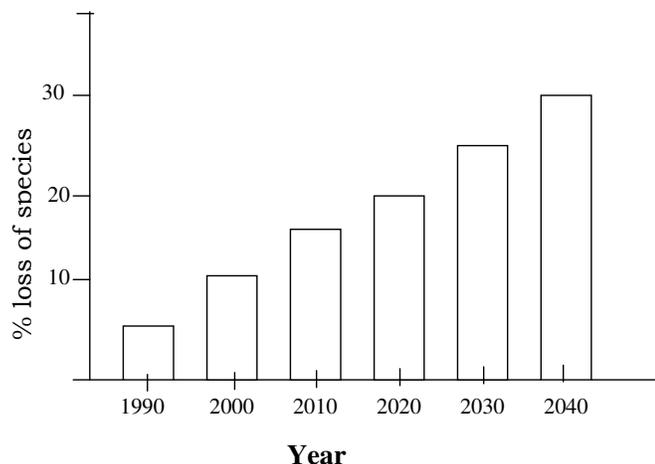


Figure 1. Projected gradual loss in tropical plant species (After Roche, 1992).

practitioners (Okigbo and Mmeko, 2006).

Traditional medicine, as a major African socio-cultural heritage, has been in existence for hundreds of years (Elujoba et al., 2005). It was once believed to be primitive and wrongly challenged by foreign religions dating back during the colonial rule in Africa, and subsequently by the conventional or orthodox medical practitioners (Elujoba et al., 2005). The populations of developing countries worldwide continue to rely heavily on the use of traditional medicines as their primary source of healthcare (Cunningham, 1993). Ethnobotanical studies carried out throughout Africa confirm that native plants are the main constituent of traditional African medicines (Cunningham, 1997). Furthermore, an increasing reliance on the use of medicinal plants in the industrialized societies has been traced to the extraction and development of several drugs and chemotherapeutics from these plants, as well as from traditionally-used rural herbal remedies (UNESCO, 1994a).

The demand of the majority of the populace of Africa and beyond for medicinal plants has led to indiscriminate harvesting of spontaneous flora, including those in forests (Cunningham, 1997). Moreover, the continent of Africa is estimated to have about 215, 634, 000 hectares of closed forest areas, and with a calculated annual loss of about 1%. Due to deforestation, many medicinal plants and other genetic materials become extinct before they are ever documented (Tuley de Silva, 1997). Habitat conversion threatens not only the loss of plant resources, but also traditional community life, cultural diversity, and the accompanying knowledge of the medicinal value of several endemic species (UNESCO, 1994b). As medicinal plant supplies diminish, constructive resource management and conservation strategies based on clear knowledge of the surrounding medicinal plant use must be designed. This study seeks, primarily, to respond to three central questions:

Of what importance are medicinal plants to developing countries?

What are the causes of the depletion of wild populations of medicinal plants species in Africa?

What can be done to ensure the effective conservation of all medicinal plant species?

CONSERVATION OF MEDICINAL AND AROMATIC PLANTS IN AFRICA

Reasons for conservation

Well thought-out arguments have been made many years ago to raise public awareness on the destruction of tropical rain forest and seasonally dry monsoon forest. The arguments were largely ignored earlier but today, dramatic efforts are being made to conserve biodiversity (Azimahtol et al., 1998).

The current cry of ecological genocide, genetic erosion, environmental degeneration, fragmentation and destruction as well as extinction of our biological heritage, is consequence of inaction (Krikorian, 1998). As long as the destruction of forest continues, medicinal plants and their natural habitats will remain under the threat of over-exploitation than ever before (Walter and Gillett, 1998).

The ultimate goal of conservation is to preserve the natural habitats of vulnerable medicinal plant species and to achieve their sustainable exploitation in less vulnerable areas (Cunningham, 1993). A projected gradual loss in tropical plants shows that tropical forest species likely to go into extinction in coming decades (Figure 1).

The graph (Figure 1) showed the progressive rise in loss of species and if care is not taken in terms of conversion of the bio-resources (including medicinal and aromatic plants), their complete extinction in the coming decades will be inevitable.

Conservation strategies

Effective conservation strategy for medicinal plants should take place within four main areas:- *in-situ* conservation, *ex-situ* conservation, education and research.

In-situ conservation

In-situ conservation involves protection and establishment of plants and other biological resources in the location of their natural occurrence. In order to ensure that representative of wild populations of vulnerable medicinal plant species are maintained, core conservation areas or other protected habitats that will allow natural processes to continue undisturbed should be designated (Cunningham, 1997). Since, it is only in nature that plant diversity at genetic, species and ecosystem levels can be

Table 1. Selected medicinal plant families of threatened species (Walter and Gillett, 1998).

Family	No of genera	No of species	% of total species threatened	Main uses	Examples of over-harvested species.
Rosaceae	100	3000	14.4	Stone fruit crops and medicinals	<i>Prunus africana</i>
Lauraceae	35-50	2000	13	Timber, medicines, cinnamon.	<i>Ocotea bullata</i>
Menispermaceae	70	400	9.5	Medicines, dyes.	<i>Stephania spp</i>
Apocynaceae	168-200	2000	7.5	Medicines	<i>Holarrhena floribunda</i>
Guttiferae	50	1200	13.3	Dyes, medicines, fruits, chewing sticks.	The West African <i>Garcinia spp.</i>
Leguminosae	590	12,000-14,200	18	Multiple uses: timber, medicinal, forage, food.	<i>Dalbergia odorifera</i> , <i>Azalia spp.</i>
Stangeriaceae	1	1	100	Traditional medicine, symbolic	<i>Stangeria eriopus</i>
Canellaceae	6	20	35	Traditional medicine, molluscides.	<i>Warburgia elongate</i> , <i>W. salutaris</i>

conserved on a long term basis, identification of ecosystems with diverse medicinal plant species is very essential.

Ex-situ conservation

This involves establishment of plantations, maintenance of living collections in farm fields, home gardens, botanical gardens, and arboreta in location outside the zone of their natural occurrence (Roche, 1992). The essence of *ex-situ* conservation is the rapid development of alternative supply sources of medicinal plants through cultivation in large enough quantities and at low enough price in order to compete with prices obtained by gatherers of wild medicinal plant stocks (Cunningham, 1997). This will satisfy market demands, result in more secure jobs and provide fewer incentives to gather from the wild. If this does not occur, naturally occurring species will disappear from the wild, thereby undermining the local medicinal resource base.

Traditional Medicinal Practitioners (TMPs)

Traditionally, rural African communities have relied upon spiritual and practical skills of traditional medical practitioners, whose knowledge of the ecology of plant species are invaluable (Cunningham, 1997). Since very little goes unnoticed in communally owned areas where traditional medicinal practitioners or community leaders are likely to be, and since they are very aware of the conservation status of local medicinal plant resources, they can be influential in changing local opinion so as to limit over-exploitation (Cunningham, 1993; Marshall, 1998).

Botanical gardens and field gene banks

Seed and gene banks of vulnerable medicinal plant

species should be maintained as precaution and backup against extinction. Medicinal plants most likely to be collected are the slow-growing species where commercial cultivation is unlikely and wild populations are jeopardized (Cunningham, 1993). These gene banks offer:

- A source of variants in case a major crop or plant is felled by disease or environmental disaster;
- The return of endangered or extinct varieties to their native lands.
- The supply of genetic material from which researchers can fashion useful plants in the years to come, even after the species represented in the bank have become extinct.

Education and training

The conservation of medicinal plants is by necessity a long term project requiring the development of trained staff, supported by organizations and a general public that is aware of issues at stake. Improvement in national education standards is a key factor in the medicinal plants conservation issue which will come about only as a result of economic development in African nations (Cunningham, 1993).

To increase the awareness of the public on the value of medicinal plant resources, the following are suggested: Campaigns that promote the importance of habitat and medicinal plant conservation and which encourage the cultivation of medicinal plants should be instituted. Target groups would include rural communities, government decision-makers, pharmaceutical companies such as Plantecam Medicam of France which works in Cameroun and Inverni della Beffa of Italy which works in Madagascar.

A media campaign through national radio networks to publicize information on the scarcity of popular medicinal plants should be implemented.

Information programme for decision makers in African government to link public health with medicinal plant conservation issues should be developed.

Studies and research information which identify threatened medicinal plants should be circulated through the International Board for Plant Genetic Resources (IBPGR) to regional gene banks.

Information relating to adverse toxic properties in medicinal plants should be circulated particularly to traditional medicinal practitioners and in primary healthcare training (Akerlele, 1987; Good, 1987).

Research and monitoring

Research into the identification of areas of high biological diversity at the macro scale and research into the properties and usage of specific medicinal plants at the microscale should use the complementary skill of the TMPs and conservation biologists (Cunningham, 1993). Series of interactive discussions involving the TMPs, commercial gatherers and market-based traders to discover the perceived scarcity of species, sites of diversity, status of popular medicinal plant species, the perceived problems and solutions, should also be initiated (Cunningham, 1997). Moreover, studies should be initiated through the co-operative effort between African and European scientific institutions to study the genetic diversity of popular medicinal plant species like *Warburgia salutaris* and *Okoubaka aubervillei* in West Africa. This, carried out through isozyme electrophoresis, would help to identify the degree of genetic erosion taking place in areas of over-exploitation or habitat destruction (Cunningham, 1993).

Overview of WHO'S guidelines for integrating African phytomedicine into the health scheme Guidelines for the institutionalization of traditional medicine into the health scheme as provided by WHO (1978) include the following.

Political Recognition

The government and Heads of States should be aware and help in the development of traditional medicine. This has already been achieved when the African summit of Heads of state declared 2001-2010 as 'Decade of African Traditional Medicine'.

Development of policy, legal and regulatory framework

Government should formulate national policies, legal framework and registration. WHO (1978) has provided guidelines for the assessment of herbal medicine.

Promoting scientific research on traditional medicine and collaboration work

Scientific research should be conducted on safety,

efficacy and quality of traditional medicine as proposed by WHO (Akerlele, 1993).

Ensuring that intellectual property rights are protected

Intellectual property rights are a priority item on the agenda of member states to protect indigenous knowledge about traditional medicine (Elujoba et al, 2005; WHO, 1978) and legislation should be made on this (Calixto, 2000).

Disseminating appropriate information to the general public on the use of traditional medicine

Appropriate information should be given to the general public to empower them with knowledge and skills for the proper use of traditional medicine (WHO, 1978). This is achieved through organization of seminars to raise awareness as recorded by Makhubu (2006).

Providing a good economic environment

The government should ensure that a good economic, political and regulatory environment is established for local production by traditional herbal practitioners as well as develop industries that can produce standardized remedies to increase access (WHO, 1978).

Utilization of medicinal and aromatic plants in Africa

The use of medicinal and aromatic plants among Africans is widespread and has been in existence for many generations (Kokwaro, 1993). About 70% of the wild plants in North Africa are known to be of potential value in fields such as medicine, biotechnology and crop improvements (UNESCO, 1994a).

Therapeutic uses

Studies in the use of plant extracts for control of diseases have shown the importance of natural chemicals as possible sources of non-phytotoxic and easily biodegradable alternative fungicides and antibiotics (Akueshi et al., 2002; Okigbo and Nmeke, 2005). Virtually all native plant species are used for the treatment of one ailment or another. These involves the traditional medicinal use for despoil, preventive, curative and magical purposes (Osemeobo and Ujor, 1999). Some chemical substances in the plant tissues brought about the medicinal value of such drug plants. Phytomedicine have a wide range of therapeutic uses as shown in Table 2.

Economic benefits and industrial uses

African continent is mad up of many developing nations

Table 2. Some African medicinal and aromatic plants with their therapeutic uses (Sofowora, 1993).

Medicinal plant	Family	Active Ingredients	Therapeutic uses
<i>Atropa</i> <i>Belladonna</i> L., <i>Datura stramonium</i> L. <i>Digitalis purpurea</i> L.	Solanaceae	Atropine, Hyoscine, Hyoscyamine.	Antispasmodic, mydriatic.
<i>Ephedra sinice</i> Sprag.	Scrophulariaceae	Purpurea glycoside A and B, digoxin, digitoxin	Myocardia / stimulant.
<i>Zingiber officinale</i> _Roscoe	Ephedraceae	Ephedrine	For relief of asthma and hay fever
<i>Papaver somniferum</i> L.	Zingiberaceae	Volatile oil; gingerol.	As condiment and medicinally as carminative and aromatic
<i>Rauwolfia serpentina</i> Benth or <i>R. vomiforia</i> Afz. <i>Carum carvi</i> L.	Papaveraceae	Morphine, codeine, thebaine, narceine, papaverine.	Narcotic; Analgesic.
<i>Ricinus communis</i> L. <i>Cinnamomum zeylanicum</i> Blume.	Apiaceae	Volatile oil	Used in psychiatric cases and antihypertensive.
<i>Cinchona succiruba</i> PAV and other species.	Apiaceae	Volatile oil	Flavouring agent and carminative.
	Euphorbiaceae	Fixed oil	Purgative; vehicle for eye drops
	Lauraceae	Volatile oil, tannin.	Stimulant, astringent, antiseptic, carminative, stops vomiting.
	Rubiaceae	Quinine, quinidine.	Bitter tonic, quinidine for atrial fibrillation.

Table 3. Phytotherapeutic Sales in World Market (Blumenthal 1999; Calixto 2000; Grunwald 1995; Robbers et al, 1996).

Year	Europe						America	Asia
	Germany	France	Italy	UK	Spain	Netherland		
1995							U.S.A	India \$ 400 million
1996							\$ 3.2 billion	
1997	\$ 3.5 billion	\$ 1.8 million	\$ 700 million	\$ 400 million	& 300 million	& 100 million		
1998							\$ 5 billion	
1999								

with very limited resources like minerals or petroleum oil to sustain their economic development. Therefore, majority of the inhabitants of these nations depend on the natural vegetation as a source of necessities such as fuel, building material, food, fodder and fibre (Kokwaro, 1993). Presently, there is a resurgence of natural product-based industries and pharmaceutical products because of the increasing interest in traditional medicine and natural products in developing countries (Cunningham, 1997).

Phytotherapy has demonstrated its contributions to the reduction of excessive mortality, morbidity and disability due to diseases such as HIV/AIDS, malaria, tuberculosis, sickle-cell anemia, diabetes and mental disorders (Elujoba et al., 2005). It has also reduced poverty by

increasing economic well-being of communities and developed health system by increasing the people's access to healthcare (Elujoba et al., 2005). The production, processing and sale of phytomedicine products create employment for the producing countries (Gunasena and Hughes, 2000). In the UK alone, herbal remedy trade is worth more than £200 (293 Euros) million per year (IUCN, 2005). The trend of sales of phytotherapeutic in the world market is shown below.

African medicinal and aromatic plant in world market

Africa is one of the main world producers of medicinal and aromatic plants (Table 4) and many of them are well known in international markets (Elujoba et al., 2005;

Table 4. Some African Medicinal plants in World Market (Okigbo and Mmekka, 2006).

Plant species	Action	Constituent	Indigenous countries	Source
<i>Ancistrocladus abbreviatus</i>	Anti-HIV	Michellamine B	Cameroun and Ghana	Sofowara, 1993; Boyd et al, 1994
<i>Zingiber officinale</i>	Spice, carminative and medicinal products.	Giingerol	Nigeria	Sofowora, 1993
<i>Catharanthus roseus</i>	Anti-Lenkemia and Hodgkin's disease	Triterpenoids, tannins and alkaloids.	Madagascar	Elujoba et al, 2005; Nayak and Pereira, 2006.
<i>Cindona succirubra</i>	Anti-malaria	Quinine	West African countries	Reiz and Lipp, 1982.
<i>Agava sisalana</i>	Corticosteroids and oral contraceptives.	Hecogenin	Tanzania	Elujoba et al, 2005.
<i>Rauwolfia vomitoria</i>	Tranquilizer and antihypertensive.	Reserpine, yohimbine	Nigeria, Zaria, Rwanda, Mozambique	Sofowara, 1993
<i>Syzigium aromaticum</i>	Dental remedy	Eugenols, terpendoids.	East africa countries. Madagascar.	Elujoba et al, 2005.
<i>Chrysanthemum cinerariifolium</i>	Insecticides	Fyrethrins	Ghana, Kenya, Rwanda, Tanzania South Africa	Wallis, 1967.

Sofowora, 1993). An Example is *Ancistrocladus abbreviatus*, a plant with anti-HIV potential and endemic to Cameroon (Sofowora, 1993).

Interest in phytomedicines in Africa

For years, public interest has increased for natural therapies (mainly phytomedicine) all over the world including Africa (Blumenthal, 1999). The pharmaceutical industry has come to consider traditional medicine as a source for identification of bio-active agents that can be used in the preparation of synthetic medicine (Cunningham, 1997). Many of the more pharmacologically (commercially) interesting medicinal plant species in use around the world are employed in more than one community, and often in more than one country, for multiple uses. The natural products industry in Europe and the United States is equally interested in traditional medicine (LeBeau, 1998). In Europe and America where phytomedicine industry is thriving, extracts from medicinal plants are sold in a purified form for the treatment and prevention of all kinds of diseases (WIPO, 1998).

According to Calixto (2000) and Grunwald (1995), there are several factors that lead to the preference and growth of phytotherapeutic market worldwide. They include:

- Preference of consumers for natural therapies.
- Great interest in alternative medicine
- High cost of synthetic drugs

- The belief that phytomedicine is used for the treatment of certain diseases where conventional medicine fails.
- The belief that phytomedicine is devoid of side effects since million of people all over the world have been using phytomedicine for thousands of years.
- Improvement in the quality, proof of efficacy and safety of phytomedicine.

Benefits of phytomedicine over synthetic drugs

Although synthetic or chemical drugs can have greater or quicker effects than do equivalent phytomedicines, they present a higher degree of side effects and risks (Okigbo and Mmekka, 2006). For instance, psycho-pharmacological products are associated with undesirable side effects such as uncoordinated motor skills and drowsiness, but phytomedicine acts on the body by regulating and balancing its vital processes rather than stopping or combating certain symptoms (Okigbo and Mmekka, 2006).

Phytomedicine have a wide range of therapeutic uses and are suitable for chronic treatments (Calixto, 2000). They are said to be gentle, effective and often specific in function in organs or systems of the body (Iwu et al., 1999). Plants like *Cimicifuga racemosa*, *Angelica sinensis* and *Agnus castus* are specifically useful for premenstrual syndrome, PMS (excessive estrogen) as recorded by Schellenburg (2001) and Wuttke (2000).

Phytomedicines are good dietary supplements, which are nutritive and replenish the body. For example, sunflower (*Helianthus annuus*) provides vitamin B₆ (Pyri-

doxine) as reported by MacDougall (2000).

Phytomedicines are effective in treating infection diseases as well as limit side effects associated with synthetic antimicrobial drugs (Iwu et al., 1999). Plants like *A. abbreviatus* from Cameroon has been reported to show a strong anti-HIV activity due to michellamine B and has been developed for treating people living with HIV/AIDS (Sofowora, 1993).

The symptoms of phytomedicine often extend beyond symptoms and treatment of diseases. For example, *Hydrastis canadensis* not only has antimicrobial properties but also promotes optimal activity of the spleen in releasing compounds as reported by Murray (1995). Finally, they are usually less expensive than the synthetic drugs (Calixto, 2000).

CONCLUSION AND RECOMMENDATION

Owing to the unsustainable exploitation of medicinal plant species in Africa for multiple uses such as grazing, fuels, food, timber and medicine, and the decline of natural vegetation due to unmonitored trade of these plant species, the survival of African medicinal and aromatic plants is in jeopardy. The Saving Africa's medicinal plants resource calls for more protection, management, research and an increasing level of public awareness about the vanishing heritage. Following the uncertainties in demographic and urbanization trends, the demand for traditional medicines is set to rise, and would mount increased pressure on the remaining areas of natural vegetation (Cunningham, 1997). There should be a shift in focus from conserving primarily conspicuous plants to the need to conserve all kinds of plants as well as their ecosystems. African countries' governments should give priority to species inventory aimed at documenting the various medicinal plants in use as therapeutics; establish local botanical gardens to ensure sustainable supply of safe, effective and affordable phytomedicines in each country; and make policies at both the international and national levels. These would ensure the success of an overall conservation strategy through elimination of wealth inequalities between nations. Furthermore, international conservation agencies, in conjunction with governments and other NGOs, need to determine a mechanism whereby those benefiting from the conservation of biotic diversity also contribute towards the costs of conserving it. The future of medicinal and aromatic plants in African rests on the ability to resolve the current conflict between conservation and resource use, as well as a shift towards more resource based agriculture that is already being challenged by the globalization of economics.

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