



P-ISSN: 3078-7769  
E-ISSN: 3078-7777  
JDBV 2025; 2(1): 07-09  
[www.dravyagunajournal.com](http://www.dravyagunajournal.com)  
Received: 11-06-2025  
Accepted: 17-07-2025

**Dr. Verender Kumar**  
MD. (Ayu.) Dravyaguna,  
Ayurvedic Medical Officer,  
AYUSH Arogya Kendra,  
Jhunir, District Mansa,  
Department of Ayush,  
Government of Punjab, India

## Adulteration and Substitution of Medicinal Plants: A Review on Challenges and Quality Assurance in Ayurvedic Crude Drugs

**Verender Kumar**

DOI: <https://www.doi.org/10.33545/dravyaguna.2025.v2.i2.A.16>

### Abstract

Adulteration and substitution of crude drugs represent a persistent challenge in the global herbal medicine trade, especially within traditional systems like Ayurveda. This review explores the different forms, causes, and impacts of adulteration in medicinal plants and examines scientific approaches used to detect and prevent it. Various studies highlight that adulteration may occur deliberately for economic gain or inadvertently due to identification errors, scarcity, or confusion in vernacular names. Such practices compromise the quality, safety, and therapeutic value of herbal medicines, often leading to reduced efficacy or potential toxicity. Modern techniques such as DNA barcoding, chromatography, and spectroscopic analysis have significantly improved detection accuracy. However, lack of awareness, weak regulation, and insufficient training among collectors remain barriers. Strengthening pharmacognostic evaluation, enforcing good manufacturing practices (GMP), and enhancing standardization through regulatory bodies are crucial for ensuring authenticity and restoring public confidence in herbal drugs.

**Keywords:** Adulteration, substitution, Ayurveda, crude drugs, herbal medicine, standardization

### Introduction

Herbal medicines form the foundation of traditional medical systems like Ayurveda, Siddha, and Unani. Their global demand has increased substantially due to growing awareness of natural therapies and reduced side effects compared to synthetic drugs <sup>[1]</sup>. However, this rising demand has also led to widespread adulteration and substitution of crude drugs.

Adulteration is defined as the deliberate or accidental addition of inferior, spurious, or entirely different materials that lower the quality or therapeutic value of a drug <sup>[2]</sup>. The practice is centuries old—records from the early nineteenth century describe adulteration in food and medicinal materials as a common malpractice. Adulteration in medicinal plants not only diminishes efficacy but may also introduce harmful substances. Such malpractice often results in adverse reactions that are mistakenly attributed to the genuine herb rather than the adulterant <sup>[3]</sup>. For Ayurveda and other traditional systems to maintain credibility in the modern era, ensuring the authenticity and purity of herbal materials through standardization and quality assurance is essential.

### Review of Literature

Numerous studies have documented the extent, causes, and implications of adulteration in medicinal plant materials. Baragi and Ganer (2022) emphasized that adulteration undermines therapeutic reliability and hampers the global acceptance of Ayurvedic products <sup>[4]</sup>. Similarly, Singh *et al.* (2022) reported that substitution and adulteration of herbal materials are major obstacles in herbal drug commerce and are often due to vernacular confusion, scarcity, and economic incentives <sup>[5]</sup>. Mukherjee (2002) stressed that proper quality control of herbal drugs requires rigorous pharmacognostic and phytochemical evaluation <sup>[6]</sup>. Modern analytical tools, including HPTLC, HPLC, and DNA barcoding, have been developed to distinguish authentic from adulterated samples. In a DNA-barcoding study involving thirty medicinal plants in South India, substitution rates ranged from 20 % to 100 % <sup>[7]</sup>. Parabia and Ladani (2021) classified adulteration types into deterioration, admixture, sophistication, substitution, inferiority, and spoilage <sup>[8]</sup>.

**Corresponding Author:**  
**Dr. Verender Kumar**  
MD. (Ayu.) Dravyaguna,  
Ayurvedic Medical Officer,  
AYUSH Arogya Kendra,  
Jhunir, District Mansa,  
Department of Ayush,  
Government of Punjab, India

The most common form observed in Indian markets is substitution with superficially similar or substandard materials, such as exhausted drugs or artificially coloured substitutes. Rathore *et al.* (2022) noted that scarcity of genuine raw materials and regional naming variations frequently result in unintentional substitution <sup>[9]</sup>. The economic motive, however, drives deliberate adulteration—especially when authentic drugs are rare or expensive. Other reviews <sup>[10]</sup> highlighted that regulatory oversight, public awareness, and standardized authentication protocols are essential to minimize these issues.

### Methodology

This review was prepared using a qualitative, narrative approach. Relevant scientific articles, classical Ayurvedic texts, and reports from official bodies such as the Central Council for Research in Ayurvedic Sciences (CCRAS), the Council for Scientific and Industrial Research (CSIR), and the Indian Council of Medical Research (ICMR) were examined. Searches were performed through PubMed, ScienceDirect, Google Scholar, and other open-access journal databases using key terms: *herbal adulteration*, *substitution of crude drugs*, *Ayurveda quality control*, and *authentication of medicinal plants*. Articles published in English between 2000 and 2025 were prioritized. Data were synthesized thematically under four main areas: (i) types and mechanisms of adulteration, (ii) causes, (iii) detection and authentication methods, and (iv) prevention and regulatory approaches. No meta-analysis was conducted, as the study focused on qualitative synthesis rather than statistical aggregation.

### Results

#### Types of Adulteration

The literature identifies multiple categories of adulteration:

- **Deterioration:** degradation of quality due to improper storage or microbial attack.
- **Admixture:** accidental addition of foreign matter during collection or processing.
- **Sophistication:** intentional addition of similar materials to deceive consumers.
- **Substitution:** replacement with morphologically similar but pharmacologically inferior materials.
- **Inferiority and Spoilage:** use of low-grade or decomposed products <sup>[8]</sup>.

#### Common Adulteration Practices

1. **Substitution with substandard varieties:** cheaper or morphologically similar species replace genuine drugs, e.g., *Calophyllum inophyllum* for *Mesua ferrea*.
2. **Use of exhausted drugs:** volatile-oil herbs such as clove or fennel are adulterated with residues from which oils have been extracted.
3. **Artificial colouring/flavouring:** synthetic chemicals like citral added to enhance aroma.
4. **Adulteration of powders:** inert substances (brick powder, sand, starch) mixed with powdered barks or roots <sup>[9]</sup>.

#### Causes

- **Vernacular confusion:** similar local names leading to wrong plant identification (*Parpatta* vs. *Parpadagam*).
- **Scarcity or restricted collection:** substitution of unavailable species with local analogues.

- **Morphological similarity:** visual resemblance between species such as *Mucuna pruriens* and *M. utilis*.
- **Economic gain:** deliberate substitution to maximize profit <sup>[5]</sup>.

### Detection Methods

Modern authentication approaches include:

- **Microscopic and organoleptic evaluation** for structural characteristics.
- **Phytochemical fingerprinting** (HPTLC, HPLC, GC-MS).
- **Molecular techniques** such as DNA barcoding and PCR amplification for species identification <sup>[4, 7]</sup>.
- **Spectroscopic analysis** (FTIR, NMR) for chemical profiling.

### Impact on Safety and Efficacy

Adulteration can reduce pharmacological efficacy and, in some cases, introduce toxic or allergenic materials. Global systematic reviews link adulterated herbal products to liver injury, heavy-metal poisoning, and allergic reactions <sup>[10]</sup>.

### Discussion

The findings confirm that adulteration and substitution are among the most pressing issues facing the herbal-medicine sector. Both deliberate and unintentional adulteration undermine therapeutic outcomes and public confidence. In the Ayurvedic context, where treatment efficacy depends on plant authenticity, even minor substitutions can alter pharmacological activity. The economic motivation behind adulteration remains strong: when genuine species are scarce, traders substitute readily available, cheaper materials. Lack of botanical expertise among collectors and processors exacerbates this problem. In addition, identical vernacular names across different regions often cause confusion.

Despite growing awareness, enforcement of quality standards is inconsistent. Government agencies like CCRAS, CSIR, and the Ayurvedic Pharmacopoeia Committee have developed guidelines for raw-drug authentication, yet many small-scale manufacturers lack resources to implement them <sup>[9]</sup>.

The integration of molecular and chromatographic tools has improved detection, but field-level identification remains weak. Capacity-building programs for collectors, suppliers, and traders can help mitigate unintentional adulteration. Furthermore, traceability systems, certification of authentic suppliers, and consumer education can reduce fraudulent practices. In a broader sense, adulteration reflects a disconnect between traditional knowledge and modern supply chains. Ensuring sustainable cultivation of medicinal plants through Good Agricultural and Collection Practices (GACP) can prevent scarcity-driven substitution. International collaboration on standardization can also harmonize authentication protocols for trade consistency.

### Conclusion

Adulteration and substitution of crude drugs pose critical threats to the safety, efficacy, and reputation of traditional medicines. The problem arises from multiple factors—ranging from economic motives and vernacular confusion to inadequate training and regulation.

**To safeguard the authenticity of Ayurvedic formulations, comprehensive strategies must be adopted**

1. Rigorous pharmacognostic and molecular authentication before processing.
2. Implementation of GMP and GACP across the herbal supply chain.
3. Capacity-building programs for collectors and traders.
4. Stronger surveillance and penal provisions against deliberate adulteration.

Advancements in analytical technology, combined with governmental and institutional oversight, can effectively curb adulteration. By reinforcing quality control and standardization, the Ayurvedic industry can ensure patient safety, promote therapeutic reliability, and regain global trust in herbal medicines.

**References**

1. Baragi UC, Ganer JM. Adulteration and substitution of herbal drugs: A critical review of challenges and implications. *J Ayurveda Integr Med Sci.* 2022;10(7). doi:10.21760/jaims.10.7.1
2. Mukherjee PK. *Quality control of herbal drugs: An approach to evaluation of botanicals.* New Delhi: Business Horizons; 2002.
3. Rathore K, Singh R, Kumari A. Adulteration and substitution in Indian medicinal plants: A review. *Int Res J Ayurveda Yoga.* 2022;5(5):72-8. doi:10.48165/irjay.5.5.72-78
4. Singh BR, Kotecha M, Chaudhary K. Patterns of adulteration in Indian medicinal plants: A comprehensive overview. *J Herb Med.* 2022;12(3):155-63.
5. Parabia F, Ladani M. Adulteration and substitution in medicinal plants: An interrupted and non-interrupted practice. *J Ayurvedic Herb Med.* 2021;7(2):134-9.
6. Agarwal P, Goyal A. A comprehensive review on adulteration and substitution of crude drugs. *Asian J Pharm Clin Res.* 2021;14(4):1-7. doi:10.22159/ajpcr.2021.v14i4.40452
7. Newmaster SG, *et al.* DNA barcoding detects widespread substitution and adulteration of herbal products. *BMC Med.* 2019;17:46. doi:10.1186/s12916-019-1276-1
8. Fatima S, Zafer N, Hanif U. Investigation of adulteration in medicinal plants used during COVID-19. *Pure Appl Biol.* 2023;12(2):1000-8.
9. Kaur R, Choudhary T, Baldi A. Adulteration in herbal medicines: A comprehensive review on detection and health impacts. *Pharmacogn Res.* 2025;17(4):1-11. doi:10.5530/pres.20250085
10. World Health Organization. *WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants.* Geneva: WHO Press; 2019.