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Integrating DNA Barcoding and Chemotaxonomy for Rigorous Pharmacognostic Authentication in Ethnopharmacological Research

Mustafa Algasem¹ , Reza Dashti^{2*} 

¹ Faculty of Medicine, Tehran University of Medical Sciences, Tehran, Iran.

² Faculty of Pharmacy, Eastern Mediterranean University, Famagusta, Northern Cyprus.

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***Corresponding Author:** Email: r.dashti@gmail.com

Dear Editor

Ethnopharmacology, grounded in the interdisciplinary study of medicinal plant use, depends fundamentally on correct taxonomic identification. However, taxonomic ambiguity remains a persistent and underappreciated threat to the credibility of ethnopharmacological research. Vernacular names, phenotypic plasticity, cryptic species, and inconsistent vouchers continue to produce misidentified plant material, compromising reproducibility, safety, and comparative analysis across studies (Group1 et al., 2009, Saki & Pourrahim, 2025).

Traditional morphological authentication, although indispensable, is insufficient for many taxa. Closely related species and processed herbal products often

lack diagnostic macroscopic or microscopic features. This limitation is particularly acute in ethnobotanical fieldwork, where identification may rely on local names or dried specimens of uncertain provenance. A misidentified voucher specimen propagates errors through every subsequent pharmacological, phytochemical, and toxicological investigation (Coghlan et al., 2012, Heinrich et al., 2017).

DNA barcoding offers a powerful complementary solution. Standardized markers, such as *rbcl*, *matK*, and *ITS*, provide species-level resolution for many medicinal plants and are applicable to degraded or processed samples (Hebert et al., 2003). When integrated with authoritative reference databases, barcoding can detect substitution, adulteration, and contamination, thereby strengthening the

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evidentiary basis of ethnopharmacological claims (Coghlan et al., 2012). However, DNA barcoding alone cannot resolve all cases, particularly where hybridization, polyploidy, or introgression blur species boundaries (Group1 et al., 2009).

Chemotaxonomy, the classification of plants based on secondary metabolite profiles, addresses a different dimension of authentication. Chromatographic and metabolomic fingerprints, such as HPLC, LC-MS, or NMR profiles, capture the chemical complexity that directly relates to pharmacological activity (Wink, 2003). Chemotaxonomy is especially valuable for distinguishing chemotypes that are genetically similar but chemically distinct, a distinction with major implications for efficacy and safety (Simmler et al., 2018).

We argue that robust pharmacognostic authentication in ethnopharmacology requires the combined application of DNA barcoding and chemotaxonomy. Genetic identification establishes taxonomic identity, whereas metabolomic profiling confirms the presence of relevant bioactive constituents. Together, they address both identity and quality, transforming authentication from a preliminary formality into a scientifically rigorous component of study design (Coghlan et al., 2012, Simmler et al., 2018).

Therefore, we urge journals and researchers to adopt minimum authentication standards, including the deposition of voucher specimens with geographic and ecological metadata, DNA barcode sequences deposited in public repositories, and chromatographic or metabolomic profiles of tested extracts. Only through such integrated authentication can ethnopharmacological research achieve the reproducibility and credibility required for evidence-based pharmacology (Heinrich et al., 2017, Simmler et al., 2018).

Declarations Conflict of Interest

The authors declare no conflicts of interest.

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Consent for Publications

The authors certify that that this work in its final form has been thoroughly reviewed and approved for publication.

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Authors' Contributions

Conceptualization: Mustafa Algasem, Reza Dashti

Data curation: Mustafa Algasem, Reza Dashti

Formal analysis: Mustafa Algasem

Funding acquisition: Mustafa Algasem

Methodology: Reza Dashti

Project administration: Reza Dashti

Resources: Reza Dashti

Software: Mustafa Algasem

Supervision: Reza Dashti

Validation: Mustafa Algasem

Visualization: Mustafa Algasem, Reza Dashti

Writing – original draft: Mustafa Algasem, Reza Dashti

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Ethical Considerations

All ethical principles and standards for scholarly research—covering plagiarism, data integrity, originality, and proper citation—were diligently upheld throughout the development and submission of this work.

AI Use Disclosure

The authors confirm that QuillBot AI and Grammarly were used strictly for language editing, grammar correction, and paraphrasing assistance during the preparation of this manuscript. Specifically, these tools were appl.

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