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Helmut Kloos
Department of Epidemiology
and Biostatistics, University of
California, San Francisco, CA,
USA

Traditional medicinal plants and plant products sold in open markets in Africa for COVID-19, their uses, medicinal properties, trade and sustainability: A review

Helmut Kloos

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Abstract

This review examines the trade of traditional medicinal plants in open markets in Africa and their potential use for the prevention, amelioration and treatment of COVID-19. It identifies from online sources plant species used by African populations for COVID-19 and plants with bioactive compounds against the SAR-CoV-2 virus. The paper also describes the risk of their decline and extinction. Several possible interventions to plant decline are evaluated. We conclude that the popularity of open markets and the use of medicinal plants with promising bioactive properties warrant further biomedical studies and clinical trials. We recommend that governments increase the sustainability of medicinal plants by enforcing environmental laws and establish nature preserves and promote research on the development of candidate species for the prevention and management of COVID-19 and that value chains be improved to ensure a reliable supply of medicinal plants in markets and economic equitability for all actors.

Keywords: Medicinal plants, anti-COVID-19 compounds, open markets, trading of medicinal plants, sustainability of plants, Africa

Introduction

Traditional medicines, or complimentary, alternative folk, indigenous and ethno-medicines, meet the health care needs associated with infectious, non-infectious and mental diseases as well as spiritual afflictions of many people worldwide. The utilization of traditional medicines has been increasing in recent decades due to the spread of drug resistance to many pathogens, together with the scarcity of public health services and rapid population growth in many developing countries and an increase in the prevalence of chronic non-infectious diseases in Africa ^[1]. According to the World Health Organization ^[2], 80% of all Africans use traditional medicines but rates ranging from 4.6% to 94% have been reported by different studies ^[1]. Starting in 1978, WHO ^[3] promoted traditional medicine as a necessary component of primary health care systems and as an important tool for preventing and managing coronavirus infections. By 2022, 40 African nations were in the process of formulating new or refining existing policies, laws and regulations on traditional, complementary or alternative medicine ^[2]. COVID-19 has been reported from all African countries but published mortality and infection rates are relatively low due to the small number (eight) of African countries having compulsory death registration ^[4] and the scarcity of health services. By January 4, 2024, 11.8 million people had reportedly been infected with the SAR-CoV-2 virus and an estimated 250,000 had died in Africa ^[5].

Herbal therapies account for the major part of the empirical component of traditional African medicine ^[1] and functional foods, especially spices, are also widely used for medicinal purposes ^[6]. Open markets, also known as open-air markets and wet markets, and the natural environment are the largest sources of medicinal plants in Africa, followed by small retail stores and super markets ^[7]. The definition of open markets used here includes street vendors because they trade medicinal plants in settings similar to open markets. An estimated 5,400 medicinal plant species in African are used by culturally diverse indigenous healers and populations in many ways for a wide range of diseases and illnesses. This constellation has given rise to a remarkable diversity in healing systems and treatment practices ^[1, 8].

Corresponding Author:
Helmut Kloos
Department of Epidemiology
and Biostatistics, University of
California, San Francisco, CA,
USA

Traditional medicinal plants are also widely used concurrently with allopathic medicine, which constitutes a major challenge for medical practitioners [1]. Medicinal plants are defined in this paper as plants used exclusively for medicinal purposes, as well as spices and culinary herbs used both as food and medicines because all three categories of plants are commonly sold in open markets, often by the same vendors [9]. Only one study has been carried out on the sale of traditional medicines for COVID-19 in open market; it was carried out in Gondar Town in Ethiopia [9]. Most medicinal plants are gathered in the wild, leading to increasing pressure on this resource), an issue increasingly addressed by many researchers and governments [1]. The objective of this study is to examine the availability and trading of medicinal plants in *open markets in Africa, with a focus on the phytochemical properties and use of the plants for COVID-19, supply of the plants, the use of value chains in their trade, threats to medicinal plants, and potential interventions.*

Materials and Methods

A literature review was carried out that searched the terms “medicinal plants sold in African markets for COVID-19”, “bioactive compounds against SARS-CoV-2 virus in medicinal plants in Africa”, “safety of medicinal plants in Africa”, “medicinal plants and spices in African open markets”, “foods and spices used for COVID-19 in Africa”, “value chains of medicinal plants in Africa”, “threats to medicinal plants in Africa”, and “conservation and cultivation of medicinal plants in Africa” on the Google Scholar platform for the period 2000 to 2024. The abstracts of all articles and reports were reviewed to select publications relevant to the objectives of the study.

Results and Discussion

The use of medicinal plants and plant products for COVID-19

The World Health Organization promotes and supports research on medicinal plant medicines for the prevention, treatment and management of COVID-19 [3]. Traditional medicines have increasingly been used world-wide for the prevention and management of COVID-19 since the start of the pandemic in 2019, facilitated by their affordability, accessibility, and cultural acceptability [3]. Market analysts estimate the traditional medicine market world-wide will grow from \$US 174.9 billion in 2023 to 289.6 billion in 2030, an annual growth rate of 7.5% [10].

The use of and research on traditional medicines for the treatment of COVID-19 and other viral diseases is increasing in many countries, especially in China, where they have shown promises in the treatment of this disease [11]. In a review of 328 African plants included in 36 studies, 127 species were described as anti-viral, including 42 plant species with anti-polio properties, 34 with anti-HSV, 16 with anti-coxsackievirus, 14 with anti-rhinovirus, 12 with anti-influenza and 10 with anti-SARS-CoV-2 properties [12]. In a study in Ethiopia, 56 out of 111 medicinal plants and spices were described as having 30 antiviral components considered potentially effective for the treatment and management of COVID-19 [13]. A review by Akindele *et al.* [14] identified eight medicinal plants with a wide range of demonstrated antiviral, immunomodulatory and anti-inflammatory activities. They are two wild plants used for medicines (*Sphenocentrum jollyanum* and *Garcinia kola*), two wild plants used as medicine or food (*Garcinia kola* and *Adansonia digitata*) and four functional food plants (*Aframomum melegueta*,

Sutherlandia frutescens, *Hibiscus sabdariffa* and *Nigella sativa*). The potentially important role of spices in mitigating coronavirus infection is indicated by the lower COVID-19 prevalence in countries with higher consumption of spices [15], although this relationship requires further study.

Pharmacological properties of medicinal plants and plant products used for COVID-19

Various pharmacological studies revealed anti-COVID-19 compounds in some widely used African medicinal and functional food plants. They include amaranthine in amaranth (*Amaranthus tricolor*), thymohydroquinone, hederagenin, nigellidine and *a*-hederiin in Niger seeds (*Nigella sativa*) [13, 16, 17], myricetin 3-O-beta-glucopyranoside in tea (*Camellia sinensis*) [17], quercetin, alliin and allicin in garlic (*Allium sativum*) [18], oleanic acid and ursolic acid in basil (*Ocimum lamifolium*) [13], kaempferol and quercetin in garden cress (*Lepidium sativum*) [19], 6-gingerol in ginger (*Zingiber officinale*) [20], and thymol and carvacrol in thyme (20) and thymol and carvacrol in thyme (*Thymus vulgaris*) [21]. These bioactive compounds exhibited anti-inflammatory, COVID-19 inhibitory, immunomodulatory, anti-oxidant and other properties. These results indicate the potential use of these plants in the prevention and treatment of COVID-19. However, further pharmacological, toxicological and clinical studies will be required to determine their efficacy and safety. [22].

Safety of medicinal plants

Little is known about the safety and quality of medicinal plants and spices. WHO [23] reported that, 38 of its 138 member countries, all of them in Africa, had regulations requiring that traditional medicines be safe, effective and of good quality. However, although several countries have developed legislation aiming at managing biodiversity, sharing intellectual property and registering medicinal plant medicines, lack of enforcement of laws and regulations jeopardizes the full benefits and the quality and safety of medicines [24]. One of the few toxicological and clinical studies of side effects of medicinal plants revealed adverse effects on the reproductive system and cytotoxic effects [25]. Gastrointestinal upsets, followed by malaise, headache and dizziness were the most common adverse effects reported by users [1]. On the other hand Kamsu-Foguem and Foguem [26] concluded that many of the adverse drug reactions of traditional medicines are the result of their improper preparation and utilization. But the risk of disease transmission via contaminated herbal medicines is common in unhygienic market settings, especially since many medicines are administered in their natural state without boiling [27, 28].

Trading of medicinal plants

Open markets exist in many developing and developed countries. In developing countries they are crucial in the trade of staple foods and vegetables in rural communities and in larger urban markets also of clothes, tools, household ware and increasingly electronic goods [29-31].

Most African communities have open air markets, either periodic markets in rural communities that have traditionally been held on certain days of the week, or daily markets in towns. A large number and variety of medicinal plants including spices and culinary herbs, are sold in open markets in Africa. The type and quantity of the products sold in markets depend largely on the health needs of local populations, the demand for indigenous medicines, and their

availability. About 70-80% of the South African population use traditional medicine for their health care needs [23], although many people use them concurrently with allopathic medicine [1]. Numerous empirical and spiritual treatment approaches used in Africa have evolved among ethnic and socioeconomic groups as well as ecological zones [1]. Markets surveys in Ethiopia [31], Benin [32], Ethiopia [31], South Africa [33] and Gabon [8] found between 45 and 283 medicinal plant species in individual or groups of markets. Significantly fewer taenicides were sold in the Merkato market in Ethiopia in 2014 than in 1973, due to preference for the now widely available pharmaceutical drugs. [31]. Van Andel *et al.* [34] recommended that quantitative surveys be carried out periodically in the same markets for monitoring purposes, indicating the need for further longitudinal studies to examine changes in the distribution of individual plant species in the wild over time Meke *et al.* [35] found 123 plant species in markets in eight district in Malawi bordering South Africa, where traders reported that 26 or more species were being exported to neighboring Mozambique, South Africa and Zambia, including one species that is endangered in South Africa, indicating unregulated international trade. In Mpumalanga Province in South Africa, 33% of 176 plant species in local markets were imported, mostly from Mozambique [36]. In South Africa's Limpopo Province, Rasethe *et al.* [35] found 75 plant species, mostly roots (50% of all plants), bulbs [19%] and bark [16%]. Seven of the nine species in high demand were considered to be endangered. Spices and culinary herbs usually sold both by vendors of medicinal plants and vendors of staple foods. Vegetables and culinary herbs. The number of plants with both culinary and medicinal uses is under-reported because spices are often categorized as medicinal, alternative or complimentary medicines. [1] The number and composition of these plant products in individual markets largely depends on local food systems. In Ethiopia, where more than 50 species of spices are cultivated or gathered in the wild, Agize and van der Zouwen [37] reported 18 spices, mostly kororima (*Aframomum corrorima*), rue (*Ruta chalepensis*), cardamom (*Elettaria cardamomum*), basil (*Ocimum basilicum*), and wild pepper (*Piper capense*) in a survey in 70 rural Ethiopian households. Workneh *et al.* [9] found five spices, most commonly garlic (*Allium sativum*), black cumin (*Nigella sativum*) and ginger (*Zingiber officinale*) in two markets in an Ethiopian town. Subsistence farmers, herbalists and traders are the major suppliers of medicinal plants in open markets, although wholesalers and other middlemen are also involved in many trading systems. The suppliers and vendors selling their produce are mostly people from the lower socioeconomic strata who are carrying out these activities to earn primary or supplementary income [32, 38]. Open markets in many African countries are tolerated but not legalized by governments, making many traders subject to harassment, confiscation of their goods or forced removal of their goods by the authorities [30]. In this legally ill-defined setting, self-employed vendors and middlemen, who constitute part of a "hidden economy", are suspicious of outsiders and reluctant to be questioned [9, 39]. The informal food sector, including open markets, street vendors and small retail shops, is increasingly facing competition from supermarkets in Africa and other developing regions. Nevertheless, open markets continue to be the major source of food and spices in most countries because they are highly competitive and resilient [29, 40] and crucial in ensuring food security of the rapidly growing poor

urban populations. In 11 southern African urban areas, more than two-thirds of 6,000 poor households regularly purchased food from the informal sector; even higher rates have been reported from the largest urban areas, including Harare, Blantyre and Maputo [30]. Wayama *et al.* [41] reported that less than 4% of poor urban households in Nairobi, Kenya, and Kampala, Uganda, obtained all foods from supermarkets, purchasing them mostly from the indigenous food sector instead. There is also some evidence that the foods sold in open markets have a competitive nutritional advantage over supermarket foods-users of the former tend to have lower body mass index (BMI) and lower rates of metabolic diseases than clients of supermarkets [42]. These various features of open market and street vending have contributed to making informal food markets the favorite source of staple foods and spices in African cities.

The economic value of medicinal plants

The economic value of the trade of medicinal plants in Africa is increasing both in plant production and employment, is increasing. In addition to the growing demand by urban populations for medicinal plants, the increasing demand from pharmaceutical companies for new and novel formulations is boosting the plant supply [43]. The value of the medicinal plants trade in five countries in Sub-Saharan Africa was estimated to be \$1.4 billion [44], highest in South Africa [7,34]. In South Africa, the trade in traditional medicines employs more than 133,000 people and represents 5.6% of the national health budget [45]. The prices of medicinal plants have increased substantially over the years, especially for species in high demand. In South Africa, for example, the cost of a dose of *Warburgia salutaris* increased from about \$0.25 in 1969 to \$6 in 1980 and *Gunnera perpensa* and other lesser used and more abundant species rose from \$0.25 to \$0.60 in that period [46]. This author noted similar price increases in the Merkato in Ethiopia between 1973 and 2014. Even though medicinal plants are minor crops in comparison to staple crops, their values are among the highest among traded plant worldwide [47].

Threats to the sustainability of medicinal plants

Increasing exploitation of medicinal plants, combined with habitat destruction, population increase and selective gathering of preferred wild plant species is threatening the survival of an increasing number of species around population centers. Sub-Saharan Africa's population is currently growing 2.5% per year, higher than in any other region world-wide [48]. Africa's population is estimated to grow from 491 million in 2015 to 1.5 billion by 2050 and most people living in urban areas are experiencing food insecurity [49], indicating increasing pressure on natural resources, including medicinal plants. This situation has contributed to severe exploitation of medicinal plants that resulted in the extinction of at least one species - *Encephalartos woodii* in South Africa and an increasing number of plants in Ethiopia, South Africa and other countries have plants listed in the IUCN (International Union for Conservation of Nature) Red List, a catalog of highly endangered species [50, 51]. Many popular medicinal plant species have become scarce or unavailable in local open markets because of overharvesting and their widespread use for construction, tools and other purposes. Harvesting of plant parts that are crucial for sustainability, such as roots and bark, is also contributing to the dwindling and degradation of medicinal plants and biodiversity [35, 51]. Increasing numbers of plants species sold in open markets are

threatened. In 16 urban markets in Benin, for example, all but 2 of 283 plant species were reported to have become scarce [32]. As a result, many vendors sell smaller portions of medicines [46], plant collectors must travel longer distances to find plants [31, 52], the supply of some plants is becoming more irregular, and many heavily used species are no longer available in some markets [52].

Efforts to ensure the supply and sustainability of medicinal plants

At least six African countries have developed national policies together with laws and regulations prohibiting harmful practices in efforts to conserve medicinal plants and ensure their sustainability. These guiding principles are aimed at ensuring biodiversity, sustainable use of plant species, and the right of local communities to equitable use and development of their plant resources [54]. The transition from gathering wild plant to cultivating them in home gardens is promising to play a major role in this endeavor and the use of value chains can facilitate the movement of medicinal plants to open markets.

Cultivation of plants

Cultivation of medicinal plants in home gardens and on small holder farms is increasingly pursued as an efficient and environmentally sound approach to meet growing demands in urban areas. Home gardens provide the overwhelming amount of cultivated medicinal plants for household use but subsistence farmers in several African countries have begun to cultivate leafy plants and trees with pharmacological properties for local markets [55-59]. Increasing food insecurity in African cities is also fostering the development of urban agriculture. A study of 2,687 households in 18 towns in Zambia and Kenya reported that 33% of the households practiced urban agriculture [59]. In view of declining agricultural production in many African countries in recent decades and increasing demand for indigenous medicines in urban areas, the diversification of cropping systems with medicinal plants may improve the livelihoods of subsistence farmers [55].

Unlike the gathering of wild plants, which, together with environmental degradation, climate change, population increase, and deforestation lead to increased scarcity and even extinction of species, cultivation of medicinal plants for medicinal purposes may meet the growing demand for indigenous remedies). The production of plants can be controlled and increased and their medicinal traits improved by using biotechnology including plant breeding and tissue culture, although it is not known if bioengineered plants will be acceptable to populations preferring natural products [60]. Cultivation of plants in home gardens or on farms can therefore make them more widely available and sustainable in markets than the collection of vulnerable wild plants. Cultivated medicinal plants are gradually becoming the major plant material, in areas where wild plants are scarce or have become extinct, as in Benin, where *Caesalpinia bonduc* is now cultivated after it became extinct in the forests [32]. Moreover, increasing demand for medicinal plants from the rapidly growing African population can allow poor rural and urban farmers to diversify their income [47, 61], further discussed in the section on value chains below.

Additional conservation methods

Several other approaches to facilitating the conservation of endangered medicinal plants are being considered in several

countries, mostly in South Africa. They include monitoring the type and quantity of species sold by traders and the distribution of individual plant species using spatial models to identify at-risk species as a basis for plant management programs [62]. The establishment of conservation areas is a promising approach if collaboration with local populations in managing ecosystems can be achieved. In Ethiopia, medicinal plants have been preserved in five Ethiopian biosphere reserves [63]. Schippmann *et al.* [64], addressing global issues in medicinal plant development, recommended expansion of plant domestication over large geographical areas to tap into the genetic and chemical diversity within species. They also emphasized the need for sustainable wild harvest with support from governments and local authorities towards alleviating the economic pressure that leads to damaging plant harvesting practices and overharvesting. The management would have to include the development of alternative income sources for farmers, whose low profit margins in the medicinal plant trade and declining agricultural production cause. Them to collect large quantities of medicinal plants as a survival strategy.

Value chains

The reliable supply of medicinal plants and spices to markets may be facilitated by value chains. Value chain analysis can identify the main actors, their functions, benefits and challenges, and may improve the movement of plant materials to open markets. In northern Ethiopia, value chain analysis helped increase the demand for garlic after the arrival of COVID-19 by identifying suitable markets and strengthening the communication network involving farmers, traders, retailers and consumers [65]. In Uganda, Barirega *et al.* [66] noted that lack of knowledge of trading and commercialization of medicinal plants is associated with undervaluation of wild plants and called for studies to determine their economic role in the livelihood of rural households and their market potential. In Tanzania, Mpelangwa *et al.* [67] found that lack of official standards along the value chain hampered effective relationships between harvesters of medicinal plants, wholesalers, formulators and retailers of medicinal plants. Examining the responses of traders to political and economic events since the colonial period in Tanzania using applied economic evolution theory, (Mpelangwa *et al.*) [68] concluded that new business models need to be developed to optimize the mutually beneficial interaction of the regulatory framework and market forces. Improving these relationships may strengthen the role of open markets as reliable sources of medicinal plant materials through greater coordination and collaboration between the various actors, including plant gatherers, wholesalers and market vendors [69]. Several studies of African and Asian medicinal plant production systems concluded that streamlining, research agendas and knowledge sharing should also aim to consider the benefits and interest of all players in value chains, particularly poor rural people, who have traditionally benefited least from the plant trade [70, 71]. This includes including a cultural perspective that considers prevailing use patterns of medicinal plants among different ethnic groups [72]. Similarly, as the trend towards increasing the international trade of medicinal plants continues indigenous knowledge and property rights of plant gatherers, producers and traders must be protected to prevent market chains that favor few corporate buyers [73].

Conclusion and Recommendations

This review shows the important role played by open markets

in the trade and distribution of medicinal plants, including wild plants, spices and culinary herbs, for the prevention and mitigation of COVID-19 in Africa. The use of many plants for viral infections by African people and the anti-COVID-19 compounds in some plants indicate that effective drugs may be developed with further phytochemical and pharmacological research and clinical trials. The increasing use of medicinal plants for practically all endemic diseases in Africa is mainly due to cultural preferences for natural products, their accessibility, and population growth but their widespread use endanger the sustainability of popular species. Interventions, above all, the cultivation of plants, the adoption of ecologically sustainable gathering practices of wild species, the establishment of nature preserves, and the monitoring of plant distribution and supplies in markets as a basis for medicinal plant management should be considered in the development of viable interventions. Although value chains may not directly contribute to the sustainability of medicinal plants they require improvements to facilitate the reliable supply of plant materials to open markets and to equitably benefit all actors. Lastly, enforcement of legislation regulating the sustainable harvesting of medicinal plants and government recognition of suppliers and market vendors as essential distributors of this economically important and health-enhancing resource need to be strengthened to ensure the reliable supply of medicinal plants in African open markets.

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Conflict of interest

The author declares no conflict of interest.

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