



Significance of Ethnomedical Practices in Drug Discovery and Modern Medicine

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Many patients who are disillusioned with modern medical therapy look for alternatives because of its inherent limitations and lack of success. Despite the high cost, modern medical therapy often falls short of hopes for pain relief and the cure of chronic degenerative disorders. Throughout history, people have turned to ethno-medical multi-disciplinary system that incorporates spirituality, botanicals, and the natural environment as a means of healing. The study reports the significance of the ethanomedical properties of drug discovery and modern medicine. The findings demonstrated that ethnomedical practices serve as a valuable reservoir of natural compounds, offer advice for bioactivity screening, provide insights into mechanisms, and foster cross-disciplinary collaboration. These strategies increase the effectiveness and success rate of drug discovery, while also ensuring the preservation and respect of valuable traditional knowledge. Further research found that ethnomedical practices help to preserve biodiversity and establish ethical criteria for using traditional knowledge. The integration of ethnomedical practices and modern medical knowledge will improve healthcare outcomes, promote sustainability, and honour cultural heritage.

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1. INTRODUCTION



Humans have achieved greater success than any other species on Earth because of their capacity to make efficient use of the bioresources found in their natural habitat. No matter how developed or primitive a society is, the practice of seeking and treating disease has always been known as "medicine" [1]. Cultural understandings of health, sickness, and illness, as well as healthcare seeking behaviours and healing methods, are central to ethnomedicine, the study of traditional medical practice [2]. Throughout history, people have turned to ethnomedicine—a multi-disciplinary system that incorporates spirituality, botanicals, and the natural environment—as a means of healing [3].

Ethnomedicine has seen a meteoric rise in both research interest and practitioner activity within the past decade. From its beginnings, scientific inquiry into ethnomedicine has significantly advanced our comprehension of traditional ways

of life, medical knowledge, and practice [4]. An explosion of ethnomedicine literature has been stimulated by an increase in awareness of the consequences of indigenous peoples' forced displacement and/or acculturation, by the recognition of indigenous health concepts as a way to maintain ethnic identities, and by the search for new medical treatments and technologies [2,5]. For these reasons, many biomedical practitioners have long disregarded ethnomedicine components. For instance, there is a lack of clarity regarding the chemical make-up, dosage recommendations, and toxicity of plants utilized in ethnomedicine [6]. One of the most effective criteria utilized by the pharmaceutical business to discover new therapeutic agents for the many sectors of biomedicine is the ethnomedicinal applications of plants [7,8,9-10]. The ethnomedicinal uses of plants have led to the development of some remarkable medicinal drugs. Table 1 illustrate some pictures and importance of some plants used in ethnomedical practices.

Table 1. Pictures and some Plants used in Ethnomedical Practices

Common name	Scientific name	Plant pictures	Uses
Ginger	Zingiber officinale,		Ginger is effective for the relief of nausea [11]
Lemon balm	Melissa officinalis		It is purported as a sleep and digestive aid [12]
Guava	Psidium guajava		It is traditionally used to treat diarrhea; however, evidence of its effectiveness is very limited [13].
Cayenne	Capsicum annum,		Used to reduce pain and swell, lowering of triglyceride and cholesterol levels, and fighting viruses and harmful bacteria [14].
Turmeric	Curcuma longa		Used in Ayurvedic and traditional Chinese medicine to aid digestion and liver function, relieve arthritis pain, and regulate menstruation [15].

Common name	Scientific name	Plant pictures	Uses
White snakeroot	Ageratina altissima		Used to treat diarrhea, kidney stones, and fever. The smoke from burning leaves is used to revive unconscious people [16].
Common hollyhock	Alcea rosea		It is used to control inflammation, to stop bedwetting and as a mouthwash in cases of bleeding gums [17]

Other examples of plants and treatment are vinblastine and vincristine, derived from *Catharanthus roseus* (the periwinkle), are used to treat acute lymphoma and acute leukaemias, Reserpine, from *Rauwolfia serpentina* (Indian snake root), is used to treat hypertension, and aspirin, from *Salix purpurea* (willow), is used to treat inflammation, pain, and thrombosis. Quinine, from *Cinchona pubescens* (cinchona), is used to treat malaria [18,19]. According to Panday et al. [20], a large majority of the world's population now uses plants or plant extracts as their primary source of healthcare. Also, out of the 150 most popular US proprietary medications, 57% have an active ingredient that is either derived from plants or was produced from plants in the past [20].

For ages, ethnomedicinal practices have included considerations of health and illness from a spiritual perspective. However, biomedical practitioners have overlooked these considerations because they are difficult to validate using scientific concepts and experiments [7]. In traditional medicine and other forms of ethnomedicine, there are two main schools of thought when it comes to the origins of illness: the natural and the supernatural. Illness is described in natural illness in a systemic, impersonal way. This view holds that diseases are caused by external factors, such as extremes of temperature or a lack of equilibrium between the body's fundamental constituents [21]. There are two main categories of supernatural forces that might create illnesses that don't fit the usual mould: occult forces, which can be caused by bad spirits or human agents who practice sorcery, and spiritual causes, which can be caused by sins, breaking taboos, or even divine intervention [22,23]. Although there is no evidence to support the spiritual component of ethnomedicine, certain

American institutions are still offering it [21]. Also, spiritists at Balican and Puerto Rican hospitals have shown success because patients stay shorter periods of time there [24]. The words "folk" or "traditional" have become truly universal due to the fact that ethnomedical practices and ideas now constitute a whole belief system that transcends class, ethnicity, and religion beliefs [22]. Globe Health Organization (WHO) statistics show that ethnomedicine's popularity has remained high across the developing globe and is even growing in industrialised nations. Leonti and Casu [25] and Williamson et al. [26] found that traditional herbal preparations make for 30-50% of China's total medicinal intake. Sixty percent of children in Zambia, Ghana, Mali, and Nigeria who get malaria first try using herbal remedies [27]. Seventy percent of HIV-positive individuals in South Africa, San Francisco, and London practice traditional medicine [28,29]. Thus, this paper reports the significance of ethnomedical practices in drug discovery and modern medicine.

2. DRUG DISCOVERY

Drug discovery is the process of identifying and characterizing molecules with the potential to safely modulate disease, with the goal of bringing medicines that can improve the lives of patients. The ultimate goal is to deliver patients medicines that improve their lives. The process is time-consuming and demanding on resources, necessitating tight collaboration amongst several fields [30]. To find new therapeutic medications, drug discovery is a complex process that includes many steps, such as screening, testing, and optimizing lead molecules [31]. According to Vuorela et al. [32] and Thomford et al. [33], this method integrates many techniques such as chemically modifying active compounds already

known to be active, finding new pharmacological targets, and rationally designing based on biological mechanisms and drug-receptor structure. The active component in ancient medicines or by chance discoveries like penicillin was the traditional methods of drug discovery. More recently, a method called classical pharmacology was used to find compounds with good therapeutic effects by screening chemical libraries of synthetic small molecules, natural products, or extracts in entire organisms or intact cells [34].

The first step is drug screening, which examines the drug's pharmacological profile and action on many scales (molecular, cellular, organ system, and whole animal) using a battery of assays. Extensive testing is conducted on the candidate chemical to identify its mode of action, selectivity, and any harmful consequences. In situations where preclinical models are sufficiently established, drugs are chosen for future research using animal models of human disorders [35,36].

Schenone et al. [28] remark that receptor binding assays are one method that can be used to screen potential compounds for their molecular-level activity on target proteins. According to Warne et al. [37], the drug's action at specific receptors can be determined by studying cell function. Schenone et al. [36] conducted whole-animal tests to evaluate the drug's impact on various organ systems and illness models. Through screening and lead production, pharmacologically active and selective lead compounds are identified. Lead optimization begins with these lead compounds, which are then subjected to additional chemical tweaks and improvements [38]. Maximizing a lead's potency, selectivity, and other desirable properties—including its pharmacokinetic properties—requires a battery of experiments and assays. Investigations conducted on animals evaluate the compound's in vivo efficacy, possible side effects, genotoxicity, and oral bioavailability.

Discovering new drugs derived from herbs is fraught with difficulties. Everyone involved has to put in a lot of time and money [39]. Many times, resources like time and money are frittered away. Finding the source of the lead is the initial stage. According to Kesharwani et al. [40] and Katiyar et al. [41], there are multiple methods for discovering new drugs.

- (a) Random selection high chemical screening,
- (b) Random selection followed by biological assays,
- (c) Follow-up of biological activity reports,
- (d) Follow-up traditional or ethno medicinal use of plants,
- (e) Use of proper plant parts,
- (f) Use of a plant product, etc.

3. MODERN MEDICINE

Modern medicine, sometimes known as conventional or Western medicine, includes modern medical procedures that are based on scientific research, evidence-based approaches, and cutting-edge technology [42]. As a standard part of modern medicine, patients often undergo surgical procedures and the administration of medications to relieve symptoms. Pharmaceuticals, diagnostic tools, and surgical procedures are all part of a systematic approach to disease detection, management, and prevention [43].

Reasoned scientific discussion, verified facts, and well-established ethical standards are the bedrock of modern medicine. This method's applications centre on curing a specific disease by identifying and eliminating a specific pathogen [44]. According to Claridge and Fabian [42], the most effective tool in contemporary medicine is an accurate diagnosis. This tool is based on scientific knowledge and the use of rational and efficient treatments that ensure the full eradication of the infection, ending in a cure. Many patients who are disillusioned with modern medical therapy look for alternatives because of its inherent limitations and lack of success. Despite the high cost, modern medical therapy often falls short of hopes for pain relief and the cure of chronic degenerative disorders.

4. SIGNIFICANCE OF ETHNOMEDICAL PRACTICES IN MODERN MEDICINE

Ethnomedical practices hold significant importance in modern medicine for various reasons:

i. Discovery of New Drugs

Rich Source of Bioactive Compounds: Traditional medicine provides a vast repository of bioactive compounds derived from plants, fungi, and other natural sources [45]. In the view of Chaachouay & Zidane [46] ethnobotanical

knowledge has led to the discovery of many important pharmaceuticals:

- Aspirin: Derived from salicin found in willow bark.
- Quinine: Extracted from the bark of the cinchona tree, traditionally used to treat malaria.
- Morphine: Obtained from the opium poppy, used for pain relief.

These discoveries illustrate how traditional knowledge can lead to the development of life-saving medications.

ii. Holistic Health Approaches

Comprehensive Treatment Strategies:

Traditional medicine often adopts a holistic view of health, considering physical, emotional, and spiritual well-being. This perspective can enhance modern medical practices by promoting comprehensive treatment strategies that address the overall health of patients rather than just focusing on specific symptoms [40].

Preventive and Integrative Health Care:

Ethnomedical practices emphasize disease prevention and the use of natural remedies [19,40]. Integrating these practices with modern medicine can enhance preventive healthcare and offer complementary treatments that improve patient outcomes. For example, dietary recommendations from traditional medicine can complement modern nutritional advice.

iii. Cultural Relevance and Accessibility

Community Acceptance: Cultural relevance in the context of ethnomedicinal drugs refers to the alignment of these practices with the beliefs, practices, and cultural identity of a community. This includes the use of these drugs in ways that align with local customs, spiritual beliefs, and traditional practices. Additionally, the ritualistic significance of ethnomedicinal practices should be acknowledged and respected, as they hold cultural importance [47,48]. Community trust and engagement are crucial to the acceptance and effectiveness of ethnomedicinal drugs. Trusted traditional healers, who have a deep understanding of local practices and serve as community health leaders, play a significant role in this process. Engaging the community in the cultivation, preparation, and administration of these drugs ensures that the practices are respected and maintained [49,50]. The

transmission of knowledge about ethnomedicinal drugs often occurs through oral traditions, passed down through generations. Integrating ethnomedicinal knowledge into educational curricula and training programs for healthcare providers can bridge the gap between traditional and modern medicine.

Affordable Healthcare Solutions: Accessibility of ethnomedicinal drugs is another important aspect of cultural relevance. These drugs are often more affordable than conventional pharmaceuticals, making them accessible to low-income communities. Using locally available plants and materials reduces costs associated with the transportation and procurement of medicines [51]. Encouraging the cultivation of medicinal plants within communities and protecting biodiversity ensures a sustainable supply of these drugs for future generations [52], and can enhance accessibility, and health centres that offer both conventional and traditional treatments can provide more comprehensive care [53].

iv. Biodiversity and Conservation

Incentivizing Biodiversity Conservation: The search for new drugs based on traditional medicine practices can create an incentive to conserve biodiversity. Protecting natural habitats and preserving the species that inhabit them is essential for sustaining the resources needed for future modern medicine [19,51].

Sustainable Harvesting Practices:

Ethnomedical practices frequently incorporate sustainable techniques for gathering medicinal plants, providing valuable insights for contemporary conservation initiatives. Implementing sustainable techniques helps to prevent excessive harvesting of medicinal plants, thereby safeguarding them for future utilization [54].

5. SIGNIFICANCE OF ETHNOMEDICAL PRACTICES IN DRUG DISCOVERY

The following are some significant ways that ethnomedical traditions contribute to the field of drug discovery:

- i. **Source of Novel Compounds:** Traditional medicines often utilize a diverse array of plants, fungi, and other natural sources that have been used for centuries to treat various ailments. These sources are rich

in bioactive compounds that can be isolated and studied for potential therapeutic applications [55]. The historical use of these natural remedies suggests that they contain pharmacologically active ingredients, providing a strong starting point for drug discovery. Plants and other natural sources used in traditional medicine produce a wide variety of chemical compounds, including alkaloids, flavonoids, terpenoids, and glycosides. These diverse chemical structures provide unique scaffolds for the development of new drugs that might not be discovered through synthetic chemistry alone [56,57].

ii. **Guiding Bioactivity Screening:**

Ethnomedical knowledge can guide scientists in selecting plants and other natural materials for bioactivity screening. This targeted approach increases the efficiency of the drug discovery process. Centuries-old plants and remedies are likely to contain pharmacologically active compounds. Researchers use ethnomedical knowledge to identify specific plants and natural products historically used to treat particular ailments [58]. This targeted selection increases the likelihood of finding bioactive compounds because these plants have already demonstrated therapeutic potential in traditional settings. For instance, plants used traditionally for treating infections can be prioritized for screening antimicrobial properties [59].

iii. **Bioprospecting and Conservation:**

Bioprospecting, the exploration of biodiversity for new resources of social and commercial value, often involves searching for new bioactive compounds in plants, fungi, and microorganisms. Ethnomedical knowledge directs bioprospectors to specific species known for their medicinal properties, enhancing the efficiency of discovering novel compounds with therapeutic potential [50,60,61]. Ethnomedical practices often highlight biodiversity hotspots that are rich in medicinal plants. Bioprospecting in these areas, guided by traditional knowledge, can lead to the discovery of new drugs while also emphasizing the need for conservation of these critical resources [59].

iv. **Mechanistic Insights:** Studying the mechanisms by which traditional remedies exert their effects can uncover new

biological pathways and targets for drug discovery. For instance, the traditional use of willow bark for pain relief led to the discovery of salicylic acid and subsequently aspirin, highlighting the role of cyclooxygenase inhibition in pain and inflammation [62].

- **Curcumin from Turmeric:** Curcumin, a substance used in Ayurvedic and traditional Chinese medicine, has been discovered to have anti-inflammatory and antioxidant properties [61]. It achieves these benefits through many methods, such as inhibiting NF- κ B (nuclear factor kappa-light-chain-enhancer of activated B cells) and activating Nrf2 (nuclear factor erythroid 2-related factor 2) pathways [63,64].

Traditional remedies can achieve therapeutic benefits by inhibiting the NF- κ B pathway, which regulates immune response, inflammation, cell proliferation, and survival. Chronic activation of NF- κ B is associated with inflammatory diseases, cancers, and autoimmune disorders [60,64]. Traditional remedies can inhibit NF- κ B activation signals, prevent the degradation of I κ B α , directly interact with NF- κ B subunits, and reduce oxidative stress to inhibit NF- κ B activity. Examples of traditional remedies that inhibit NF- κ B include curcumin and resveratrol [64].

On the other hand, traditional remedies can also activate the Nrf2 pathway, which is crucial for cellular defense against oxidative stress. Nrf2 is a transcription factor that induces the expression of antioxidant and detoxification genes. Traditional remedies can disrupt the Nrf2-Keap1 interaction, modify Keap1, and enhance Nrf2 nuclear translocation to activate the Nrf2 pathway [52,65].

Modulating the NF- κ B and Nrf2 pathways through traditional remedies can have various benefits. It can reduce chronic inflammation, enhance antioxidant defense, suppress tumor growth and metastasis, protect against oxidative damage, and have implications for neurodegenerative diseases and cardiovascular health [65,66].

- **Quinine from Cinchona Bark:** Quinine from Cinchona bark is an effective malaria therapy. The mechanism of action of quinine, which has been used to treat malaria traditionally, was shown to include inhibiting heme polymerase in

Plasmodium parasites, preventing them from detoxifying heme, which is poisonous to them [44,66]. Its mode of action involves impeding haemoglobin digestion, altering DNA and RNA synthesis, and preventing protein synthesis in the malaria parasite [64,67]. Quinine is most efficient against Plasmodium falciparum's asexual blood stages, and it is frequently used in combination with other antimalarial medicines [66]. It is rapidly absorbed, widely disseminated throughout the body, metabolized in the liver, and eliminated via the kidney. Quinine is commonly used to treat malaria, but it has also been used historically as a muscle relaxant. Nausea, vomiting, and tinnitus are common adverse effects, but large doses can cause significant poisoning [68,69]. Resistance to quinine has been recorded; however using it in conjunction with other medications can help combat resistance.

- v. **Lead Optimization and Structure-Activity Relationship (SAR) Studies:** Further modifications can be made to a bioactive component found in a traditional treatment to increase its effectiveness, decrease its toxicity, and improve its pharmacokinetic characteristics [52,70]. The structure-activity relationship can serve as a guiding principle for this research. The structure-activity connections found in traditional use can serve as a guide for these investigations.
- vi. **Cross-disciplinary Collaboration:** The integration of ethnomedical practices into drug discovery promotes collaboration between ethnobotanists, pharmacologists, chemists, and other scientists. This interdisciplinary approach enriches the drug discovery process by combining different perspectives and expertise [64,66].

6. CONCLUSION

Ethnomedical traditions play a vital role in drug discovery and the advancement of modern medicine. They provide a valuable reservoir of natural chemicals, offer guidance for screening bioactivity, provide insights into mechanisms, and promote collaboration across disciplines. These techniques improve the effectiveness and rate of success in drug discovery and ensure the preservation and respect of indispensable traditional knowledge.

In addition, they provide assistance for preserving biodiversity and enforce ethical guidelines for utilizing traditional knowledge. By combining ethnomedical practices with current medical knowledge, we can improve healthcare results, support sustainability, and honour cultural heritage.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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