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Traditional Medicinal Plants: A Source of Phytotherapeutic Modality in Resource-Constrained Health Care Settings

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Abstract

Despite recent scientific advancement and globalization, the system of traditional medicine and complementary/alternative medicine is considered as a primary health care modality in the resource-constrained health care settings. Herbal medicinal system has been postulated and established through empirical observation and trial and error experiments since time immemorial to maintain good health and alleviate ailments and diseases. Earlier, the importance of traditional medicinal plants and phytotherapy have often been disregarded and undervalued. Presently revitalization and renewed interest on traditional medicinal plants has been observed among the public and scientific community. However, several daunting challenges need to be flagged effectively and immediately for the promotion of traditional medicinal plants. The collaborative efforts of ethnobotanists, anthropologists, pharmacists, and physicians could be a workable strategy to evaluate and validate the usage of traditional medicinal plants with the modern scientific methods and innovative techniques. Furthermore, conducting clinical trials to assess their efficacy and human safety is imperative and inevitable.

Keywords

traditional medicine, traditional medicinal plants, herbal medicine, herbs

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Since ages, humans have relied on nature for their basic needs for the production of foodstuff, shelters, clothing, means of transportation, fertilizers, flavors, and fragrances, and not the least, medicines. Plants have formed the basis of sophisticated traditional systems of medicine that have been in existence for thousands of years and continue to provide humankind with new remedies.[1] Early humans acquired the knowledge on plant utilization for therapeutic values through many years of vigilant observations, experience, and trial and error experiments.[2(pp255-256),3(pp265-270)]

Traditional medicinal plants are an important element of indigenous medical systems in China and rest of the world.[4] Traditional medicine refers to any ancient and culturally based health care practice differing from scientific medicine and is largely transmitted orally by communities of different cultures.[5] Traditional system of medicine is one of the centuries-old practice and long-serving companion to humankind in the fight against disease and in leading a healthy life. Indigenous people have been using the unique approach of their traditional system of medicine for centuries and among the most renowned are the Chinese, Indian, African systems of medicine.[6]

The *Rigveda* says that man learnt to distinguish edible plants from the poisonous ones by observing animals.[7] Traditional medicinal plants are readily available and culturally acceptable. They offer an accessible and affordable health care regime and serve as an important source of livelihood for indigenous rural populations.[8] Research on plant and use of traditional medicinal information has again received considerable interest.

Indeed, herbal medicine is an integral part of any traditional system of medicine, and the present review becomes more

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significant from this viewpoint. The main objective of the present review is to explore the significance of traditional system of medicine, in particular traditional medicinal plants as a primary health care modality in developing and resource-poor countries. It is also an endeavor to identify the existing major challenges and the opportunities to preserve this age-old precious gift of nature to humankind.

Methods

To collect appropriate research materials for the present scrutiny a detailed search on Scopus, Medline, Google Scholar, Academic Search Premier Databases is carried out for the time period 1990-2011. A Boolean search strategy is adopted where the key words entered for search are traditional plants, herbal medicine, herbs, challenges and issues in differing orders to extract studies for this narrative review.

Definitions

Traditional Medicine

The World Health Organization (WHO, 2002)[9] observes that it is difficult to assign one definition to the broad range of characteristics and elements of traditional medicine, but that a working definition is essential. It thus concludes that the traditional medicines "[include] diverse health practices, approaches, knowledge and beliefs incorporating plant, animal and/or mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness."

Complementary/Alternative Medicine

The terms *complementary medicine* and *alternative medicine* are used interchangeably with traditional medicine in some countries. They refer to a broad set of health care practices that are not part of that country's own tradition and are not integrated into the dominant health care system.

African Traditional Medicine

One of the definitions given for African traditional medicine by the WHO Centre for Health Development is the following:

> The sum of all knowledge and practices, whether explicable or not, used in diagnosis, prevention and elimination of physical, mental, or societal imbalance, and relying exclusively on practical experience and observation handed down from generation to generation, whether verbally or in writing.

Medicinal Plant

According to the WHO,[9] "a medicinal plant is plant which, in one or more of its organs, contains substance that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis."

Herb

An herb in the botanical sense is a plant lacking a permanent woody stem that produces seeds and flowers and that dies down after its growing season. In a culinary or gardening sense, these materials possess, in addition, strong flavors and fragrances and therefore make foods more attractive to consume. These definitions are broader than that applied in traditional medical systems. In a traditional medical sense, an herb is a small and nonwoody plant valued for its medicinal, savory, or aromatic qualities. An herbal preparation is, then, a natural remedy derived from herbs.

Traditional Medicine and Complementary/Alternative Medicine

Significance of Traditional Medicine and Complementary/Alternative Medicine

Despite globalization and modernization, a sizable fraction of the rural poor purely rely on the traditional medicines as their primary health care modality.[10] The dependence on traditional medicinal plants and their role in health care system will only increase in the future as they are culturally viable and expected to remain affordable[11] and because the existing modern health care service is limited and expensive compared with traditional medicine.[12] Traditional system of medicine has been the only option available for health care prior to the induction of modern medicine for prevention, diagnosis, and treatment of social, mental, and physical illness.[13]

Renaissance of Traditional Medicine and Complementary/Alternative Medicine

Indeed, the induction of modern health care services has posed immense threat to indigenous health practices because of their potential and speedy therapeutic effect. This has led to the disappearance and displacement of traditional systems of medicine. Also, traditional systems are undervalued by the people.[6] However, the rise in population, inadequate supply of drugs, prohibitive cost of treatments, side effects of several allopathic drugs, and development of resistance to currently used drugs for infectious diseases have led to increased emphasis on the use of plant materials as a source of medicine for a wide variety of human ailments.[14] Globally, there is a resurgence of traditional system of medicine because of its user-friendly nature and because of the intrinsic side effects of modern medicines.[15] Over the past 3 decades, the scientific community worldwide is extremely inclined toward long-standing traditional systems of medicine to explore the opportunities to formulate novel phytotherapeutic agents.[10]

Traditional Medicine and Complementary/Alternative Medicine and Resource-Poor Settings: Intimate Companions

Traditional medicine is used in all parts of the world and is rapidly growing in economic importance, mainly because the

Table 1. Plant Species With Therapeutic Value Under Different Plant Groups

	Name of the Plant Groups	Number of Species
1	Thalophytes	230
2	Bryophytes	39
3	Pteridophytes	382
4	Gymnospermae	55
5	Angiospermae	
a	Monocotyledones	676
b	Dicotyledones	3495
Total		4877

use of medicinal plants has gained a respectable position today, especially in the developing countries,[16] where modern health service is limited and represents the only accessible treatment. In sub-Saharan Africa, the ratio of traditional healers to the population is approximately 1:500, whereas the ratio of medical doctors to the population is 1:40 000.[17]

The WHO estimates that, at present, more than 80% of the world's population relies on traditional healing modalities and herbals for primary health care and wellness.[9] Several developed countries have a major proportion of the population that uses traditional practice of health, especially medicinal plants, and have taken steps to preserve its popularity for historical and cultural reasons. Moreover, it has been reported that more than 70% of the developing world's population still depends on the complementary/alternative systems of medicine, otherwise known as traditional medicine, for example, up to 80% of the population in Africa, 71% in Chile, and 40% in Colombia, and others.[18] It is clear that traditional healers play an influential role in the lives of the African people and have the potential to serve as crucial components of a comprehensive health care strategy.

Traditional health care is culturally deep rooted with oral and written pharmacopoeias. In Ethiopia, 70% of human and 90% of livestock population depends on traditional medicine.[19] More than 80% of South Asia's 1.4 billion people have no access to modern health care; they rely instead on traditional medicine using native species.[8] The limited availability and affordability of pharmaceutical medicines show that the majority of the world's population depends on traditional medical remedies.[20,21]

Traditional Medicinal Plants

Of the 2 50 000 higher plant species on earth, more than 80 000 species are reported to have at least some medicinal value.[20,21] There are about 400 families in the world of flowering plants, of which at least 315 are represented in India. According to WHO, approximately 21 000 plant species have the potential for being used as medicinal plants.[14] Although some of the therapeutic properties attributed to plants have been proven to be erroneous,[1] the use of traditional medicinal plants for the treatment of various diseases is well known and documented since ancient times.[22] According to Jiaxiang[23] 4877 plant species belongs to different plant groups having potential therapeutic value (Table 1).

Plants have been used as medicines throughout history. Indeed, studies of wild animals show that they also instinctively eat certain plants to treat themselves of certain illnesses. Medicinal plants are widely and successfully used on every continent. In Asia, the practice of herbal medicine is well established and documented. As a result, most of the medicinal plants that have international recognition come from this region, particularly from China and India. In Europe and North America, the use of herbal medicine is increasing rapidly, especially for correcting imbalances caused by modern diets and lifestyles. In Africa, attitudes toward traditional herbal medicines vary widely.[24]

History of Traditional and Folk Herbal Medicine

The use of plants as medicine goes back to the period of early humans. Fossil records date human use of plants as medicines at least to the Middle Paleolithic age. Evidences of this early association have been found in the grave of a Neanderthal man buried 60 000 years ago. The earliest known medical document is a 4000-year-old Sumerian clay tablet that recorded plant remedies for various illnesses. By the time of the ancient Egyptian civilization, a great wealth of information already existed on medicinal plants. This information, along with the hundreds of other remedies, has been preserved in the *Ebers papyrus* for nearly 3500 years.[4,25]

Ancient China is also a source of information about the early medicinal uses of plants. The *Pun-tsao*, a pharmacopoeia that was actually published around 1600 BC, contained thousands of herbal cures that are attributed to the works of Shen-nung, China's legendary emperor who lived more than 4500 years ago.[5] The development of systematic pharmacopoeias dates back to 3000 BC, when the Chinese were already using more than 350 herbal remedies. China has demonstrated the best use of traditional medicine in providing health care. Ayurveda, a system of herbal medicines widely practiced in India, Sri Lanka, and Southeast Asia has more than 8000 plant remedies and uses nearly 35 000 to 70 000 plant species.[14]

Among the ancient civilizations, India has been known to be the richest repository of medicinal plants. About 8000 herbal remedies have been codified in Ayurveda. The *Rigveda* (5000 BC) has recorded 67 medicinal plants, the *Yajurveda* 81 species, the *Atharvaveda* (4500-2500 BC) 290 species, and the *Charak Samhita* (700 BC) and *Sushrut Samhita* (200 BC) have described properties and uses of 1100 and 1270 species, respectively, to compound the drugs and use. They are still used in the classical formulations of medicine in the Ayurvedic system of medicine.[14] One useful plant from Ayurveda knowledge is snakeroot or *Rauwolfia serpentina*, which has been in use for centuries together for its sedative effects. Today the active components in snakeroot are widely used in Western medicine too to effectively treat high blood pressure.[4]

Plants used in organized traditional medical systems such as Ayurveda, Unani, Kampo, and traditional Chinese medicine

have flourished as systems of medicine for thousands of years. These systems are still in place today because of their organizational strength and because they focus primarily on multicomponent mixtures.[26] In other parts of the world, medicinal plants are also important elements of indigenous medical systems. For example, in the northwestern Amazon, indigenous people use at least 1300 plant species to create *drogas do certão* or ''wildness drugs.'' In Southeast Asia, traditional healers use 6500 different types of plants to treat malaria, stomach ulcers, syphilis, and other disorders.[4]

Herbs are staging a comeback and herbal ''renaissance'' is happening all over the globe. Herbal products today symbolize safety in contrast to the synthetics that are regarded as unsafe for humans and the environment. Although herbs have been prized for their medicinal, flavoring, and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importancee.[14] The focus is now on replacing chemical substances with plant-derived ones.[27]

Patients use traditional medicine for many reasons. They may be from a remote area where modern medicine is not available when they need it. They may belong to communities whose habits and treatment-seeking behavior resorts to traditional medicine as the first choice. They may prefer traditional medicine believing, for example, that they produce fewer side effects or cures them more effectively. They may have experienced a failure with a modern treatment and want to try traditional methods. They may want to avoid modern health facilities because they perceive them as expensive, unfriendly, dangerous, or ridden with corruption. Patients may also avoid modern drugs sold on the market because they are aware of the fact that many of them are counterfeit or ''fake'' drugs.[28]

Major Challenges and Opportunities in Developing Traditional Medicine and Complementary/Alternative Medicine Care

The safety, efficacy, policy, access, rational use, and quality control of traditional medicine and complementary/alternative medicine have become important concerns for both health authorities and the public. To maximize the potential of traditional medicine and complementary/alternative medicine as a source of potential health care, a number of issues must first be tackled. Relatively few countries, only 25 among WHO's 191 member states, have developed a policy on traditional medicine and/or complementary and alternative medicine.[9]

Traditional knowledge built on the long experiences of people was adopted in social, economic, environmental, spiritual, and political practices. Since traditional knowledge is developed through a long process of trial and error, this could guide search for new drugs. Together with the recognition of the importance of the traditional knowledge, serious concern about the loss of knowledge can be observed in the past few years throughout the world.[29-31]

Traditional Knowledge: So Precious to Preserve

Traditional plant usage custom is a result of thousands of years of experience. This expertise has been passed down to many generations chiefly through verbal means. This mode of transfer of information can result in distortion or loss of indigenous knowledge and usage custom of the plants.[32] The knowledge of traditional healing practices mainly by the use of wild plants is now fast disappearing because of modernization, globalization, and the tendency to change traditional lifestyles.[33]

Ethnic groups are the repositories of the knowledge on herbal remedy and these need to be documented and tapped properly.[15] The loss of traditional medicinal plants because of natural and anthropogenic factors is related to the loss of valuable indigenous knowledge associated with these plants.[34] This strong link suggests a need to conduct ethnobotanical research and to document the medicinal plants and the associated indigenous knowledge. These studies are extremely useful to identify endangered medicinal plant species and to take appropriate conservation measures in the near future.[31,32,34]

Modernization: A Threat

The most serious threat to existing knowledge and practice on traditional medicinal plants include cultural change, particularly the influence of modernization and lack of interest shown by the younger generations. These were the main problems reported by the informants during the field survey.[35] Hence, the proper documentation of the use of traditional medicinal plants as phytotherapeutic agents and the related indigenous knowledge held by the tribal community is inevitably required to preserve our traditional knowledge.

Dearth of Scientific Knowledge: Need to Explore

People who use traditional remedies may not understand the scientific rationale behind their medicines, but they know from personal experience that some medicinal plants can be highly effective if used at therapeutic doses. Since we have a better understanding today of how the body functions, we are in a better position to understand the healing powers of plants and their potential as multifunctional chemical entities for treating complicated health conditions. Medicinal plants typically contain mixtures of different chemical compounds that may act individually, additively, or in synergy to improve health.[1]

Lack of Standardization on Safety, Efficacy, and Quality in Traditional Medicine and Complementary/Alternative Medicine Care

In industrialized nations, herbal medicine is now a multibillion dollar industry, and in developing countries, up to 80% of people rely on plant-based medicines. The identity, authenticity, and quality of crude plants are often uncertain

and difficult to assess. The quality of manufactured products varies considerably worldwide, and regulations can be complex or inadequate. Standardization is possible for the few herbs for which all active ingredients are known (panel), but is technically difficult and would make drugs unaffordable in developing nations.[36]

Safety

In general, traditional procedure-based therapies are relatively safe, if they are performed properly by well-trained practitioners. But accidents do occasionally occur, most probably when practitioners are not fully trained. Therapies should be performed within accepted parameters, and the indications for a therapy should be evidence based when possible. Serious adverse effects of therapies are rare, but supportive data on adverse effects are not readily available. Accordingly, the evaluation of adverse effects should be considered a priority area for systematic evaluation of safety of these therapies.[37]

The active ingredients used in many traditional medicines are potentially toxic, often containing dangerous elements and can include heavy metals.[38,39] Even the use of ineffective nontoxic remedies can be harmful if it delays effective treatment. For instance, fears have been expressed that, in Nigeria, witchcraft and traditional remedies of unknown efficacy are widely employed as treatments for malaria to delay the access to modern medicines of proven effectiveness.[40]

Efficacy

Traditional medicines are currently under scrutiny to evaluate their effectiveness and to monitor their adverse effects.[41,42] Such analyses have often failed to confirm the efficacy of traditional remedies: For instance, of nearly 25 000 applications for registration of traditional medicines received by Malaysian authorities, 37.3% were rejected, either on grounds of safety or ineffectiveness.[43] However, there is currently no compelling explanation for the prevalence of low-efficacy treatments.[44] Traditional and complementary and alternative medicine practices have developed within different cultures in different regions. So there has been no parallel development of standards and methods, either nationally or internationally, for evaluating them.[9]

Quality

Although widely used, the efficacy of many herbal drugs is unproven. Moreover, many consumers misinterpret the natural origin of herbal medicines as a sign of safety, without appreciating the fact that herbal ingredients can also cause serious adverse effects.[45] Therefore, herbal medicines should be assessed with randomized controlled trials. For example, in Ghana, majority of the people administer plant products in the form of decoction; however, none of the people interviewed provided proper information about how they might "standardize" treatments, and it has been observed that the amounts used by them were generally vague. Thus the quality could vary greatly between prescriptions.[46] This lack of standardization and quality control is seen as one of the major disadvantages of traditional/complementary and alternative medicine.[2,47] In the traditional system of medicine, some plant species are also used as mixtures, which makes it more complex to standardize, investigate, and monitor the levels of biologically active compounds. Therefore, efficient quality control methods need to be developed.[35]

Conservation of Medicinal Plants

Medicinal plants are threatened by anthropogenic activities, since these plants have several other useful applications, for example, as timber, fuel, and construction poles.[48] It is necessary to initiate systematic cultivation of medicinal plants in order to conserve biodiversity and protect endangered species. In the pharmaceutical industry, where the active medicinal principle cannot be synthesized economically, the product must be obtained from the cultivation of plants.[14]

Sustainable management of medicinal plant species is important, not only because of their value as a potential source of new drugs but also because of the reliance on medicinal plants for health care.[48] Systematic conservation and large-scale cultivation of the concerned medicinal plants are thus of great importance. Efforts are also required to suggest appropriate cropping patterns for the incorporation of these plants into conventional agricultural and forestry cropping systems.[14]

Decisively, despite its existence and continued use over many centuries, and its popularity and extensive use during the past decade, traditional medicine has not been officially recognized in most countries. Consequently, education, training, and research in this area have not been accorded due attention and support. The quantity and quality of the safety and efficacy data on traditional medicine are far from sufficient to meet the criteria needed to support its use worldwide. The reasons for the lack of research data are not only health care policies but also a lack of adequate or accepted research methodology for evaluating traditional medicine. It should also be noted that there are published and unpublished data on research in traditional medicine in various countries, but further research on safety and efficacy should be promoted, and the quality of the research should be improved.[37]

Conclusion

Traditional system of medicine is one of the age-old practices and humans have postulated and ultimately established this system, in particular, the usage of traditional medicinal plants through empirical observation and by trial and error experiment. Even in the era of modern computational pharmacology approach, traditional medicinal plants serve as an important source and as a tool to treat various ailments in the developing countries. Currently, the world's most efficacious potent antimalarials such as chloroquine and artemisinin are the gifts of our precious traditional knowledge and custom of traditional

medicinal plants. The recent success of drug development from medicinal plants inspires and encourages many researchers to investigate and validate the uses of traditional medicinal plants. However, there are many thorny issues and daunting challenges that need to be addressed effectively and immediately for the promotion of traditional medicinal plants. The collaborative efforts of ethnobotanists, anthropologists, pharmacists, and physicians could be a workable strategy to evaluate and validate the usage custom of traditional medicinal plants with the existing modern scientific methods and innovative techniques.

From our personal observation, being born and brought up in developing countries like India and Ethiopia, especially from the rural underprivileged section of the society, we have experienced that the sick primarily approach the proximate traditional healer who is the primary health care provider in that area. Subsequently, they may travel to the adjacent modern (allopathy) health facilities if they do not get completely cured by the former. In true sense, our traditional knowledge on medicinal plants plays a major role, especially in developing countries, and helps the rural poor to lead a healthier and disease-free life. Based on the existing data for the betterment of traditional medicinal plants practice and future prospects, the present review makes the following recommendations:

Recommendations

- In developing countries, a sizable fraction of the rural poor still depends on traditional herbal medicine; however, the efficiency and the intrinsic compounding factors are still unknown and imprecise, which needs to be scientifically validated by conducting more detailed antimicrobial assays.
- Many believe that phytotherapeutic agents are quite safe; nevertheless, a few of them might have intrinsic toxicity too. There is a possibility of contamination or adulteration, and so these should be administered with great care and under the supervision of herbalist. Human safety must be determined by conducting standardized scientific clinical trials.
- In several instances, the administered herbal medicinal products' dosage is unknown or imprecise, which may lead to severe adverse side effects. Therefore, the desirable and appropriate dosage level must be determined by conducting more scientific experiments.
- Education programs such as short courses on modern traditional medicine or exposure to the subject in the undergraduate curriculum will be of benefit and will awareness among health care practitioners.[49]
- Special herbal system of medicinal units should be established within the premises of the modern health facilities, which would offer the opportunity to the patients to acquire traditional medicine, based on their personal interest.
- Worldwide, conservation of traditional medicinal plants is a matter of grave concern. The well-known traditional *Materia Medica* should be protected and preserved by employing various projects to realize the plant conservation for our future need.

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Author Contributions

KK conceived the study; KK, KJ, JV and EM planned the study and designed the protocol; KK, KJ, JV managed and collected the data, analysed and interpreted the data assisted by EM; KK wrote the manuscript; KK, KJ, JV and EM read, commented on and approved the final manuscript. KK, KJ, JV and EM are guarantors of the paper.

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