

## BIBLIOGRAPHIC INFORMATION SYSTEM

**Journal Full Title:** Journal of Biomedical Research & Environmental Sciences

**Journal NLM Abbreviation:** J Biomed Res Environ Sci

**Journal Website Link:** <https://www.jelsciences.com>

**Journal ISSN:** 2766-2276

**Category:** Multidisciplinary

**Subject Areas:** Medicine Group, Biology Group, General, Environmental Sciences

**Topics Summation:** 130

**Issue Regularity:** Monthly

**Review Process:** Double Blind

**Time to Publication:** 21 Days

**Indexing catalog:** [Visit here](#)

**Publication fee catalog:** [Visit here](#)

**DOI:** 10.37871 ([CrossRef](#))

**Plagiarism detection software:** iThenticate

**Managing entity:** USA

**Language:** English

**Research work collecting capability:** Worldwide

**Organized by:** [SciRes Literature LLC](#)


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**IndexCopernicus  
ICV 2020:  
53.77**

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OPINION

# The Worldwide Herbal Market: Trends and Opportunities

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## INTRODUCTION

For many centuries, plant species have been used by local and indigenous communities as part of their culture and traditions for the preparations of medicines to treat, both human and animal diseases. Local and Indigenous communities are culturally distinct ethnic groups with a different identity, culture, and traditional expressions from the national society, and draw their existence and survival from their local resources or environment [1]. Furthermore, indigenous, and local communities are socially and culturally extinct from the dominant society and often times regarded as vulnerable and disadvantaged by the modern society development processes [2].

The local and indigenous communities have been using their local indigenous knowledge or traditional knowledge, accumulated over time, using as an important and key factor in identifying useful plant species to treat human and animal diseases [3-6]. This knowledge has been acquired through interaction with the natural environment, learning experiences and ancestral dreams for survival and to heal the nation [7-10].

About 80% of the world population consult the traditional health practitioners for plant-based traditional medicines, either in their liquid and dry form [11]. This ancient use of traditional medicines resulted to the conceptualisation and launching of Research and Development (R&D) programs to investigate the traditional uses of these products, which consequently generated the requisite scientific data to commercialise traditional medicines within the herbal medicines market. From R&D programs into traditional medicines hundreds of academic papers have been published in peer-reviewed journals and many students have obtained masters' and doctoral degrees. More than 50% of clinically tested pharmaceutical drugs used in the world are derived from traditional medicinal plants [12]. About 10,000 medicinal plants of 2,50,000 higher plant species globally, have been documented for their traditional uses of which about 200 has been developed into western and pharmaceutical medicines. It therefore becomes increasingly evident that plants represent potential avenues to explore into herbal medicines with the requisite scientific data substantiating safety and efficacy [13].

Herbal medicine industry is one of the fastest growing industries in the world, mainly due to many countries are seeking to expand coverage of herbal medicines [11], consumer expectations for natural products, rising costs for synthetic pharmaceutical drugs and budget cuts for health care.

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**DOI:** 10.37871/jbres1482

**Submitted:** 03 May 2022

**Accepted:** 19 May 2022

**Published:** 21 May 2022

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MEDICINE GROUP

THERAPEUTICS

VOLUME: 3 ISSUE: 5 - MAY, 2022



**How to cite this article:** Bareetseng S. The Worldwide Herbal Market: Trends and Opportunities. J Biomed Res Environ Sci. 2022 May 21; 3(5): 575-584. doi: 10.37871/jbres1482, Article ID: JBRES1482, Available at: <https://www.jelsciences.com/articles/jbres1482.pdf>

## Herbal Medicines and Indigenous and Traditional Knowledge

The WHO refers to herbal medicines as preparations and/or finished products made of whole plants, parts of plants, or other plant materials, including leaves, bark, berries, flowers, and roots, and/or their extracts as active ingredients intended for human therapeutic use or for other benefits in humans and sometimes animals [11,12] and there is increasing demands for herbal medicines, both in the developing and developed countries.

According to several market research studies, herbal medicines are also known as botanical medicines, which are used to help with health-associated problems and enhance general human health. Other names for herbal medicines include dietary herbal supplements, phytomedicines, and pyrotherapeutic agents and complementary medicines, which are used globally as a source of well-being due to their antioxidant, anti-inflammatory, and pharmacological properties to treat chronic diseases such as HIV/AIDS, dementia, cancer, malaria, tuberculosis [13]. Herbal medicines have often evaluated through scientific research for safety, quality and efficacy and plant species used in herbal medicine preparations processed into standardised active constituents, such as phenolics, terpenoids, alkaloids, flavonoids and lignans) and extracts [14,15]. Zahn and co-researchers provide examples of scientifically evaluated herbal medicines for safety and efficacy through scientific research as indicated in table 1 [13].

Unlike pharmaceuticals, herbal medicines are not highly purified or chemically modified medicines and typically do not involve identification of active constituents and characterisation of biological activity [16].

Traditional and indigenous knowledge remains an important element to research institutions including the universities and private sector companies to guide the scientific research and product development processes to investigate the traditional uses of traditional medicines into herbal medicines to treat a particular human disease. Hence, there is an increased interest by the research institutions including the universities and private sector companies to collaborate with local and indigenous communities to identify plant species and associated traditional and indigenous knowledge for scientific research, consumer acceptability studies and marketing and branding informed by stories associated with indigenous communities has increased the use of traditional knowledge in marketing and branding.

## OVERVIEW OF THE GLOBAL MARKET BY APPLICATION

### Herbal medicines

**Global market:** The global market for herbal medicine

has continued to grow over the years, with the demand also increasing in developing countries. This is partly because of population growth, the preferred health benefits of herbal products, as well as such products being considered safer and more cost-effective than pharmaceutical drugs. The United States of America is the largest market for herbal medicines, followed by Europe, Australia, and Canada [17,18]. The World Health Organisation (WHO) indicates that between 75 and 80% of the world's population rely on herbal medicines to meet their primary health care needs [11]. For instance, today, pharmacies in developed countries sell plant derived drugs over the counter.

According to [19], who cited the WHO, about 11% of the about 250 drugs that are considered essential for basic health care are of plant origin. Examples of drugs that are used in their natural state include quinine and artemisin (antimalarials), reserpine (antihypertensive), paclitaxel, docetaxel, irinotecan and etoposide (anticancer drugs), digitalis (cardiotonic), morphine (narcotic analgesic) and turbocurarine (muscle relaxant). The WHO refers to herbal medicines as preparations and/or finished products made of whole plants, parts of plants, or other plant materials, including leaves, bark, berries, flowers, and roots, and/or their extracts as active ingredients intended for human therapeutic use or for other benefits in humans and sometimes animals. Herbal medicines are also known as botanical medicines and make use of medicinal plants linked to the traditional knowledge of local and indigenous communities, which guide a product development process to treat a specific disease.

The use of over-the-counter herbal products has since become popular with an estimated 12% of the world population for primary health [19]. According to the BCC market research report published in 2017, the use of the over-the-counter herbal products has resulted to a global market of USD 59.45 billion in 2017 [17]. This market will increase to USD 104.78 billion by 2026 at a Compound Annual Growth Rate of 6.5%. This increase is attributable to public and scientific community's increased awareness and interest in medicinal plants use as a primary health care. The WHO has played a leadership by producing strategies and guidelines to its Member Countries on the scientific models for traditional medicines [20], to meet the regulatory standards of safety, efficacy and quality and play a pivotal role in the growth and development of the economies of countries. The key factors driving interest in herbal medicines are summarized in box 1.

In the USA alone, more than 25% of prescription drugs contain active ingredients that are derived from plants [21]. Table 2 indicates the growth of herbal medicines market in relation to the growth of plant-based pharmaceutical drugs market from 2017 to 2022. Compared to plant derived pharmaceutical drugs, expected growth for herbal medicine market is in respiratory infections, pain, infectious diseases, cancer, and cardiovascular segments.

**Table 1:** Examples of herbal medicines.

Herbal medicine	Health property	Plant source
Paclitaxel	Anti-Cancer Drug	Yew Tree Taxus
Etoposide	Anti-Cancer Drug	Mayapple (Podophyllum)
Artemisinin Derivatives	Plasmodium Falciparum Malaria	Wild Wormwood (Artemisia Vulgaris),
Metformin	Type 2 Diabetes	Galega Officinalis
Capsaicin	Pain	Capsicum Annuum (Cayenne)
Capsaicin	Dementia	Galanthus Nivalis
Valerian	Insomnia	(Valeriana Officinalis
Arnica	Pain, Inflammation, Wound Treatment,	Arnica Montana
Cinnamon	(Cinnamomum Verum)	Lowering Blood Pressure
Cinnamon	Mentha Balsamea	Irritable Bowel Syndrome

**Box 1:** Key drivers for herbal medicines.

- ◆ The desire to bring diversity to a product portfolio, particularly when herbal medicines can have the intrinsic baked-in protection of being difficult to copy from both a proprietary processing standpoint.
- ◆ An increasing belief among the public that herbal medicines are better than pharmaceutical synthetic drugs.
- ◆ Herbal medicines, compared to other synthetic drug types, can have proven lower toxicity profiles.
- ◆ Long history of in many instances of the successful and safe use of many herbal medicines to treat many diseases.
- ◆ Attractiveness of the possibility that one herbal medicine approval could result in sales in several indications or disease applications.
- ◆ Greater awareness of the need for and movement on collaboration internationally between industry, government and academia and local communities to bring herbal medicines (including the traditional Chinese medicine) to market.
- ◆ The lack of generic reproducibility for most herbal medicines when their patents expire.
- ◆ Increasing health care costs could potentially be offset using herbal medicines as opposed to synthetically created compounds.
- ◆ A more favourable regulatory climate toward herbal medicines, which is not stringent compared to pharmaceutically derived synthetic drugs.
- ◆ Increasingly open markets in China, Indian and Africa for the acceptance of herbal medicine and exchange of materials.
- ◆ Costly experiences with synthetic pharmaceutical drugs being pulled from the market.
- ◆ Evolution of new biotechnology processing techniques that make the creation of herbal medicines easier.
- ◆ Potentially less costly development of many herbal medicines, given that extracts are not subject to isolation of chemical isolates, but can be moved directly to testing for clinical efficacy.
- ◆ Government initiatives aimed at increasing the number of herbal medicines in the market

**Table 2:** Global Market for herbal medicines in comparison to Plant-based pharmaceutical drugs (USD Millions).

Category	Year (USD Millions)			
	2016	2017	2022	CAGR% 2017-2022
Plant-Based Pharmaceutical Drugs	27	29	39	6
Herbal Medicines	60	57	425	50

Further, since 2022, herbal medicines for cardiovascular diseases accounted for the biggest share of revenues, excluding the sales of non-branded and non-FDA-approved drugs, which are already sold as a medicine. In 2022, the size of the herbal medicine assumed line extensions for diarrhoeal diseases, as well as anti-aging, weight loss, joint and bone health, arthritis, stress relief, eye health and female and male health and libido. Table 3 indicates the top selling FDA approved herbal medicines [16].

Developed countries, such as France, Germany, Italy, and the United Kingdom have interest in herbal medicines use and thus make up the largest market for herbal medicines. It is projected that emerging economies such as Brazil, China and India will have faster growth than developed countries in the coming years in both the consumption and production of herbal medicines. It is predicted that during this year, China will become the largest global producer and consumer of herbal medicines, more especially due to the COVID-19

as many research and development programs has been established to investigate Chinese traditional medicine for COVID-19 [22-24] (Box 2).

### African market

It is widely known that 70% and 80% of the people in Africa rely on herbal medicines for primary health care [25]. This high percentage is attributed to various factors including limited accessibility, availability, and affordability of pharmaceutical drugs. There are generally about 6000 medicinal plant species on the African continent used in traditional medicines [26]. There are various studies generated from the different African countries which suggest that trading of the medicinal plant species in the informal herbal medicine markets in Africa has significant socioeconomic importance, as this enables millions of people to generate incomes. For instance, in Benin, herbal medicines generate economic opportunities for vulnerable

**Table 3:** Top selling herbal medicines in the United States of America.

Herbal Medicine Product	Plant Species	Geographic Origin	Revenue (USD)
Horehound	<i>Marrubium vulgare</i>	Europe, North Africa, SW Central Asia	106,897,772
Yohimbe	<i>Pausinystalia yohimbe</i>	Central Africa	67,393,961
Cranberry	<i>Vaccinium macrocarpon</i>	North America	48,808,893
Black Cohosh	<i>Actaea racemose</i>	North America	45,967,801
Senna	<i>Senna alexandrina</i>	North Africa	32,260,528
Cinnamon	<i>Cinnamon spp.</i>	Asia	29,525,719
Flaxseed	<i>Linum usitatissimum</i>	Europe, Mediterranean	28,363,954
Echinacea	<i>Echinacea spp.</i>	North America	28,277,149
Valerian	<i>Valeriana officinalis</i>	Eurasia	28,258,909
Saw Palmetto	<i>Serenoa repens</i>	North American	21,612,897
11 Aloe Vera	<i>Aloe vera</i>	South Africa	18,243,186
Bioflavonoid complex	<i>Citrus spp.</i>	South and Southeast Asia	16,332,400
Milk Thistle	<i>Silybum marianum</i>	North America	16,293,694
Ginger	<i>Zingiber officinale</i>	Asia	16,203,615
Horny Goat Weed	<i>Epimedium spp.</i>	North Africa/Asia	15,086,408
Garlic	<i>Allium sativum</i>	Eurasia	14,520,837
Red Yeast Rice	<i>Monascus purpureus</i>	Asia	11,952,456
Ginkgo	<i>Ginkgo biloba</i>	Asia	11,603,100
Horsetail	<i>Equisetum spp.</i>	Cosmopolitan, Europe	11,159,101
Bromelain	<i>Ananas comosus</i>	South America	8,755,864

**Box 2:** Summary of the challenges for herbal medicines.

- ◆ Lack of funding. As most herbal medicines move through a regulatory drug pathway using standard data requirements, companies with limited botanical experience could be required to pay for outside or contracted resources/expertise.
- ◆ Too few approvals to build confidence or supply a template for companies or investors.
- ◆ Companies' perception that regulatory submission will be easy and fast, meaning an inherent failure to prepare for the regulatory tasks ahead, including engaging with the FDA on expected steps.
- ◆ Inadequate human subject or existing animal toxicity data to support the safety of a clinical trial. • Insufficient characterization of the botanical materials or ingredients.
- ◆ Poor harvesting or manufacturing practices to ensure batch consistency of therapeutic elements.
- ◆ Potential toxicity in ingredients that have not been evaluated adequately in animal studies. • Poor clinical trial design (e.g., inadequate controls).
- ◆ Poorly defined study subjects. Quality issues that compromise the safety and integrity of a study (e.g., contamination or adulteration).
- ◆ Standard process to ensure consistency is not well understood.
- ◆ Lack of overall expertise in small companies, particularly regarding the technical difficulties of handling complex natural materials.
- ◆ Investment can be challenging if botanicals are poorly understood and/or the economy is weak. Viewed from a business development perspective, the field of plant-derived drugs can be seen through a SWOT (strengths, weaknesses, opportunities, and threats) analysis.

groups living in peri urban, rural, and marginalized areas especially women and farmers facing decreasing agricultural incomes [27].

About 90% of herbal traders in southern and central Malawi derived more than 50% of their households' income from selling medicinal plants [28]. Similarly, over 61 000 kilograms of non-powdered medicines valued USD 344,882 are traded in informal herbal medicine markets of Tanzania per year. In Morocco, annual revenues generated from export of medicinal plants were USD 55.9 million in 2015 [29] and USD 174, 227, 384 in Egypt [8]. Approximately 951 tonnes of crude herbal medicines with an estimated total value of USD 7.8 million was traded in Ghana's herbal markets in 2010 [30]. These findings from these aforesaid studies show that

trading in medicinal plants play an important socioeconomic role in several African countries, and the African herbal medicine industry has the potential to compete globally.

The drive-in policy shift for herbal medicines coupled to a regulatory framework will drive the market growth. The herbal medicine industry encompasses at least nine different philosophical approaches to medicine preparation and application, requires a workable regulatory system to ensure that products are of a good quality and are safe for use.

### South African herbal medicine market

Like many African countries, South Africa is rich in plant

species and the demand for medicinal plant species locally and internationally, is rising. There are more than 500 000 traditional health practitioners active throughout the country and about 80% of South Africans, mainly from rural areas consult a traditional health practitioner for plant-based traditional medicine to meet their primary health care needs and even cultural or spiritual purposes [31]. About 3,000 indigenous plant species to South Africa are used in traditional medicines [32]. The South African National Department of Forestry, Fisheries and the Environment have identified 25 plant species to develop the South African herbal industry through research, cultivation and access and benefit sharing (Figure 1). The plant species have selected based scientific research data availability, traditional uses, and trading of the plant species on the South African local market.

The economic value of trade in raw medicinal plant species in South Africa is estimated at R520 million, contributing towards the worth of the herbal medicine at R2.6 billion per year [34]. With an estimated 27 million consumers of herbal medicines, the trade is vibrant and widespread, generating least 133 000 people employed in the trade, a large percentage of them being rural women [35]. The plant trade is a key rural industry and business incubator.

As in many countries, herbal medicines are widely available in supermarkets, pharmacies, and health shops commercialised by the private sector companies (Table 4). The bulk of traditional medicines are herbal. Each year, around 20 000 tons of plant materials are collected from the 771 plant species used by local traditional health practitioners to develop new herbal medicines [34].

## REGULATORY REQUIREMENTS FOR HERBAL MEDICINES

The new regulatory process for herbal medicines in South Africa is much the same as for synthetic drugs. However, it has certain freedoms, such as reduced time-to-market for drugs with established safety, efficacy and quality profiles in humans and no requirement to further purify extracts. Like the regulatory process for synthetic drugs, the new process also includes Good Manufacturing Practices, Good Laboratory Practices and Good Agricultural Practices in terms of the allowances and constraints made on the manufacture of plant-derived drugs. More specifically, according to the new Food and Drug Administration guidelines, to prepare for a Phase 1 or 2 clinical trial with a botanical product, companies need to submit information on the active constituent or marker compound, all documentation on the historic and current use of those elements and some

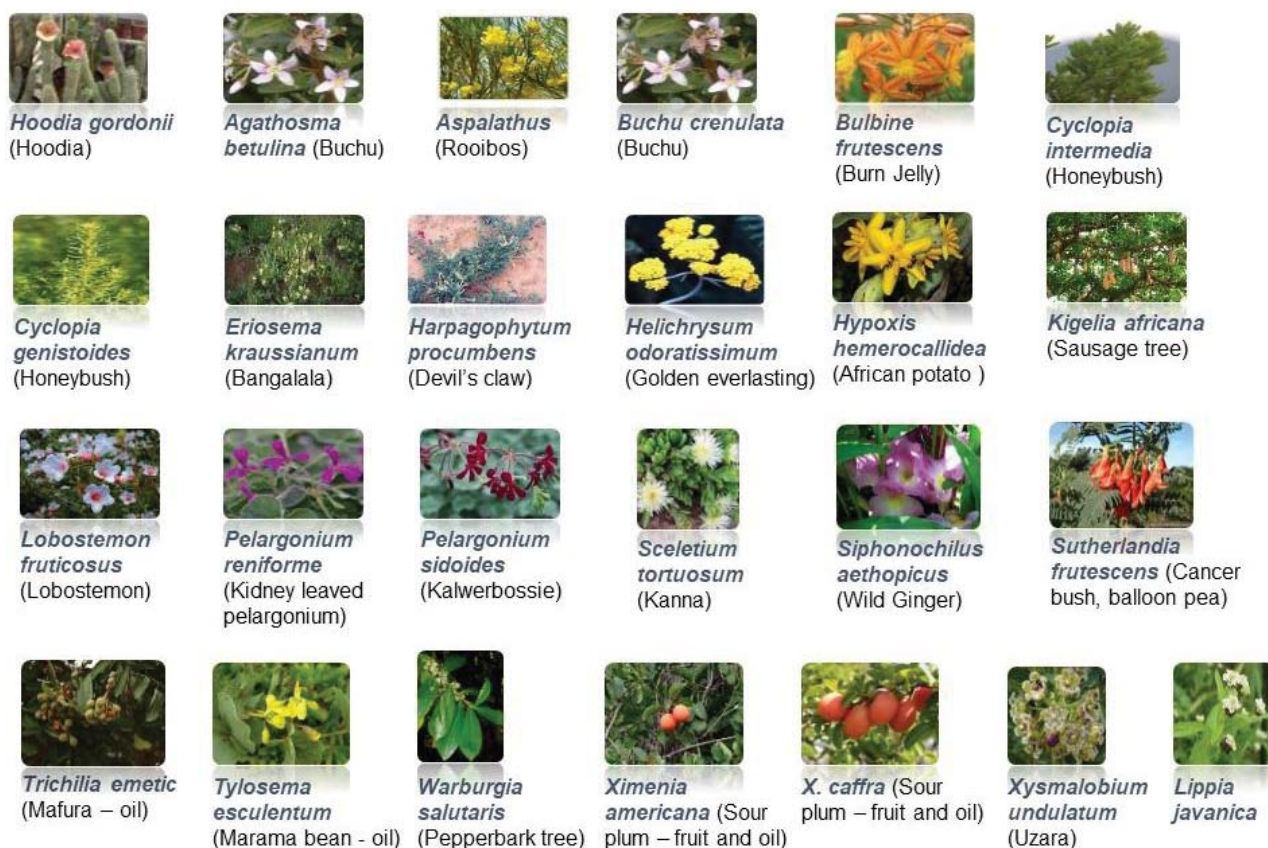


Figure 1 South African indigenous plant species to develop South Africa's herbal medicine industry, source [33].

**Table 4:** South African private sector companies operating within the herbal medicine industry, source [35].

Company's name	Company' Description
Afrilex (Pty) Ltd	The company (2001/016535/07) was established in August 2001 and operates as a contract plant extracting, manufacturing, and distribution company, owning five commercial farms. Afrilex manufactures products for the food flavor and beverage markets, as well as the complementary medicine market, and manufactures a range of products to client specifications
Ascendis Health Ltd	The company is for a healthcare group which owns a portfolio of branded pharmaceutical, medical, wellness, cosmetic, and nutrition products. The group markets and exports its products predominantly in South Africa, Europe, and Australia, and owns production facilities in South Africa (3), Spain (1), Cyprus (1), and Hungary (1). The group's divisions market to retailers, beauty salons, pharmacies, wholesale, dispensing doctors, state tenders, private hospitals, network marketing, and agricultural businesses (co-operatives)
SA Natural Products (Pty) Ltd	The company imports, wholesales and distributes herbal and homeopathic remedies, gluten-free foods, tea tree body care and nutritional supplements. It supplies pharmacies, health stores and private doctors. Bioforce South Africa (Pty) Ltd, a subsidiary company, undertakes the local manufacture of nutraceutical products
CoMED Health (Pty) Ltd	The company operates as a manufacturer and distributor of homeopathic medicines made from plant and herb extracts. The goods are supplied on a wholesale basis to chemists, health shops and homeopathic practitioners. The company holds the agency for Mediherb in South Africa
Hersol Manufacturing Laboratories (Pty) Ltd	The company operates as a contract manufacturer of chemicals, health foods, cosmetics, and nutraceutical products for Swissgarde, Health and Performance Products International, Spectron and most major nutrition companies in South Africa.
Forever Living Products South Africa (Pty) Ltd	The company was originally founded in 1978 in the United States of America. F L P Products South Africa (Pty) Ltd was established in March 1995, subsequently undergoing a name change to Forever Living Products South Africa (Pty) Ltd. Forever Living Products South Africa (Pty) Ltd operates countrywide and is involved in the import and distribution of nutritional and health products, selling directly to the public through distributors
Afrinatural Holdins	Offers natural, botanical ingredients and value-added products from all over Africa to the rest of the world and cover the entire supply chain from the grower, harvester, manufacturer, and supplier to the consumer
Umuthi Essentials oils	Product developer for a wide range of aromatherapy and massage products now available wholesale to the public in South Africa. Buy Essential Oils from this simple to use uncomplicated online shop.
Eco Products	based in Limpopo province and has been involved in the development and supply of baobab oil and baobab powder to several companies since 2006
Skimmerberg (Pty) Ltd	Production of rooibos and buchu products. Also grow and process rooibos and buchu to develop their own product concepts
African Medicines (Pty) Ltd	Imports the raw materials of medicinal plant species to African countries (probably for scientific research and product development)
AMKA Products (Pty) Ltd	Manufacturer and distributor of hair care, personal care, and home care products under various brand names, as well as hand sanitiser under the Clere brand. The company has 4 manufacturing facilities located in Pretoria

chemical, manufacture and control information. For Phase 3 trials, regardless of whether the product has been used as a dietary supplement, more chemical, manufacturing and control information is needed on preclinical safety and additional toxicology studies.

The WHO reported that member states with regulations or laws for herbal medicines increased from 65 in 1995 to 124 in 2018. Regulations of herbal medicines, according to the WHO, mean principle, rule, or law designed to control or govern manufacturers and producers of herbal medicines. In other words, regulations require herbal medicines to be safe, effective and of good quality for human consumption, and this principle is common across all the signatories to the WHO. South Africa is such a country, regulating herbal medicines under the Medicines and Related Substances Act, 1965 (Act 101 of 1965), of which the South African Health Product Regulatory Authority operationalises this law by regulating all medicines, and medical devices in South Africa by ensuring that they meet standards of safety, efficacy, and quality. While countries may have the regulatory systems for herbal medicines, the harmonisation of regulations across countries globally is promoted as a way of streamlining and providing clarity on what are currently extremely inconsistent regulatory frameworks. Regulations within the European Union, for example, are considered some of

the most stringent in the world, while the relatively lax US regulatory environment is sometimes referred to as the "wild west".

Regulators across the world require a range of data from companies to ensure the identity, purity, quality, strength, potency, and consistency of botanical drugs. Proving efficacy requires additional clinical trials that are time-consuming and might run into many millions of dollars, and so are undertaken by only the largest companies. In addition to that found in large companies, advanced research is undertaken by government and academic research programmes; companies will also make use of pharmaceutical company's research and development on products that have been abandoned.

Traditional knowledge is the primary guide to new product development; it is integral to acquiring approval from regulatory agencies and is used when marketing products to consumers by validating claims for safety and efficacy. Therefore, it is the foundation of the herbal medicine industry. Unlike most sectors that demand access to genetic resources, herbal medicines continue to depend on traditional knowledge. As such, the regulators are required to address the implementation of the Nagoya Protocol on Access and Benefit Sharing in to promote the equitable and

sustainable use of genetic resources. The Nagoya Protocol also offers opportunities for the herbal medicine industry to better clarify their obligations and responsibilities to the traditional health practitioners who are the holders of traditional knowledge.

Herbal medicinal products are gaining global importance because of their health benefits. The demand for access to new medicinal plant species and traditional knowledge persists, but awareness of the Nagoya Protocol on Access and Benefit Sharing and the legal and ethical obligations associated with using traditional knowledge, and bringing new species to market, remains limited.

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## CASE STUDY: THE CSIR AFRICAN GINGER PROJECT

### The CSIR-traditional health practitioners

The CSIR (Council for Scientific and Industrial Research) is one of the leading public research, technology development and implementation for industrialisation on

the African continent. The objects of the CSIR are, through directed and particularly multi-disciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act." [36].

The CSIR collaborates with a traditional healers committee that has networks across South Africa. Through this collaboration, African ginger was identified as having been used traditionally for mild allergic asthma, colds, influenza, and sinus problems. The method of preparation of the traditional remedy includes cold and hot infusions of the rhizomes and roots, steaming of the rhizomes and inhaling the vapour, and chewing on the fresh rhizomes.

### Description of African ginger and traditional uses

African ginger, which scientific or botanical name is *Siphonochilus aethiopicus* (Schweinf.) B.L. Burt is a member of the family Zingiberaceae. The plant species is a fragrant aromatic plant species widely occurring in countries on the African continent, such as in Mozambique, Zimbabwe, Malawi, Angola, Senegal, Benin, and Ethiopia [37,38]. The plant species is used in traditional medicines throughout Africa to treat malaria, pain coughs, influenza, sinuses, digestive and cardiovascular diseases. The plant species is reported to be used as spices in dish flavouring in Nigeria [39].

In South Africa, the natural distribution of African ginger is restricted to the selected provinces of South Africa, namely Mpumalanga, Limpopo, and Kwa-Zulu Natal [40,41]. The plant species as been described as aromatic and deciduous with large and elongated leaves developing annually from a small, cone-shaped rhizome [42]. The purple flowers appear at ground level in early summer (Figure 2).

It has been shown the wild populations of African ginger have already depleted from the provinces where is naturally restricted [40,41], due to over harvesting for trade on the muthi markets around South Africa [42], thus a highly commercially important medicinal plants in Southern Africa, especially through research, product development and cultivation [48]. Small scale cultivation sites for African ginger in South Africa exist to back the plant species from the brink of extinction [42,43]. This plant is currently listed in the Red Data book of South African plants [42].

### The CSIR R&D based on African ginger and Intellectual property

The CSIR R&D based on the African ginger from Mpumalanga has shown that the active extracts, both tested



**Figure 2** A) The photograph of purple flowering African ginger, with elongated leaves developing from the cone-shaped rhizomes B) Source: Author of the report.

*in vitro* and *in vivo* demonstrated the beneficial effect of the plant species for the improvement of the symptomatology associated with allergic and infectious diseases and provides scientific evidence for clinical trials on humans to investigate its traditional use to treat allergic diseases and inclusion in complementary medicine products.

Organic extracts developed from the rhizomes of African ginger consist mainly of furanoterpenoids as investigated by the LC-MS method. This major chemical marker has been shown by the CSIR to be responsible for potential therapeutic properties of African ginger to treat asthma *in vitro* and *in vivo* studies, as reported by [44].

The CSIR has been granted an international patent WO/2007/113698 for the preventative treatment and remission of allergic diseases. The patent is about compounds that are useful in mammals in supporting, promoting, and maintaining health, and in the amelioration, prevention, and treatment of Central Nervous Systems (CNS) disorders or conditions, unit dosages forms containing the compounds, delivery systems for the compounds, and methods for preparing the compounds. More specifically, the invention relates to plant extracts containing the compounds and uses thereof for the support, promotion and maintenance of health and the amelioration, prevention and treatment of such disorders or conditions. The invention also relates to methods of preparing a plant extract containing the compounds. Moreover, the CSIR holds the bioprospecting permit (BABS/000511P) based on African ginger to further investigate African ginger products in relation to traditional use in clinical studies. The permit was issued in terms of the South African Biodiversity Act, 2004.

In conclusion, the CSIR has fully characterised African ginger through research and development. Scientists have undertaken animal studies for allergy and asthma and the remedy is now ready for development into herbal medicine through clinical studies and registration as a complementary medicine, as part of the implementation of the South African legislation, Biodiversity of 2004, which the custodian is the National Department of Environment, Forestry and Fisheries. Capitalising on the scientific evidence produced by the CSIR, African ginger provides an ideal opportunity for the development of herbal medicine.

### Cultivation of African ginger and indigenous knowledge

Based on experiences of the CSIR gained during the scientific research and development, and considering the conservation status of the plant, it was evident that commercial quantities of plant material can be supplied more cost-effectively and in an environmentally sustainable manner through use of cultivation sites as opposed to harvesting from the wild. Different areas in South Africa have already been identified by the CSIR as ideal sites where cultivation programmes have been initiated for the plant species. This is in collaboration with the farmer from Mpumalanga province of South Africa.

African ginger is well adapted to the climates of the Limpopo and Mpumalanga provinces and is easy to cultivate in a well-drained, compost rich soil and a warm but shady position, either in a container or in a garden, growing from cuttings of the rhizomes in the winter when they are dormant. Watering should be reduced to a minimum during the winter months, while the plant is dormant and may

be resumed with the onset of spring. During the growing season plants respond very well to high levels of feeding with organic matter [45]. The plant may also be propagated from seed, although this may take up to a year to germinate. Tissue culture is another way in which the plant may be propagated. Cultivation is an important aspect for future development programmes for African ginger, which is critically threatened in the wild.

The study of Seile and co-researchers in 2022, explored the potential role of indigenous knowledge on the uses, sustainability, and conservation for African ginger among two communities in Mpumalanga province of South Africa, through a qualitative research method entailing in-depth interviews [46]. As revealed by the participants, the multiple uses of African ginger are major contributing factors exacerbating the demands for the plant. The uses of African ginger have resulted in the scarcity and possibly extinction of this plant species in the wild, which remain a major concern to several stakeholders especially traditional health practitioners. To ensure the sustainable utilisation of African ginger, harvesting of the rhizomes of African ginger is recommended instead of the root given the relative ease and higher chances for survival and regeneration. Cultivation of African ginger has been revealed as one of the strategies to conserve African ginger from depletion. However, there is a need for further intervention to assess how the community members can be assisted with developing and adopting indigenous conservation protocols for the continuous sustainability of African ginger. In addition, it is pertinent to strongly discourage the indiscriminate destruction of natural habitats and create more awareness on the importance of designating protected areas among local communities.

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**How to cite this article:** Bareetseng S. The Worldwide Herbal Market: Trends and Opportunities. J Biomed Res Environ Sci. 2022 May 21; 3(5): 575-584. doi: 10.37871/jbres1482, Article ID: JBRES1482, Available at: <https://www.jelsciences.com/articles/jbres1482.pdf>