World Journal of Pharmaceutical Science and Research

www.wjpsronline.com

Review Article

ISSN: 2583-6579
SJIF Impact Factor: 6.916
Year - 2026
Volume: 5; Issue: 3
Page: 308-312

FROM TRADITION TO THERAPEUTICS: ETHNOMEDICINE AS A FOUNDATION FOR MODERN DRUG DISCOVERY

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Article Received: 17 January 2026 | | ***Article Revised: 7 February 2026*** | | ***Article Accepted: 27 February 2026***

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DOI: https://doi.org/10.5281/zenodo.18875705

How to cite this Article: Dhale D. A. (2026) FROM TRADITION TO THERAPEUTICS: ETHNOMEDICINE AS A FOUNDATION FOR MODERN DRUG DISCOVERY. World Journal of Pharmaceutical Science and Research, 5(3), 308-312. https://doi.org/10.5281/zenodo.18875705

ABSTRACT

Ethnomedicine has historically served as a foundational source for drug discovery and therapeutic innovation. Traditional knowledge systems across civilizations-preserved through oral traditions and ancient manuscripts-have contributed significantly to the identification of bioactive compounds and the development of modern pharmacology. This paper traces the evolution of medicine from indigenous practices to organized systems and ultimately to modern scientific medicine. It highlights representative ethnomedicinal examples that led to validated therapeutics, discusses historical literature documenting medicinal knowledge, and evaluates contemporary challenges in drug discovery from plant sources. Emphasis is placed on quality control, regulatory frameworks, safety considerations, systems biology, and novel drug delivery approaches. Ethnomedicine remains a vital reservoir of pharmacologically active compounds and demands systematic scientific integration for future drug development.

KEYWORDS: Ethnomedicine, History, Development, Drug Discovery, Natural Products.

1. INTRODUCTION

Human civilization has continuously relied on natural bioresources for survival and healthcare. The ability to observe, interpret, and utilize plant-based remedies enabled early societies to combat diseases effectively. Medicine, in its earliest form, emerged from empirical observations and accumulated wisdom transmitted across generations.

According to Mashelkar (2002), traditional knowledge systems represent parallel knowledge frameworks derived from experiential learning in the "laboratory of life." These systems require preservation, scientific validation, and value addition. While early medicinal practices evolved independently within communities, modern drug discovery has

increasingly shifted toward laboratory-based synthetic approaches. However, the resurgence of interest in natural products underscores the continuing relevance of ethnomedicine.

This paper examines the historical development of medicine, selected ethnomedicinal case studies, the doctrine of signatures, and contemporary strategies and challenges in drug discovery from plant sources.

2. Development in Medicine: Ethnomedicinal Glimpses Across Cultures

Ethnomedicinal knowledge, particularly in biodiversity-rich regions, reflects centuries of plant–human interactions. Various traditional remedies have transitioned into validated modern therapeutics (Cox, 2005; Dhale, 22).

2.1 Selected Historical Examples

a) ***Angelica sinensis*** **(Dang Gui)**: Traditionally used in Chinese medicine as a blood tonic; currently administered for improving circulation and managing blood deficiencies (Hoizey & Hoizey, 1993; Unschuld, 1985).

b) ***Ammi visnaga***: Mentioned in the *Ebers Papyrus* (c. 1500 BC), used traditionally for kidney stones and still applied therapeutically for similar indications (Manniche, 1989).

c) ***Cinchona calisaya***: Used in 17th -century Peru for fever; quinine isolated from its bark became a landmark antimalarial drug.

d) ***Panax ginseng***: Recorded in *Shen Nong Ben Cao Jing* (1st century BC); used traditionally as a tonic and adaptogen, validated in modern herbal pharmacology (Hoizey & Hoizey, 1993).

e) ***Terminalia arjuna***: Prescribed by Vagbhata (7th century AD) for cardiac ailments; modern research confirms cardioprotective and antihypertensive properties (Patil, 2006).

Such examples demonstrate that traditional medicine provided early leads for pharmacological isolation and validation. Advances in chemistry facilitated the extraction of active principles, transforming crude plant materials into standardized therapeutics.

3. Historical Traditions in Medicine

Medicinal knowledge is preserved in numerous ancient texts worldwide. Greek and Roman scholars such as Aristotle, Theophrastus, Pliny, Dioscorides, and Galen documented herbal therapeutics extensively. Chinese classical texts such as *Shen Nong Ben Cao Jing* and *Huang Di Nei Jing* systematized herbal knowledge over 2000 years ago (Unschuld, 1985). Egyptian medical knowledge is reflected in the *Ebers Papyrus* (Manniche, 1989).

In India, Ayurveda evolved over 5000 years, with foundational texts such as the *Charaka Samhita*, *Sushruta Samhita*, and *Ashtanga Hridayam*. These works established systematic therapeutic principles integrating physical, emotional, and spiritual dimensions.

3.1 Doctrine of Signatures

The doctrine of signatures, formalized by Paracelsus (1493–1541), proposed that the morphology of plants indicates their therapeutic uses (Arber, 1999). Although often dismissed in modern pharmacology, recent scholarship suggests that symbolic associations may have guided empirical experimentation (Patil, 2009). For instance, *Scrophularia nodosa* roots resemble swollen lymph nodes and were historically used to treat scrofula.

While requiring cautious interpretation, such heuristic frameworks may offer ethnobotanical clues for bioprospecting.

4. Transition from Folk Medicine to Modern Pharmacology

The progression of medical systems can be summarized as:

Ethnomedicine → Organized Systems (Ayurveda, Unani, Chinese, etc.) → Modern Medicine

Ethnomedicine involved empirical and trial-based methods without chemical explanations. Organized systems developed theoretical frameworks and structured pharmacopoeias. Modern medicine introduced chemical isolation, biological validation, and clinical trials.

Several modern drugs originated from ethnomedicinal leads:

Compound	Source	Indication
Quinine	*Cinchona* spp.	Antimalarial
Vincristine/Vinblastine	*Catharanthus roseus*	Anticancer
Reserpine	*Rauvolfia serpentina*	Antihypertensive
Morphine	*Papaver somniferum*	Analgesic
Digitoxin	*Digitalis purpurea*	Cardiac disorders

These examples illustrate how traditional leads evolved into globally significant pharmaceuticals.

5. Drug Discovery from Ethnomedicine: Approaches and Challenges

Drug discovery from ethnomedicine represents a strategic and knowledge-driven approach that integrates traditional therapeutic wisdom with modern scientific methodologies. Unlike random synthetic screening, ethnomedicinal selection increases the probability of identifying biologically active lead compounds because the plants have already undergone centuries of empirical validation (Cox, 2005, Dhale, 2023). The process typically begins with ethnobotanical documentation, followed by taxonomic authentication, phytochemical screening, bioassay-guided fractionation, and pharmacological evaluation. However, significant challenges persist. Natural products are often isolated in minute quantities, complicating lead optimization, large-scale production, and clinical validation. Additionally, issues of standardization, quality control, and reproducibility remain critical concerns in herbal drug development (Mukherjee, 2002, Dhale and Chamle, 2018). Regulatory compliance, safety evaluation, and potential herb–drug interactions further complicate commercialization (Mukherjee & Saha, 2003). Modern advances such as systems biology provide a holistic framework to understand multi-component herbal formulations and their network-based mechanisms of action (Kitano, 2002, Dhale, 2024). Thus, while ethnomedicine offers a promising and cost-effective reservoir of novel drug leads, its successful translation into modern therapeutics demands rigorous scientific validation, multidisciplinary collaboration, and strong regulatory frameworks.

5.1 Challenges

a) Limited quantities of isolated natural compounds
b) Time-consuming lead optimization and clinical trials
c) Regulatory and intellectual property issues
d) Standardization difficulties

The process remains expensive and uncertain, but ethnomedicine improves success rates by narrowing candidate selection.

6. Quality, Safety, and Regulatory Considerations

Quality, safety, and regulatory compliance are fundamental requirements for the successful integration of ethnomedicinal products into modern healthcare systems. Ensuring quality begins with correct botanical identification, followed by standardization using physicochemical parameters, chromatographic fingerprinting, and marker compound analysis to guarantee purity, consistency, and therapeutic efficacy (Mukherjee, 2002). Quality assurance must also extend to cultivation, harvesting, processing, storage, and manufacturing practices, which should comply with Good Manufacturing Practices (GMP) to prevent contamination, adulteration, and variability in active constituents (Mukherjee & Saha, 2003). Safety evaluation is equally critical, as herbal medicines, despite their traditional use, may cause adverse effects or interact with conventional pharmaceuticals. Therefore, toxicological studies, pharmacovigilance, and clinical validation are essential to ensure safe therapeutic application. Regulatory agencies play a crucial role in establishing guidelines for standardization, quality control, and documentation to protect public health and ensure the efficacy and reliability of herbal medicines (Liu et al., 2008). These measures collectively help bridge the gap between traditional ethnomedicine and evidence-based modern therapeutics.

7. Novel Approaches in Ethnomedicine-Based Drug Development

Recent advances in science and technology have significantly enhanced the potential of ethnomedicine-based drug development by improving the efficacy, safety, and delivery of plant-derived therapeutics. One of the most promising innovations is the application of advanced drug delivery systems, including nanoformulations, targeted drug delivery, and controlled-release technologies, which enhance the bioavailability, solubility, and stability of phytoconstituents while reducing dosage requirements and side effects (Liu et al., 2008). These approaches allow precise delivery of active compounds to specific tissues, thereby increasing therapeutic effectiveness and minimizing toxicity. Additionally, metabolomics, genomics, and proteomics have facilitated the identification of bioactive compounds and their mechanisms of action at the molecular level. Systems biology further contributes by enabling the study of complex interactions among multiple phytochemicals and biological pathways, reflecting the holistic nature of traditional herbal formulations (Kitano, 2002, Tayade et al, 2013). Integration of ethnobotanical knowledge with modern screening techniques, computational drug design, and biotechnology has accelerated lead identification and optimization. These novel multidisciplinary approaches not only validate traditional medicinal knowledge but also provide innovative pathways for the development of safe, effective, and scientifically standardized herbal drugs (Dhale, 2013).

8. CONCLUSION

Ethnomedicine represents humanity’s earliest pharmacological experimentation. Historical manuscripts, oral traditions, and empirical practices collectively contributed to modern drug discovery. Numerous clinically significant drugs originated from traditional plant-based remedies. Despite technological advancements, ethnomedicine remains indispensable for identifying novel lead compounds. However, challenges related to standardization, safety, regulatory compliance, and sustainability must be addressed. Integrating systems biology, nanotechnology, and rigorous quality control can enhance the translational potential of ethnomedicinal resources. Future drug discovery should not distance itself from nature but instead harmonize traditional wisdom with scientific rigor.

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