
Abbreviations

%	Percent or Percentage
AD	Anno Domini
AHM	Arab Herbal medicine
AM	Arabic medicine
AMM	Arabic materia medica
AMPK	5' AMP-activated protein kinase
BC	Before Christ
BCE	Before the Christian Era
CAM	Complementary and alternative medicine
CAMHI	Conference of African Ministers of Health
<i>COVID-19</i>	Coronavirus disease 2019
FDA	Food and Drug Administration
HIV/AIDS	Human immunodeficiency virus acquired immunodeficiency syndrome
HPLC	High-performance liquid chromatography,
IIS	<i>C. elegans</i> insulin/IGF-1 signaling (IIS) pathway
JNK	c-Jun N-terminal kinases
MAPK	Mitogen-activated protein kinase
NFκB	Nuclear factor kappa-light-chain-enhancer
OAU	Organization of African Unity
ORID	Other related infectious diseases
SARS-CoV-2	Severe acute respiratory syndrome <i>coronavirus 2</i>
SATM	Standardized African traditional medicines
TB	Tuberculosis
TCM	Traditional Chinese Medicine
U.S.	United States
USA	United States of America
USD	United States Dollars
USG	United States Government
WHM	Western Herbal Medicine
WHO	World Health Organization

1 Introduction

Medicinal plants are the source and foundation for the effectiveness and efficacy of both traditional and modern medicine. In both industrialized and developing countries, medicinal plants are crucial in the management of diseases and are the foundation for many maladies that have been treated for thousands of years [85]. Traditional medicine is becoming more popular in both developed and developing nations due to its natural origins and perceived lack of negative side effects. Herbal medicine has gained increased attention at the policy level, as evidenced by the

Astana Declaration on Primary Healthcare [12], which promotes the impartial integration of both herbal medicine and scientific knowledge in basic healthcare. The declaration calls for greater political commitment to organizations and individuals that contribute to the provision of primary healthcare to everyone around the world. Herbal medicine is vital to primary healthcare because of the knowledge and capacity-building considerations. Nonetheless, it is impossible to not overstate the therapeutic significance of traditional medicine.

According to the World Health Organization (WHO), around 80% of the people in the world are reliant on herbal medicine for their basic healthcare needs ([85]; WHO, [208]). Based on the most recent estimates, two-thirds of the global populace are heavily reliant on unorthodox medical treatments because they are more widely accessible, more affordable, and more in line with patients' ideologies, placate the fears of negative effects from chemosynthetic medicines, satisfy the inclination for individualized healthcare, and enable widespread public access to personal and relevant health records [1, 37, 40]. As a result, several more individuals have embraced the use of indigenous plants. Chemically synthesized drugs are widely spread over the past century and have profoundly reformed medical services in several countries across the globe. Nevertheless, a larger fraction of the developing nation population continues to depend on natural remedies and traditional alternative medicine practitioners for their primary care. At least 90% of the African populace and 70% of the Indian descendants count on herbal medicine to aid and/or satisfy their healthcare needs [30, 49, 120]. Over 40% of all healthcare services provided in China are traditional medicine, whereas over 90% of general hospitals already established departments for traditional health medicine practice [54, 211, 216]. Furthermore, the use of traditional medicine is not restricted to third-world nations only; the last 200 years have witnessed an upsurge in the people's interest in natural remedies in developed nations, along with an expansion of the use of ethnobotanicals. Herbal medicine is at the heart of several healthcare systems across the globe – Western Herbal Medicine (WHM) is practiced in New Zealand, Canada, Australia, Great Britain, and Western Europe; Traditional Chinese Medicine (TCM) in China; Ayurveda in India; and Kampo in Japan. In addition, a variety of over-the-counter medicines approved by the European Union's Traditional Herbal Medicinal Product Regulation are widely available in pharmacies [62].

This chapter aims to provide a historical background to herbal medicine resources, practices and techniques, products, values, and challenges to the promotion of the age-long medical practice and highlight areas in need of attention to help increase the competitiveness of the practice and help integrate it into or ensure it is sustainably practiced alongside conventional medicine. It is organized into five parts – history of herbal medicine, utilization of herbal medicine, herbal medicine techniques, trends in herbal medicine, and herbal medicine research needs. This is the oldest form of medicine known to humans all over the world and is proven to be effective in the treatment and management of diverse diseases and ill health conditions. This work highlights the need for globally standardized procedures and research support to help clarify processing methods, routes of administration, doses, and compatibility issues.

2 Historical Perspectives of Herbal Medicine

It is difficult to clearly distinguish the history of herbal medicine into different eras because human societies evolved different herbal medicine practices and systems in isolation which contributed to the various forms of medicine available today. However, here we adopt a system that presents the views and historical practices of herbal medicine in some ancient human societies around different parts of the world, and these are arranged in no particular order.

2.1 Ancient Babylonians

The ancient Babylonians used plants as medical remedies as far back as 60,000 years ago. Written accounts of herbal medicine are at least 5000 years old in China and 2500 years old in Asia Minor and Greece [160]. There are several herbal medical systems, and each one's beliefs and practices are shaped by the area where it initially emerged [211]. Traditional Chinese medicine, which has been practiced for centuries, is the country's unique system [202]. The world's first known herbal book was published over 2000 years ago (*Divine Farmer's Classic of Herbalism*) and was written in China. Many herbal pharmacopeias and other monographs on certain plants are also available [200].

2.2 Ancient Hindustani Doctors

Ancient Hindu doctors and saints established Ayurveda, a medical system that has been practiced in India for over 5000 years. In its material medica, more than 1500 plants and 10,000 formulas are fully described. In contrast to Western medicine, the Indian government has acknowledged Ayurveda as a full healthcare system [53]. The Japanese herbal medication Kampo medicine has roughly 148 formulas and is over 1500 years old [205]. The majority of people continue to practice Ayurvedic medicine in India, Kampo medicine in Japan, Traditional Chinese Medicine, and Unani medicine in the Middle East and South Asia. The demand for herbal medicine and other botanicals by Western cultures has been continuously rising in the recent herbal renaissance period. Acupuncture and herbal treatment, which are both parts of TCM, are now more popular than ever in Western nations [21]. Together with herbal medications, other herbal items including cosmetics, perfumes, teas, health foods, and nutraceuticals are also widely used and make up a sizable component of the worldwide herbal market.

In actuality, it likely predates contemporary *Homo sapiens*. In Neanderthal graves in Iraq going back 60,000 years, archaeologists have discovered pollen and flower pieces from several different medicinal plants. Among them were species of *Ephedra*, *Centaurea*, *Senecio*, *Althea*, and *Achillea*. This can be evidence of the widespread usage of different herbal treatments at that very early time. According to legend, China has utilized *Cannabis* plant (*C. sativa* L.) for more than 8000 years [41].

The opium produced from the poppy (*Papaver somniferum* L.), which was first grown in Mesopotamia around 5400 years ago [19], has been used for medical purposes continuously ever since. Two fragments of the birch fungus *Piptoporus betulinus* (Bull.) Karst was found inside the mummified human body known as the “Iceman” that was found in the Italian Alps in 1991. According to scientists, this 5300-year-old person may have been utilizing the fungus as a medicine to cure intestinal parasites [24]. It is without dispute that herbal therapy has a long history.

2.3 Chinese Medicine

Chinese people have employed Traditional Chinese Medicine since ancient times. While components from animals and minerals have been employed, plants are the main source of cures. About 500 of the more than 12,000 items used by traditional healers are regularly used [103]. Botanical products are only used after being processed, which could include stir-frying or soaking in vinegar or wine, for example. In clinical practice, a complex and frequently individualized treatment may be prescribed after a conventional diagnosis. In China, conventional Chinese medicine is still widely practiced. Traditional medicine is regularly used by more than 50% of people, with rural areas having the highest rates of use. In China, there are over 5000 traditional medicines that makeup about one-fifth of the country’s pharmaceutical sector [103]. Numerous herbal treatments made their way from China to the Japanese traditional medical systems. In the ninth century, the earliest pharmacopoeia of Japanese traditional medicine included a classification of native Japanese herbs [173].

2.4 Arab Herbalists

It is generally known that in the Middle Ages, Arab herbalists, pharmacologists, chemists, and doctors modified and enhanced classical Hippocratic-Greek medical knowledge. In addition, the vast majority of Arabs are Muslims, and Islamic philosophy and Arabic culture are intimately intertwined. As a result, Arabic medicine (AM), Arabic materia medica (AMM), and Arabic herbal medicine (AHM) are also known as Greco-Arab or Islamic medicine. Arabs in the Baghdad area were the first people in history to distinguish between medicine and pharmaceutical science in the eighth century. The Arab world is where the first pharmacies were opened (Baghdad, 754 CE). Certain medication formulations may still be found in pharmacopoeias today, and the forms utilized at the time are still used in treatment [116]. Mesopotamia produced the oldest records of herbs, which were recorded on clay tablets and written in cuneiform (dating back to 2600 BCE). The Ebers Papyrus, which dates back to 1500 BCE, is the most famous Egyptian medical record. It lists 700 herbal remedies (mostly derived from plants) and their dosage forms, including gargles, snuffs, poultices, infusions, pills, and ointments, as well as their carriers, including beer, milk, wine, and honey [171].

AHM has been practicing the use of organic and inorganic natural medicines for the prevention and cure of illnesses since the eighth century, including camel urine [123]. It is interesting to note that camel urine therapy had a significant cytotoxic impact on mouse bone marrow cells, according to pharmacological investigations [115]. Just 200–250 plant species are still used in traditional Arab medicine to treat different ailments, despite the Middle East being home to more than 2600 plant species, more than 700 of which are known for their usage as medical herbs or botanical insecticides [6].

From Alexandria to Sallum in Egypt, the western Mediterranean coastal area has 230 species of plants from 48 families; 89% of them were useful for medicine, 62% were common, around 24.9% were unusual, and 15% were rare [14]. The Mediterranean area and/or the worldwide market still sell or trades 236 plant species, 30 animal species, 29 organic compounds, and 9 materials of other or mixed sources that are still used to cure human ailments [6]. Around 250–290 plant species are still in use in the Mediterranean area, according to ethnopharmacologists' surveys of the region's plant species [101, 172]. A total of 129 plant species are used in AM in Israel to treat a range of illnesses. About 40 species of these plants are used to cure skin conditions, 27 species for digestive issues, 22 species for liver issues, 16 species for respiratory conditions and coughing, 22 species for different types of cancer, and 9 species for weight reduction and cholesterol lowering [15]. Yet throughout the Arab Empire, Islamic doctors employed more than 1400 different types of herbal remedies (632–1258). The late nineteenth and early twentieth centuries, up to the implementation of the Food and Drugs Act of 1906, were likely the height of herbal medicine use in the USA. Hundreds of patent herbal preparations, many of which included a significant amount of alcohol, were easily accessible on the US market before this regulation. Some of these, such as Swift's Syphilitic Specific, later shortened to SSS Tonic [191], and Lydia E. Pinkham's Vegetable Compound [192], continued to be sold and are still well remembered by many people today. Yet, the majority of these items and the absurd advertising that supported them were put out of business by the 1906 Act.

2.5 Aztec Medicine

This is a system of herbal medicine that evolved within Aztec societies where human health is managed holistically using spiritual and material bodies (plants and animal products and by-products). It began among the Nahuatl-speaking indigenous people of Mexico. Today, Mexico is the nation with the second-highest number of registered medicinal plants after China and has a long history of using medicinal plants [7, 50]. [36]. Indigenous traditional medicine in Mesoamerican societies began to emerge about 1500 B.C., beginning with the Olmec, the mother culture, and continuing with the Toltecs, Teotihuacans, and Mayans [170]. This came to an end, however, with the collapse and invasion of the Aztec empire in 1521 by Spanish colonizers, who lost a great deal of knowledge about the use of plants as medicines. After the conquest, however, it was possible to reconstruct the Aztecs' medical

history. The *de la Cruz-Badiano Codex* (Código de la Cruz-Badiano), which was produced in 1552 by Nahuatl native Martin de la Cruz and translated by Juan Badiano, is the earliest book on medicinal plants used by Native Americans on the American continent [68]. Religion, astronomy, divination, and the polarity of cold and warm served as the foundation for Aztec medical doctrine. The estimated number of Indigenous people in Mexico now is 25.5 million (or 21.5%) [69]. The majority of herbal medicine used to treat common ailments is used by these Indigenous groups [29].

2.6 Indigenous or Native American Societies

Presently, 4.9% of Canada's population, or 1.7 million people, and 1.7%, or 5.6 million people in the USA, identify as Indigenous [110, 184]. The Indigenous people who resided on the land and were assimilated into several nations in Canada before the advent of European invaders, such as the Inuit and Metis, are known as First Nations [184]. Native Canadians' traditional medical practices are in danger of disappearing since they were historically replaced by the modern medical system and lost the trust of the populace as a result of conquering. As a result, governments, medical professionals, and European Canadian missionaries gradually banned indigenous healing practices [39]. For instance, with the Indian Act of 1876, Federal Indian policies increased and codified the monitoring and control of Native Americans' lives [52, 98].

Children from these villages were taken away by force in the 1960s and put in foster care to be adopted by non-Native families in Canada. Intergenerational trauma resulted from the assumption that the parents of these children did not have enough residences and educational opportunities to care for them [39, 88]. As a result, it has been challenging for the Indigenous community to transmit their ancestors' traditional medical knowledge. Nonetheless, this persecution and cultural marginalization have been reversing in recent decades. Indigenous peoples of Canada have used their traditional knowledge of medicinal plants for thousands of years, and it has been handed down verbally down the generations. Particularly significant in this sense for Indigenous peoples like the Metis, Cree, Dene, Sekani, Innu, Ojibwa, Chippewa, Abekani, and others are the boreal forest regions of Canada [195].

According to the most recent population census, the majority of the Indigenous people in the USA are American Indians, Alaskan Natives, and Hawaiian Natives, with a combined population estimated at five million (1.5%) [194]. Before the coming of European colonizers, Native Americans in the USA engaged in health practices that, during therapeutic sessions supported by goods like herbs, emphasized the connections between individuals (family and social groups) and the environment [215]. The loss of lands and other resources experienced by the American Indians and Alaskan Natives in particular during colonialism influenced their way of life, particularly the repression of their spiritual and healing practices, which is still

happening today [215]. With the loss of their rights came the relocation of American Indians and Alaskan natives to reservations, separation from their holy places and medically significant flora and fauna. Congress was given extensive constitutional authority to negotiate with these groups in 1787. The American Indian Religious Freedom Act was enacted by the US Congress in 1978. However, many American Indians and Alaskan Natives are not recognized by the federal government [215].

Before the coming of the European conquistadors, traditional Native American medicine was used for generations. Yet these techniques were outlawed, and this information was given a lower value. Because of this, little is known about how these activities affect human health, and it is challenging to interpret both archaeological and human remains. The 1990 Native American Graves Protection and Repatriation Act, in particular, restricts research on the latter [193]. However, the contemporary tribal tribes are attempting to revive these historical rituals [215]. In the USA, the study of traditional indigenous medicine made from wild plants dates back more than a century [156]. The mesophytic woods of Appalachia are thought to include 1100 plant species of therapeutic use [25]. Eastern Tennessee, Western North Carolina, and Southeastern Virginia make up these woods; this area has a wide range of temperatures that favor the development of a wide diversity of plants. Although, traditional medicine and the use of medicinal plants can be traced back to Mesopotamia and Egypt, the foundation of European medicine was established by physicians and philosophers during Greek antiquity and the time of the Roman Empire, who began establishing a written consensus about what was considered effective medical knowledge. The oldest known fragment of a Greek herbal is preserved in the ninth book of Theophrastus of Eresos' (c. 370–287 BC) *Enquiry into Plants*, which is about the juices and therapeutic characteristics of plants [65]. Hippocrates of Kos (c. 460–370 BC), Galen (129–c. 199/200 or 216–217 AD), and Pedanios Dioscorides (first century AD) were the most illustrious and significant ancient writers who successfully merged botanical and medicinal knowledge. The most significant herbals ever published are considered to be Dioscorides' *De Materia Medica* and Galen's first alphabetical compilation of simple medications (*De simplicium medicamentorum facultatibus libri XI*). These writings had an impact on Mediterranean and European medicinal plant usage up to the eighteenth century via the constant copying and distribution of their content [11, 196].

Dioscorides discussed the therapeutic use of almost 900 herbal species, 600 medicinal plant species, 35 animals, and 90 mineral remedies [166]. A century later, Galen recorded roughly 850 simple medicines, most of which were similar to those named by Dioscorides but had far fewer medical use [100]. Each plant taxon was frequently referred to by a “code” made up of a list of the vernacular names and was known by various languages. This rigorous cross-referencing of names and uses served as a protocol for academic rigor to ensure accurate plant identification between regions, allowing herbal texts to be applicable in a wider geographical and cultural context and fostering the growth and consolidation of scientific knowledge.

2.7 Greek-Roman-European Herbalism

Greek herbals have a rather well-documented history, including their mutual effect and phylogeny. Lost copies may even be found by looking for missing connections [181]. Dioscorides, for example, cites and alludes to a variety of various writers and books, some of which have survived (such as works attributed to Theophrastus and Hippocrates) and others of which are now lost or have only partial copies left. Translations into Syriac served as a crucial intermediary step that permitted the transfer of Greek and Byzantine medical knowledge into Arabic and to the medieval Islamic world [169]. In addition to preserving classical medical knowledge, the Arab culture advanced it and made it possible for it to be transmitted back to the Occident via al-Andalus and the School of Salerno (about 1000–1300 AD) (711–1492; [196]). The analysis of the so-called Syriac Galen Palimpsest is likely to provide new and important insights on the transfer of Greco-Roman medical knowledge to the Arabic world. The earliest copy of Galen's writings on herbal remedies is now this manuscript, which is significant because it offers other readings from the more recent Greek versions that may be used to spot interpolations and other textual interpretations [18].

The middle and Northern European herbals were also affected by the traditional Mediterranean materia medica in terms of their organization, literary style, and substance. Back in the Medieval Ages according to monastic law, Benedictine monks were required to maintain therapeutic herb gardens, such as those at the abbeys at Montecassino, Italy, and St. Gall, Switzerland [190]. Classic Greco-Roman herbals and medicinal books underwent rigorous examination, commentary, and translation into contemporary languages throughout the Renaissance, garnering significant print runs. Renaissance herbals, however, also included the consensus of northern and central European medical folklore and were accompanied by woodcut drawings enforcing the commentators' botanical identifications.

The *Gart der Gesundheit* is recognized as the first thorough German herbal, authored by Johann Wonnecke von Kaub (ca. 1430–1504), physician to the city of Frankfurt and illustrated by Dutch artist Erhard Reuwich (1445–1505). [121]. The 435 monographs in the *Gart der Gesundheit* are based on texts from the Mediterranean region, including Pliny's *Natural History* from the first century AD, *The Canon of Medicine* by Avicenna (Ibn Sina, ca. 980–1037), the *Pseudo-Serapion* (Aggregator) by Ibn Wafid from the eleventh century in Toledo, and the *Circa Instans* by Matthaeus Platearius from the twelfth century [114].

The printing press' development led to a surge in the creation of European herbals and a race among writers, who weren't always free of nationalist emotions. The documentation of traditional folk knowledge on central and northern European materia medica was combined with the translation, commentary, and integration of ancient Greco-Roman knowledge by Peter Schoffer (1425–1503), Jan Stanko (1430–1493), Jean Ruelle (1474–1537), Otto Brunfels (1488–1534), Adam Lonitzer (1528–1586), Leonhard Fuchs (1501–1566), Hieronymus Bock (1498–1554), and William Turner (1508–1568). Nevertheless, a thorough examination of the problems

of which plant species and applications were first recorded and in which herbal and how much materials were used is still absent.

The Greco-Roman and Arabian medical treatises were a major source of inspiration for the first formal pharmacopoeias. In addition to Hippocrates, Pliny, Dioscorides, and Galen, Matthaeus Platearius (twelfth century), Rhazes (865–925), and Avicenna were all significant figures (ca. 980–1037; [196]). Three texts written after 1000 AD at the School of Salerno, namely, the *Antidotarium Nicolai* (ca. 1100), the *Antidotarium Nicolai Myrepsi* (thirteenth century), and the *Antidotarium or Grabadin of Pseudo-Mesue* (ca. thirteenth century), are considered to be the forerunners of the official city pharmacopoeias due to the format and presentation used [196]. Constantinus Africanus (eleventh century), a Carthage herbal trader who collected Arabic medical works in North Africa and translated them into Latin, contributed a significant amount to the corpus of work created at the School of Salerno [121].

Roman era records of early imports of spices and herbal medicines from the Orient well-documented both the New World and Southeast Asia, showing the significance of exotic goods for European pharmacopoeias [198]. Prior to the creation of the European Pharmacopoeia, there were several factors that prevented attempts to synchronize pharmacopoeias, official or not, including the notion that locally sourced medicines would have a disproportionately high level of positive effects and the economic case for supporting locally produced goods [196]. The quest for effective treatments, often known as the trial and error method, during the outbreak of new epidemics (such as syphilis) and the testing of imported “strange” plant species supplied the laboratory for experimentation at the same time. After the Conquest, when Christopher Columbus and his ship returned from the Caribbean with their cargo, the syphilis pandemic was transferred from the Americas to Europe. The core wood of *Guaiacum officinale* L., a remedy used by the native people of the West Indies to treat syphilis, was imported to Europe and advertised against the disease, but later proved to be ineffective. This was because it was believed that the origin of specific diseases would be connected with the source of effective medicines [111]. Matthioli was the first to identify mercury’s particular usefulness against syphilis, even though Arabian pharmacists had brought the substance to Europe as a therapy for skin conditions [111].

The Swiss physician Paracelsus (1493–1541) attempted to depart from the traditional medical theories of the time, particularly those of Galen and Avicenna, and promoted high hygienic standards for surgery. Paracelsus is best known for developing the fundamental toxicology principle that “the dose makes the poison” [111]. Yet even Paracelsus, an alchemist, was susceptible to esoteric and symbolic thinking. The “doctrine of signatures” was put out by Paracelsus in *De natura rerum* in 1537 as a holistic and harmonic theory that could foretell the medicinal properties of plants based on characteristics like form, color, smell, and taste [121]. While the theory of signatures’ fundamental premise is founded in folk medical practices all over the globe, Paracelsus systematized it in conceptual contrast to Galen’s humoral pathology [121]. The German physician Samuel Hahnemann (1755–1843) developed homoeopathy, which still adheres to the

idea of signatures today, although conventional herbal therapy in Europe is likely losing ground in this regard.

Since there were fewer early herbals and because they had more time to exert their causal influence on the spread of medical knowledge and popular herbal knowledge, the earlier herbals were generally more important. Due to their large print runs, which are estimated to have exceeded 30,000 for the older editions of *I Discorsi* alone, others, like Matthioli's Renaissance commentary on Dioscorides' *Materia Medica* (*I Discorsi*), originally published in 1544, also had a significant influence [99]. The work of Dioscorides was included into Matthioli's herbal, which also included 600 new medicinal species. It was also published in Italian and translated into more vernacular languages, including French, German, Czech, and Arabic, with a total of almost 60 distinct editions (Barberi, 1967–1970). *I Discorsi* was founded on Matthioli's experience as a medical doctor and botanist who was acquainted with the Mediterranean flora, making Matthioli's translation simple to understand [185].

2.8 Alkebu-Lan or African Herbalism

Alkebu-lan medicine may be the oldest form of herbal medicine practice and system from which every other system evolved considering the history and origin of humans. The lack of scripts and high secrecy associated with the practice in most parts of Africa makes it difficult to trace most of these practices, but remnants still exist to date in the form of African traditional medicine (ATM) on which a large proportion of the population depends on for their primary health care because it is cheap, easily accessible, and highly relatable [132, 134, 138, 139, 147, 152]. In large part, the system is connected to how plants are used both as food and medicine and their conservation [128–131, 133, 135–137, 140–142, 149–151]. According to Ozioma and Chimwe [153], ATM involves spiritualism, divination, and herbalism and permeates the culture, religious beliefs, attitudes, knowledge, and understanding systems of African communities. Practices include the use of materials (plants and or animal parts) with incantations, sacrifice, and exorcisms. The system was challenged and almost pushed out by the European and Arab colonizers who seek to increase the spread of their religion and modern medicine practice while the locals were challenged with economic (poverty) and other developmental issues. Enslaved Africans who were taken to different parts of the world may have contributed to the growth and development of the practice in those parts. Although enslaved they maintained small plots containing medicinal plants that are used in the preparation of herbal tinctures, decoctions, teas, incense, etc. for the treatment and management of diverse ailments. According to Okaiyeto and Oguntibeju [143], some factors contributing to the preservation of ATM include:

1. Accessibility and cost-effectiveness.
2. The perception that it is natural and safe.
3. Connection to their gods, dead relatives, and nature.
4. Superior efficacy to modern medicine.

5. Ability to self-medicate.
6. High levels of confidentiality associated with ATM.
7. Fear of erroneous diagnosis in the hand of modern medicine practitioners.
8. Long waiting periods are often associated with modern medicine in Africa.
9. Advertisement of herbal products, practices, and practitioners.

3 Utilization of Herbal Medicine

Globally, the interest and use of medicinal herbs have seen exponential growth with an estimated market value of USD 152 billion and a forecast of USD 350 billion by 2030 [47]. In Europe, Germany has the largest market for herbal medications with medical claims and those that are typically prescribed in pharmacies [62]. According to German manufacturer prices, the market costs €1.33 billion annually, which is proportionate to 20.7% of the entire European market. Other significant nations in conformity with the provision and sales of herbal medicines include Spain (6.3%), Poland (7.2%), Italy (17.1%), Russia (9.2%), and France (13.0%) [62]. A survey by Rashrash et al. [164] revealed that more than a third of adults in the USA utilize alternative medicine for the management of their health. The most frequently utilized alternative medicine, except for vitamins and minerals, was herbal products [16]. In most developed countries, over-the-counter sales of herbal medicine products can take in the form of plant oils, herbal supplements, or teas (such as chamomile, ginger tea, peppermint tea, green tea, etc.) sold in drug stores alongside conventional medicine. Traditional medical practices vary considerably from one nation to another and area to region due to influences from such things as culture, history, philosophy, and individual attitudes. Usually, their theory and practical application differ markedly from those of mainstream medicine [210].

Traditional medicine has been utilized in Nigeria to treat a variety of illnesses. In a study by Abubakar et al. [3], it was found that 85% of the respondents used traditional medicine to treat a variety of health issues, including diabetes, typhoid fever, pneumonia, pile, cancer, fever, measles, diarrhea, and cough. Accessibility, affordability, perceived safety, and therapeutic recommendation potential for treating numerous ailments are believed to be the major driving factors for the surge in the utilization of herbal medicine [124]. As such, the upkeep of human health has become the primary focus of the widespread usage of herbal medicine [4, 5, 70]. Past studies have revealed that Nigerians of various socioeconomic status engage in the use of herbal medicine [45]. Botanical treatments persisted in the form of tinctures, fluid extracts, and concentrated extracts. One might argue that such galenical medicines served as the cornerstones of period medicine. Products like the fluid extract of Ergot U.S.P. and the tincture of *Digitalis* U.S.P. were quite popular. With the advent of sulfanilamide in the middle of the 1930s, the first suppression of plant treatments started. The race was on as synthetic organic chemists created hundreds of novel compounds with potential therapeutic qualities in response to this new German antibacterial medication. Old plant medications

were quickly superseded by new, often very helpful, synthetic pharmaceuticals for two reasons [167]. They could be marketed at a premium price to pay the expenses of the research needed in generating them while still allowing the maker to make a sizable profit since they were unique chemical entities covered by patent protection. Also, since they were unique chemical entities, it was simple to standardize their action and achieve predictable potency. In contrast, many of the traditional botanicals were likewise efficient but were abandoned since they could not be patented and did not guarantee profit margins. They were challenging to standardize since they often ascribed their action to many constituents, many of which remained unknown. Almost impossible was action uniformity. The issue is typified by *Digitalis* (*Digitalis purpurea*). The herb is prized as a treatment for congestive heart failure because it contains both short-acting and long-acting glycosides with rapid and slow onset, making it basically superior to any single glycoside isolated from it. However, it was difficult to accurately standardize the leaf in any way. Researchers eventually gave up after trying a variety of animals with little success, including guinea pigs, goldfish, chick hearts, frogs, cats, water fleas, and pigeons. As a result, digitalis leaf is no longer used in America. Eventually, almost all herbal remedies vanished from pharmacy shelves, and by the 1960s, American medications, unlike those used in the majority of other nations, were almost entirely synthetic. According to local custom, herbal remedies are utilized in several EU nations. For instance, according to the Allensbach Study from 2017, 70% of Germans have tried “natural medicines,” with herbal treatments being the most popular kind. Without a prescription, by mail order, or in pharmacies, herbal medications worth 1.36 billion market data were sold in Germany alone in 2015 [67]. In addition to properly approved medications, other goods have been registered as traditional medicines due to their extensive history of usage. This presents some significant issues for ethnopharmacology, particularly in terms of how to establish a solid evidence foundation for the use of such items and define what exactly qualifies as a tradition of usage as a medicine. In the 1970s and 1980s, sophisticated European nations, particularly Germany, started to publish scientific and clinical papers demonstrating the medicinal and financial value of herbal treatments, which had never been completely abandoned in that region [175]. The oldest and maybe most diverse treatment approach is African Traditional Medicine. With its great biological variety and cultural diversity, which is reflected in regional variations in healing methods, Africa is regarded as the birthplace of humanity [10, 56]. Sadly, the systems of medications are still not well documented. Traditional African Medicine encompasses the body and mind holistically in all of its manifestations. Before administering medications, especially medicinal plants to address the symptoms, the traditional healer often determines the psychological cause of a disease and treats it [57].

The main natural resources ever employed by humanity for maintaining preventive, curative, and rehabilitative health in Africa include plants, minerals, and animals. These materials have been employed by traditional healers for more than 10,000 years, much like any other continent. In traditional African medicine, herbalists, midwives, and diviners are all involved. The diagnosis of illnesses,

which in certain circumstances are said to be brought on by ancestor spirits and other forces, is the responsibility of diviners. Native plants are often used by traditional midwives to facilitate delivery. A herb trading market in Durban reportedly draws between 700,000 and 900,000 merchants annually from South Africa, Zimbabwe, and Mozambique since herbalists are so well-liked on the continent. There are smaller herb markets in almost every town [58].

4 Herbal Medicine Applications and Techniques

Plants contain a wide range of compounds, including minerals (molybdenum, potassium, calcium, sodium, zinc, magnesium, and so on) and phytonutrients which include sugars (cellulose, starch, rhamnose, sucrose, ribose, fructose, maltose, etc.), carotenoids (flavonoids, lignans, lutein, carotene, plant sterols, isothiocyanates, lycopene, and others), and polyphenols (cinnamic acid, vanillic acid, curcumin, ellagic acid, tannins, etc.) all of which play integral roles in the prevention of diseases and health management [59, 86, 95]. A majority of these compounds possess antioxidant properties, enhance immunity, prevent cancer, suppress inflammation, protect the brain, and effectively reduce the progression of aging [66, 95, 182, 199]. Plant components are used directly as chemotherapeutics; thus, ethnobotanicals are crucial in pharmacognosy research, drug discovery, and development. They can also be used as building blocks in the design and production of drugs or serve as models for pharmacodynamic substances [104]. Morphine (named after Morpheus – the Greek god of dreams) was the first physiologically effective pure compound, isolated from *Papaver somniferum* (opium) by Friedrich Serturmer at the start of the nineteenth century [13]. This stimulated an avalanche of research on medicinal plants and led to the discovery of numerous lifesaving bioactive compounds of natural origin. Some known examples include artemisinin (*Artemisia annua*), aspirin (*Salix* spp.), atropine (*Atropa belladonna*), cannabinoids (*Cannabis sativa*), cocaine (*Erythroxylum coca*), codeine (*Papaver somniferum*), digoxin (*Digitalis purpurea*), galanthamine (*Galanthus nivalis*), quinine (*Cinchona officinalis*), and reserpine (*Rauwolfia* spp.), among others [13]. This epoch of drug discovery was further broadened to include microorganisms by Fleming's discovery of penicillin which established the scientific and economic platform for modern medicine and the biopharmaceutical industry [38].

According to recent aging studies, bioactive compounds have exhibited enormous promise for managing even the most severe ailments and may one day replace conventional medications [197]. Nevertheless, the effects of many plant products on humans are largely a mystery, despite the multitudes of research in this area. The best active ingredients and doses can be chosen to produce the optimal beneficial effects from herbal medicines by carefully analyzing the mechanisms by which they affect the aging process. It is better to examine *in vivo* the efficacy of biologically active substances and plant extracts with geroprotective characteristics. The animal model systems employed for this purpose include but are not limited to zebra fish (*Danio rerio*), mice (*Mus musculus*), fruit fly (*Drosophila melanogaster*), nematode

(*Caenorhabditis elegans*), and rats (*Rattus norvegicus*) [64, 118]. These models make it easier to thoroughly research how newly created medications affect the aging process. However, the model organism *C. elegans* is gaining increasing popularity in these studies because of its numerous advantages. They include a short life span; easy lab maintenance; transparent body for real-time imaging; advanced genetic, genomic, and molecular tools and manipulations; high genetic homology with humans; etc. [189]. Havermann et al. [61] revealed that the bioactive compound baicalein extended life span and improved stress resistance via the activation of Keap-1/Nrf-2 signaling pathway using *C. elegans*. In addition, luteolin and chrysin demonstrated life span extension via the activation of AMPK pathway in both *D. melanogaster* and *C. elegans* [97]. Rosmarinic acid, a natural polyphenol, has been shown to increase the average life span of *C. elegans* by upregulating the S pathway via *ins-18* and *daf-16*, the MAPK pathway via *skn-1* and *sek-1*, and stress resistance and antioxidant genes like *ctl-1*, *sod-3*, and *sod-5* [106]. Curcumin has also been reported to increase life span in *C. elegans*, which is dependent on the functions of *age-1*, *skn-1*, *sir-2.1*, *sek-1*, *unc-43*, *osr-1*, and *mek-1*, which are related to the S, MAPK, and JNK signaling pathways [105].

Furthermore, natural products remain the fulcrum of more than 60% of cancer therapeutics that are available or undergoing investigation. Over 70% of the globally approved 177 anticancer drugs are derivatives of natural products, and several of them have been optimized using combinatorial chemistry. Camptothecin (*Camptotheca acuminata*), a precursor for irinotecan and topotecan; combretastatin derived from *Combretum erythrophyllum*; paclitaxel, isolated from *Taxus brevifolia*; vincristine from *Catharanthus roseus*; noscapine from *Papaver somniferum*; and flavopiridol, a structural isomer of rohitukine derived from *Dysoxylum binectariferum* are some examples of plant-derived medications that have been employed for cancer therapeutics [31, 32, 158, 178]. In addition, alpinumi isoflavone and 4'-methoxylicoflavanone isolated from the stem bark of *Erythrina suberosa* exhibited cytotoxicity against human leukemia (HL-60 cells) through the suppression of the membrane potential in the mitochondria and activation of apoptotic proteins [96]. The chemoprotective and anticancer activity of curcumin has also been well established both in vivo and in vitro. Some of its known mechanisms include apoptotic stimulation via the inhibition of cyclin D1, cyclo-oxygenase-2, and other relevant NFκB target genes [188]; autophagy [27], mitotic arrest [55], and antioxidant and anti-inflammatory activities [48].

In addition, the inherent capacity of herbal medicine to fight COVID-19 became an important research focus during the global pandemic. Due to their potent suppression of SARS-CoV-2, traditional Chinese medications garnered a lot of interest. For instance, Qingfei Paidu decoction demonstrated an outstanding clinical efficacy of >90% in treating COVID-19 patients at all phases [119, 163, 201]. Shuanghuanglian, also popular in TCM, suppresses SARS-CoV-2 Mpro replication in a dose-dependent manner [187]. Natural products such as graveospene A, deguelin, and erianin have been utilized mono-therapeutically for the management of lung cancer in vitro, while baicalein, resveratrol, and ginkgolic acid were employed during the fight against SARS-CoV-2 [217]. Moreover, the combination

of some Food and Drug Administration (FDA)-approved drugs with biologically active compounds has been reported to mitigate the pernicious effect of SARS-CoV-2 [217]. For instance, the combination of nelfinavir and cepharanthine, remdesivir and linoleic acid, cisplatin, and curcumin have all been reported [217]. It is noteworthy that more than 40% of pharmaceuticals approved by the FDA have come from natural sources or their derivatives [157].

Possibly, due to the phytochemical content of plants, many of them have been reported to be used as an alternative agent for the treatment of several diseases. Hence, they can be used to treat diseases caused by microbes possibly due to their antimicrobial potentials [42–44, 71–73, 77–83, 89–93]. It can be used to control vectors or insects such as mosquitoes [17, 74–76, 176, 177, 218]. They can be used as preservatives. Other diseases and conditions that can be managed with plants include memory loss, cardiovascular diseases, arthritis, osteoarthritis, digestive, respiratory, reproductive, skin, neurological diseases, diabetes, cancer, hypertension, gastrointestinal, and conditions such as pregnancy, etc. Two main factors that support the continued interest in traditional medicine in the African healthcare system include affordability and accessibility. Contemporary medical care is often too expensive, or not available. Secondly, although having an almost worldwide distribution, certain diseases like malaria and HIV/AIDS, disproportionately affect Africans more, and the reliability of traditional medicine makes them try it out [126, 127]. Medicinal plants are often the community's primary readily available source of healthcare in many regions of Africa. Also, they are often the patients' first choice. For the vast majority of these individuals, traditional healers provide information, counseling, and therapy to patients and their families in a personal way while also being aware of their patient's surroundings [10, 56, 58]. Africa is endowed with abundant biodiversity [144, 145, 161, 162, 174]; it is thought to have between 40 and 45,000 plant species with the potential to become developed, of which 5000 species are utilized medicinally. This is not unexpected given that Africa has a tropical and subtropical climate and that plants naturally collect significant secondary metabolites as a method of surviving in a harsh environment [109].

Written records of herbal medicine go back 5000 years in Egypt. The Edwin Smith, Ebers, and Kahun papyri include a wealth of information on Ancient Egyptian medicine. The Edwin Smith Papyrus and the Ebers Papyrus, both published in 1930 by Breasted and Bryan, respectively, are from the seventeenth and sixteenth centuries BCE. It is thought that these writings came from previous sources. These include spells and recipes for a wide range of illnesses and symptoms. They go through illness diagnosis and provide anatomical facts. They go into great depth into the anatomy, physiology, and medicine of the Ancient Egyptians. A gynecological literature called the Kahun Papyrus [51] discusses issues such as the reproductive system, conception, pregnancy testing, childbirth, and contraception. Crocodile dung, honey, and sour milk are some of the substances that are recommended for contraception [168]. Pygeum (*Prunus africana*), a traditional African remedy for mild-to-moderate benign *prostatic hyperplasia*, has gained widespread acceptance outside of Africa. It has been offered in Europe since the 1970s. Pygeum barks are gathered annually in Madagascar and Cameroon in quantities of 600 metric tons and 2000 metric tons, respectively. The bark is brewed into tea in Africa [125].

It is offered everywhere in the globe in the forms of powders, tinctures, and tablets; often, it is mixed with other herbs thought to be beneficial for prostate issues. Customers experience less inflammation and cholesterol buildup, as well as easier urination. The significance of this therapeutic method in Africa may be shown by comparing the numbers of traditional healers and physicians. There is one traditional healer for every 700–1200 individuals in the Venda region of South Africa, compared to 1 doctor for every 17,400 people. For every 110 individuals, Swaziland has one traditional healer. The percentage is the same in Benin City, Nigeria. In urban Kenya, there is 1 traditional healer for every 833 people.

The chiefs of state and government of the former Organization of African Unity (OAU) in Africa acknowledged that 85% of the continent's people rely on it for their healthcare requirements. The OAU proclaimed 2001 to be the Decade of Traditional Medicine. Following this historic pledge by African leaders, the Plan of Action and implementation mechanism that were endorsed by the AU summit heads of state and government in Maputo in 2003 were adopted by the First AU Session of the Conference of African Ministers of Health (CAMH1), held in April 2003 in Tripoli, Libya. The Plan of Action's primary goal is for all Member States to recognize, embrace, advance, and institutionalize traditional medicine within the region's public healthcare system by 2010. [58]. Additionally, the Maputo Declaration on Malaria, HIV/AIDS and Other Related Infectious Diseases (ORID) of July 2003 resolved to keep supporting the Plan of Action for the AU Decade of African Traditional Medicine (2001–2010), particularly research in the area of treatment for HIV/AIDS, tuberculosis (TB), malaria, and ORID. The Lusaka Summit proclaimed the years 2001–2010 to be the OAU Decade for African Traditional Medicine in July of the same year. The 11 priority areas, which have been developed into strategic activities, are institutional arrangements, information, education, and communication, resource mobilization, research and training, cultivation and conservation of medicinal plants, protection of traditional medical knowledge, local production of standardized African traditional medicines (SATMs), partnerships, and evaluation. The African Union (AU) Member States have been carrying out the plan of action of the AU Decade of African Traditional Medicine and the priority interventions of the WHO regional strategy since 2001, namely, policy formulation, capacity building, research promotion, development of local production, including cultivation of medicinal plants, and protection of traditional medical knowledge and intellectual property rights [168].

5 Trends in Herbal Medicine

Now, several nations throughout the globe are still reacting to the Beijing statement from November 8, 2008. The World Health Organization assembly urged nations to take charge of their citizens' health by creating national policies, rules, and standards that would guarantee the proper, safe, and efficient use of traditional medicine [212]. Since traditional medicine has helped millions of people throughout the globe get cheap treatment, it has shown the ability to meet the WHO's goal for

universal healthcare [26]. Studies demonstrate that patients who see a general practitioner with extra training in alternative medicine have lower healthcare expenses and death rates than those who do not support this claim [94]. Less use of prescription medications and hospital stays was said to have reduced costs. Hence, every government in the world has made the significance of complementary and alternative medicine (CAM), which mostly employs plant items as pharmaceuticals, a top priority. These medications are prescribed over the counter, utilized as over-the-counter home treatments, and serve as pharmaceutical industry raw ingredients. They make up a significant share of the global medication industry and help millions of people throughout the globe get basic healthcare. This section will examine the use, regulation, integration, and quality control trends for herbal medicine on a worldwide scale. Almost 100 million individuals in Europe use traditional medicine-related goods and procedures, with 5% utilizing it as an alternative to mainstream treatment and the same amount as a supplement to it [148]. According to reports from the UK, 40% of doctors reportedly recommend patients to alternative healthcare providers. Complementary and Alternative Medicine (CAM) is used by the populations of France, Canada, and Australia at rates of 49, 76, and 46%, respectively. In Asia, China is reported to have produced 83.1 billion US dollars worth of Chinese herbal medicine in 2012, while the Republic of Korea increased its yearly spending on traditional medicines from 4.4 billion US dollars in 2004 to 7.4 billion US dollars in 2009 [148].

Regarding regulation, conventional Western medicine is completely controlled by government agencies, as is the use of Traditional Chinese Medicine. Almost 1146 species had been listed by 2005 in the well-established Chinese Pharmacopoeia, which was created to assure the quality of Chinese material medicine. These species may be examined using over 479 different HPLC techniques, 45 TLC methods, and 47 GC methods [33, 34]. The Ministry of Standardization and Methodology in Japan has accepted and standardized over 148 formulas from various manufacturers [60]. In addition, over 210 formulations are available over the counter and are utilized in medical institutions. In Hong Kong, traditional healers are consulted by around 60% of the population. For instance, local researchers in Singapore employ software to examine multi-herb mixtures [203]. The usage of straightforward preparations (cut and dried) and those in other dosage forms is regulated by law (an example is existing statutes in Singapore). Only items that adhere to the necessary safety and quality criteria may be listed and authorized for production, importation, supply, or sale. In the USA, it was predicted that 14.8 billion dollars were spent directly on natural goods in 2008. According to further South American figures, traditional medicines are used by 71% and 48% of the populations of Chile and Colombia, respectively. In several of these nations, medical schools educate about traditional remedies. To assure the identification, quality, purity, potency, and consistency of herbal medications, the US FDA suggests a variety of tests. Chemical assays, distinctive markers, and chromatographic fingerprints are used in many testing for drug substances and products. Raw material process controls and drug substance validation are also conducted. Moreover, in the USA, the creation of herbal monographs has benefited greatly from microscopy [9].

Several African nations have not yet included these types of medications in their primary healthcare systems. According to Ghana, traditional medicine has been incorporated into South Africa's and Nigeria's current healthcare systems [209]. Others have partly incorporated it, such as Tanzania, Ethiopia, and Rwanda. More nations, such as Uganda, Chad, and Gabon, are creating integration policies. According to the World Health Organization, traditional medicines are the primary source of healthcare for 70–90% of Africa's rural population [210]. In a 10-year assessment, the World Health Organization found that the majority of African communities continue to rely on herbal therapy [213]. According to research by Chatora et al. [28], the majority of basic healthcare on the African continent is still provided by traditional medical practices and products. To substantiate Chatora's research report from 2003, Abdullahi [2] references the increased usage of traditional medicines in Africa despite the problems it faces. This indicates that, despite the changing circumstances, the need for herbal treatments has grown over time due to the growing population. The growth in chronic and noncommunicable illnesses, as well as their availability and cost, have all been linked to an increase in the use of traditional medicine, particularly herbal remedies, across the world [26, 102]. One reason for the widespread usage, for instance, is that middle- and low-income nations in Africa lack access to contemporary pharmaceuticals. According to a survey conducted in 36 low- and middle-income countries by Cameron et al. [23], a significant portion of the population cannot afford traditional medications. The evidence from nine African nations may support this.

The World Health Organization has created a traditional medicine plan for the years 2014–2023 to improve the integration of herbal medicines into member nations' primary healthcare systems. The main objectives of the approach are to assess, control, incorporate, and maximize the potential of traditional medicine for people's health and welfare [214]. By 2023, the plan will have identified some of the problems harming traditional medicines and strategies to work with the relevant member states and other stakeholders to resolve them. Its continuous use, expanding economic significance on a worldwide scale, advancements in research and development, intellectual property rights, and integration with healthcare systems are among the problems [214]. Evaluation of both safety and efficacy, quality control, regulatory and safety monitoring, education, and training of health authorities and control agencies are some of the areas in which research is required [211]. Australia is an island continent that has been inhabited by Aboriginal people for thousands of years. The many ecofloristic zones, including wet tropics, savannahs, evergreen forests, shrublands, grasslands, and wetlands, have taught over 500 different clan groupings or countries to coexist peacefully [87, 117]. While there are many distinct tribal groups in these very diverse places, what unites them all is their close and deep connection to nature and their utilization of its resources [107]. Native plants are an important part of their culture and are used to manufacture a variety of products, including food, medicine, narcotics, stimulants, adornments, ceremonial artifacts, weapons, clothing, shelter, tools, and artwork [35, 186]. Using local flora, animals, and abiotic resources over thousands of years, this native wisdom has developed [155]. Aboriginal lore serves as a means of knowledge preservation and transmission in the absence of written language. Songs, storytelling, dance, and other forms of art have been used to pass down practices and

stories from one generation to the next. There are still hundreds of Aboriginal people who speak their native language and maintain the knowledge, songs, and rituals of their ancestors despite the disruption of oral traditions and lore practices by colonial contact, with English being the second or third language [113, 159]. Several Aboriginal clan groupings continue to practice Aboriginal ethnomedicine, although the amount to which it is employed varies greatly across rural and urban areas of Australia and between communities [146].

Aboriginal cultures still use numerous plants such as bush food and bush medicine, particularly in isolated locations. This makes Aboriginal plant knowledge the oldest surviving pharmacopoeia [154]. Australia has a total of 1511 plant species that have been documented as being used medicinally [154, 204]. The Aboriginal groups in the Northern Territory, New South Wales, South Australia, and Western Australia are responsible for the majority of the medicinal plant knowledge that has been documented in the literature [179]. Just a few publications on Aboriginal medicinal plants of Cape York Peninsula have been made, and there hasn't been much written on Native medicinal plants of Queensland [122, 180]. Several Native medicinal plants continue to be either unreported in the literature or unavailable to the general population [179]. Like many indigenous knowledge throughout the globe, Australian Aboriginal knowledge has been underexplored in a "Western scientific" sense and is at grave risk of disappearing entirely [84]. According to Stack [183], because the European immigrants brought their ailments and utilized their traditional treatments, Aboriginal traditional medicine did not play a role in their lives 200 years ago. Nonetheless, there exist documents that demonstrate that certain doctors and botanists collaborated with Native healers and conducted experiments with local plants for therapeutic reasons throughout the early years of European arrival. For instance, Denis Consideen, the first assistant surgeon to Surgeon-General John White in the first fleet (1788–1794), claimed to have discovered indigenous medicinal plants before any other European physicians; however, his methods of discovery are unknown, and it is unclear whether he enlisted the help of indigenous informants [108]. Macpherson and Consideen [108] noted the effectiveness of various indigenous medicinal plants, such as native sarsaparilla (*Smilax glycyphylla*) as an anti-scorbutic and myrtle (*Eugenia australis*) and yellow gum (*Xanthorrhoea hastilis*) for dysentery [108]. In addition, local sarsaparilla was reportedly thought to be more pleasant than Jamaican or Central American varieties, according to Macpherson and Consideen [108]. He said that Sydney herbalists had used it often as a trade item before 1927. Macadamia nuts were one of the plants that both the Aboriginal people and the European settlers traded regularly (*Macadamia* sp.). Notwithstanding the disruption of Native medical traditions by Europeans, Aboriginal people have made some significant contributions to global medical knowledge. For instance, Pearn [159] claims that Native childcare ethnomedicine is among "the world's oldest pediatric traditions" [159]. Native ethnomedical traditions are still a vibrant part of many Aboriginal communities today. Many groups in Australia employ various medicinal herbs depending on their local flora and habitat [146].

For instance, Southern Australia uses the fruits of the native plant *Solanum laciniatum*, whereas Eastern Australia once utilized *Solanum aviculare* (Kangaroo Apple) [183]. For joint swelling, both species were used as poultices [183].

The alkaloid solasodine, found in both of these *Solanum* species, serves as a precursor to cortisone and other steroids used in the creation of oral contraceptives (often known as “the pill”) [112]. Due to their ability to biosynthesize this important phytochemical, these plants have been introduced to Russia and Eastern Europe, where they are now grown extensively [183]. A similar study was conducted on the congeneric *Duboisia myoporoides* when it was discovered that the native Australian Aboriginal narcotic plant pituri (*Duboisia hopwoodii*) was particularly useful. Aboriginals were chewing “pituri,” a plant, in a manner like that of tobacco or East Indian betel, according to Joseph Banks, the first European botanist to visit the East Coast of Australia (in 1770) [46]. Ferdinand von Mueller, a botanist for the Victorian Government, recognized the plant as *Duboisia hopwoodii* a century later (in 1872) [165]. The related *Duboisia myoporoides* were discovered to generate hyoscyne, now known as scopolamine, an alkaloid that is a very efficient remedy for motion sickness as reported by Von Mueller [63].

6 Research Needs in Herbal Medicine

There is a significant amount of work that needs to be done in the field of herbal medicines; however, this could be counterbalanced by the potential advantages of using these products, which are demonstrated by their consumption by significant populations, particularly in nations that are still developing. Be that as it may, it is necessary to research to ensure the identification of the specific compounds and bioactive elements contained within these herbal formulations [78, 79]. This will allow for the formulations to be purified and put to use treating specific diseases, as opposed to treating the disease with the whole plant [72, 73]. In addition, research is required to determine whether or not the use of extracted bioactive substances is preferable to the utilization of entire herbs. There is a significant need for additional studies to be conducted on the standardization procedures used to prepare herbal products. The evaluation of herbal medicine does not have a study approach that is considered adequate or generally acknowledged. It is necessary to have precise and repeatable procedures for the preparation of these medications to guarantee the distribution of the same herbal products despite differences in brand names and manufacturers. It is necessary to research to guarantee the safety of herbal goods in general. Further research is necessary to determine the processing methods, routes of administration, dosages, and compatibility with other herbal remedies or conventional treatments.

7 Conclusion

Herbal remedies have been used traditionally as medicine from the beginning of recorded human history. Plants have been used by humans in many parts of the world as a form of treatment and management for a wide variety of diseases and conditions. According to the World Health Organization (WHO) [206, 207], more than 80% of

people all over the world utilize herbs as a kind of treatment when they are sick. Education is a crucial component in the usage of herbs since the capacity to utilize herbs as a therapy for diseases is based on the amount of information possessed by the native people of the area. Plants play a vital part in a wide variety of traditional religious rites, such as libation, sacrifice, the appeasing of the gods, invocation, and divination. In addition, plants are used in the production of food and the delivery of medicine. Plant parts are typically used in the manufacture of herbal treatments since these plant parts are the active elements in herbal medications. Some of the diseases and conditions that have been successfully managed by using herbal medicine include memory loss, cardiovascular disease, arthritis, osteoarthritis, digestive illness, respiratory illness, reproductive illness, skin illness, neurological illness, diabetes, cancer, hypertension, gastrointestinal illness, conditions such as pregnancy, and prenatal and postnatal procedures. Herbal therapy has also been shown to be effective in the treatment of a variety of other diseases and disorders. Herbal drugs are often administered either in powdered or liquid form, with the powdered form being the more prevalent of the two. Some of these products are intended to be used internally, while others can be put on the skin or rubbed into the part of the body that is problematic. There is still a significant amount of work that has to be done in the field of herbal medicines; however, this can be counterbalanced by the potential advantages that can be gained through the utilization of these items. Despite this, it is very necessary to conduct a study to guarantee the accurate identification of the particular chemical components as well as the physiologically active components that are found in these herbal treatments. There is a need for research to be conducted so that it can be determined whether or not the use of herbs in their unprocessed form, as opposed to the use of bioactive substances that have been extracted from the herbs, is more beneficial. There is a major need for additional studies to be conducted on the standardization procedures that are utilized during the manufacturing of herbal goods. This research should be conducted as soon as possible. To ascertain the processing methods, routes of administration, doses, and compatibility with other herbal medicines or conventional treatments, additional research is required.

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