

Substitution and Adulteration in Ayurvedic Drugs: A Review with Special Reference to *Kushta*, *Pushkarmoola*, and *Sarpagandha*

Dr. Anita¹, Dr. Ayushi Uniyal², Dr. Suresh Chaubey

^{1,2}Post graduate Scholar, Rishikul, ³Professor and HOD Campus Department of Dravyaguna, Rishikul Campus, Haridwar, Uttarakhand Haridwar

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Abstract

Herbal drugs form the backbone of traditional medical systems and are increasingly used worldwide for primary healthcare. However, the authenticity of herbal medicines is frequently compromised due to adulteration and substitution, which pose serious challenges to their quality, safety, and therapeutic efficacy. Adulteration may occur intentionally for economic gain or unintentionally due to misidentification, scarcity of genuine raw materials, or lack of standardization, while substitution often arises from traditional practices, regional variations, or the depletion of original plant sources. The presence of adulterant and substitute herbal drugs can lead to reduced pharmacological activity, adverse health effects, and loss of consumer trust in herbal medicine systems. This review critically examines the major causes and types of adulteration and substitution in herbal drugs, highlights commonly affected medicinal plants, and discusses their impact on clinical efficacy and safety.

Keywords-

Adulteration, Substitute, *Apmishrana*, *Pratinidhi Dravya*, *Kushta*, *Pushkarmoola*, *Sarpagandha*,

I. Introduction

Medicinal plants are integral to traditional healthcare systems such as *Ayurveda*, *Siddha*, and *Unani*, and play a significant role in the global herbal drug industry. India is a major source of medicinal plant resources; however, the growing demand for herbal medicines has led to widespread issues of adulteration and substitution in medicinal plants.

Adulteration involves the replacement of genuine crude drugs with inferior or spurious materials, either intentionally for economic benefit or unintentionally due to misidentification, limited availability, or lack of standardization. Substitution, in contrast, is a traditional practice described in classical Ayurvedic texts such as *Bhavaprakasha*

and *Yogaratanakara*, where alternative plants with similar therapeutic properties are used when the original drug is unavailable. The improper application of substitution in commercial practices often results in adulteration.

Many researchers have contributed in checking adulterations and authenticating those.^{1,2,3,4,5}

Adulteration and substitution compromise the quality, safety, and therapeutic efficacy of herbal drugs, leading to reduced clinical effectiveness and potential health risks. They also create challenges for quality control and scientific validation of herbal medicines. Therefore, a critical evaluation of traditional substitution concepts alongside modern authentication and standardization methods is essential to ensure the authenticity and reliability of medicinal plant-based drugs.

अपमिश्रण/ADULTERATION

Adulteration refers to the partial or complete replacement of a genuine drug with similar-looking substances that lack the same chemical composition or therapeutic effectiveness.⁶

Reasons for Adulteration⁷

- Excessive Industrialization and Urbanization**
Rapid industrialization and urban expansion have made the procurement of authentic medicinal plant materials increasingly difficult for physicians. As a result, dependence on intermediaries or middlemen for sourcing medicinal plants has increased, creating opportunities for malpractices.
- Excessive Deforestation**
Large-scale deforestation has significantly reduced the natural availability of medicinal plants. The growing global demand for herbal drugs has further accelerated the conversion of many valuable medicinal plants into endangered species.
- Disappearance of Medicinal Plant Species**
Urbanization and deforestation have led to the gradual disappearance of numerous

- medicinal plant species from natural flora, forcing the use of substitutes or adulterants.
- 4. Indiscriminate Use of Medicinal Plants**
The increasing demand for herbal medicines in the healthcare sector has resulted in the indiscriminate harvesting and utilization of medicinal plants, contributing to resource depletion.
 - 5. Profit-Oriented Practices**
The intention to maximize profit often leads to the substitution of genuine crude drugs with cheaper and inferior materials, thereby compromising the quality and efficacy of herbal drugs.

Types of Adulteration⁸

1. Substitution with Standard Commercial Varieties

Genuine crude drugs are replaced with commercially available varieties that closely resemble the original in morphological, chemical, or therapeutic characteristics but are inferior in quality and cheaper in cost (e.g., *Capsicum minimum* for *Capsicum annum*; *Strychnos potatorum* for *Strychnos nux-vomica*; Indian senna for Arabian senna).

2. Substitution with Superficially Similar Inferior Drugs

Inferior materials resembling the genuine drug in appearance, but lacking comparable chemical or therapeutic value, are used as adulterants (e.g., Japan wax for beeswax; *kusumha* for saffron; *Ailanthus* leaves for belladonna leaves).

3. Substitution with Artificially Manufactured Substances

Artificial materials are prepared to imitate genuine crude drugs, particularly costly ones (e.g., chicory mixed with coffee; paraffin substituted for beeswax; citral for lemon oil).

4. Substitution with Exhausted Drugs

Previously extracted drugs, devoid of active constituents, are reused after altering their color, taste, or odor to resemble genuine drugs (e.g., colored exhausted saffron; bittered exhausted gentian; oil-extracted clove and fennel).

5. Substitution with Plant Material from the Same Source

Different parts of the same plant or associated plant materials are mixed due to similarity in color or odor (e.g., stems mixed

with roots of *Rauwolfia serpentina*; senna stems mixed with leaves).

6. Adulteration in Powders

Powdered forms of drugs are frequently adulterated because adulterants are difficult to detect and easily mixed. Common examples include turmeric powder mixed with chalk, *kampillak phalraj* powder with brick dust, dextrin in milk powder and exhausted ginger in ginger powder.

प्रतिनिधि / SUBSTITUTION

From a pharmacognostic perspective, substitution refers to replacing a drug with another that can perform a similar function and possesses comparable properties. In the Indian crude drug market, for instance, the roots, stems, and stem bark of *Coscinium fenestratum* (Menispermaceae) have long been used as a substitute for the roots, root bark, and stems of *Berberis aristata* (Berberidaceae). Essentially, substitution involves using drugs with analogous pharmacological effects and therapeutic activities in place of the original drug.

In Ayurveda, this practice is known as *Abhava Pratinidhi Dravya*. The concept was formally introduced by *Acharya Vagbhata* in the later periods, as it was not discussed in the classical *Samhita* texts. He emphasized that when a particular drug is unavailable, a substitute with similar essential characteristics should be chosen. The selection of a substitute is guided by equivalence in five key aspects: taste (*Rasa*), qualities (*Guna*), potency (*Veerya*), post-digestive effect (*Vipaka*), and most importantly, therapeutic action (*Karma*). Detailed discussions of substitute drugs can be found in classical Ayurvedic texts such as *Bhavaprakasha*⁹.

Types of Substitution¹⁰

1. Substitution with a Completely Different Drug

A drug with different taste or qualities can be used if it has similar therapeutic effects. Example: *Bharangi* (*Clerodendron indicum*) and *Kantakari* (*Solanum xanthocarpum*) for respiratory disorders.

2. Substitution within the Same Botanical Family

Species from the same family with similar chemical constituents and actions can replace each other. Example: *Datura stramonium* can replace *Datura metel* for respiratory conditions.

3. Substitution Between Different Species

Different species showing similar pharmacological effects can be interchanged. Example: *Tribulus terrestris* and *Pedalium murex* (both types of *Gokshura*) for nephroprotective and diuretic effects.

4. Substitution Using Different Parts of the Same Plant

Different parts of the same plant can be used when the official part is unavailable. Example: *Sida cordifolia*—roots are official, but whole plant is used.

5. Substitution Based on Similar Therapeutic Action

Drugs with comparable therapeutic effects can replace each other regardless of species. Example: *Amalaki* (*Emblia officinalis*) for *Bhallatak* (*Semecarpus anacardium*).

Criteria for Substitution¹¹

“
द्रव्यामेकंवायोगेतत्रनलभ्यते।तत्तदुणयुतंद्रव्यंपरिवर्तेनगृह्यते
“।। (भै०२० 4/1)

Table 1: Commonly used substitution in Ayurveda drugs^{12,13,14}

Sl. No.	Common name	Botanical name	Substitute drug	Botanical name
1.	Chitrak	<i>Plumbago zeylanica</i>	Danti	<i>Baliospermum Montanum</i>
2.	Murva	<i>Marsdenia tenacissima</i>	Jinghini	<i>Lannea coromandelica</i>
3.	Daruharidra	<i>Berberis aristata</i>	Kalambak	<i>Coscinium fenestratum</i>
4.	Tagar	<i>Valeriana wallichii</i>	Kustha	<i>Saussrea lappa</i>
5.	Jatipatra (Aril)	<i>Myristica fragrans</i>	Lavanga	<i>Syzigium aromaticum</i>
			Jatiphala (fruits)	<i>Myristica fragrans</i>
6.	Puskar mool	<i>Inula racemosa</i>	Kustha	<i>Saussrea lappa</i>
			Eranda (root)	<i>Ricinus communis</i>
7.	Chavya	<i>Piper chaba</i>	Pippali (root)	<i>Piper longum</i>
8.	Draksha	<i>Vitis vinifera</i>	Kashmari phala	<i>Gmelina arborea</i>
9.	Bharangi	<i>Clerodendrum serratum</i>	Kantakari	<i>Solanum xanthocarpum</i>
10.	Ativisha	<i>Aconitum hetrophyllum</i>	Prativisha	<i>Aconitum palmatum</i>
11.	Ahimsa	<i>Capparis sepiaria</i>	Manakanda	<i>Alocasia indica</i>
12.	Ashoka	<i>Saraca asoca</i>	Kasthdaru	<i>Polyalthia longifolia</i>
13.	Tulasi	<i>Ocimum sanctum</i>	Nirgundi	<i>Vitex negundo</i>
14.	Riddhi and Vriddhi	<i>Hobenaria spp.</i>	Varahikanda	<i>Dioscorea bulbifera</i>
15.	Ikshu	<i>Saccharum officinarum</i>	Nala	<i>Arundo donax</i>
16.	Kakoli	<i>Lilium polyphyllum</i>	Asvagandha	<i>Withania somnifera</i>
17.	Kshirakakoli	<i>Fritillaria roylei</i>	Asvagandha	<i>Withania somnifera</i>
18.	Bhallataka	<i>Semecarpus anacardium</i>	Nadi Bhallataka	<i>Semecarpus travancorica</i>
19.	Ativisha	<i>Aconitum heterophyllum</i>	Mustaka	<i>Cyperus rotundus</i>
20.	Dadim	<i>Punica granatum</i>	Vrikshamla	<i>Garcinia indica</i>
21.	Karpua	<i>Cinnamomum camphora</i>	Granthi parna	<i>Leonotis nepetafolia</i>
22.	Nagapuspa	<i>Mesua ferrea</i>	Padma kesar	<i>Nelumbo nucifera</i>
23.	Kusha	<i>Desmostachya bipinnata</i>	Kasha	<i>Saccharum spontaneum</i>

24.	<i>Pashanbedha</i>	<i>Bergenia ligulata</i>	<i>Gorkshganja</i>	<i>Aerva lanata</i>
25.	<i>Amlavetas</i>	<i>Garcinia pedunculata</i>	<i>Chukra</i>	<i>Garcinia indica</i>

1. *Kushtha* and its mutual substitute *Pushkarmoola*.¹⁵

Kushtha (Saussurea lappa) has long been subject to substitution and adulteration in the crude drug market due to its shared geographical origin, overlapping synonyms, and close resemblance in external morphology with several other plant species. In trade, the drug is commonly referred to as “*Costus*,” despite having no botanical association with the genus *Costus*, which has further contributed to misidentification. Variations in regional trade practices across northern India and the use of multiple allied species and unrelated roots as substitutes or adulterants have resulted in inconsistent identification of genuine *Kushtha*. These practices underscore the need for critical evaluation of market samples to ensure authenticity and therapeutic reliability.

Classical Ayurvedic Perspective on Substitution of *Kushtha* and *Pushkarmool*

Interpretation of *Acharya Dalhana (12th Century)*

Acharya Dalhana provided one of the earliest scholarly explanations supporting the interchangeable use of *Kushtha (Saussurea lappa)* and *Pushkarmool (Inula racemosa)*. *Dalhana* advised that when formulations mention both drugs, the root portion should be considered as

Pushkarmool, while the remaining non-root parts should be used as *Kushtha*.

View of *Acharya Bhavamishra (16th Century)*

Acharya Bhavamishra further strengthened the concept of substitution by describing *Pushkarmool* as a variety of *Kushtha*. In *Bhavaprakasha Nighantu*, he explicitly acknowledged the use of *Pushkarmool* as a substitute for several important medicinal drugs such as *Tagar*, *Pushkara*, *Langali*, and *Sthouneyaka*.

View of *Sharangadhara Samhita (16th Century)*

Sharangadhara Samhita provides a clear and practical guideline supporting substitution under conditions of non-availability. The text states that *Kushtha* may be used in place of *Pushkarmool* when the latter cannot be obtained.

Relevance of *Acharya*-Based Substitution in Contemporary Practice

The *acharya*-based justification for substitution remains relevant in modern Ayurvedic practice, especially in view of raw drug scarcity and conservation concerns. With *Saussurea lappa* being a threatened species, the classical endorsement of substitution with *Pushkarmool* provides a rational and sustainable approach. Thus, the guidance offered by ancient *acharyas* continues to inform present-day pharmaceutical preparation and clinical application while maintaining therapeutic integrity.

Table no.2 Morphological features of *Kushtha* and *Pushkarmoola*

Morphological Features	<i>S.lappa</i>	<i>S.racemosa</i>
Leaves	Membranous petiole irregularly winged, basal ones very large.	Radical to alternate, leathery, rough above, densely hair beneath
Flowers	Flower Head Stalkless, hard, rounded.	Yellowish and in many heads
Roots	<ul style="list-style-type: none"> are 7-18cm long Outer bark is occasionally ridged and irregular. Are dull Rusty brown to blackish brown. Fracture is short. But, cutting and breaking is easier than <i>pushkarmoola</i>. Cutting surface same as Horn's Deer. 	<ul style="list-style-type: none"> Are 5-14 cm long Outer bark is Characteristically contain Longitudnal wrinkles. Roots are yellowish grey to brownish grey. Horny and hard, breaking with a short smooth Fracture, but older roots are hard even to cut.



S.lappa flower



I.racemosa flower



I.racemosa Root



S.lappa Root

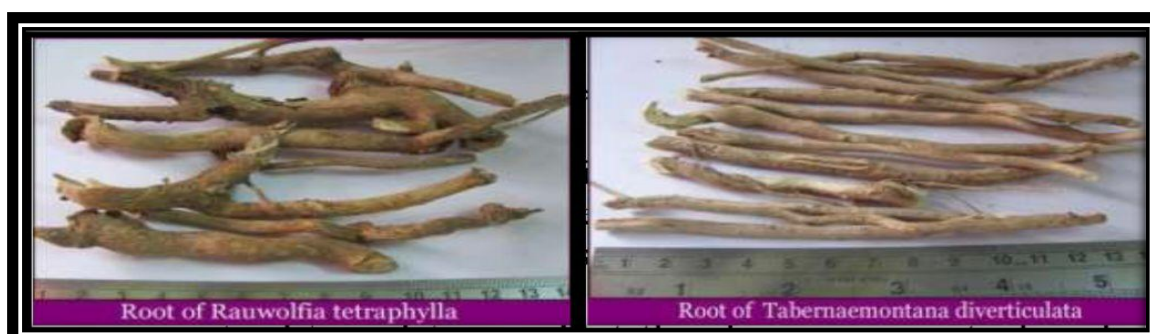
Benth. ex Kurz. The drug is named “*Sarpagandha*” due to the snake-like shape of its roots. Although *Rauwolfia serpentina* is widely cultivated across India, increasing demand has led to the use of several allied species as adulterants or substitutes. Species such as *Rauwolfia beddomei*, *Rauwolfia densiflora*, *Rauwolfia micrantha*, *Rauwolfia perakensis*, and *Rauwolfia tetraphylla* are commonly sold under the name of *Sarpagandha*. In addition, thin roots of *Tabernaemontana divaricata*(*Tagarchandani*) are major adulterants in commercial samples. Regional mixing of *Rauwolfia densiflora* and *Rauwolfia micrantha* is observed in Kerala and Western India, while *Rauwolfia tetraphylla* is the most commonly available adulterant in markets. It can be identified by its firmly attached, non-fragile root bark and non-stratified cork. These adulterations affect the quality and authenticity of *Sarpagandha*, emphasizing the need for proper identification and standardization.

2. *Sarpagandha* and its substitute Varieties.^{16,17,18}

Sarpagandha is an important medicinal drug obtained from the roots of *Rauwolfia serpentina* (L.)

Table No.3. Showing Distinguished features of Sarpagandha with its Adulterants/substitutes

Sr. No	Appearance	<i>Rauwolfia serpentina</i> (Root)	<i>Rauwolfia tetraphylla</i> (Root)	<i>Tabernaemontana divaricata</i> (Root)
1.	Size	Upto 10-18 cm. long and 1-3cm in diameter.	Upto 9-15 cm in long and 1-3 cm in diameter.	Upto 8 to 20 cm long and 5 to 15 mm. In diameter.
2.	Shape	Cylindrical, slightly tapering, and tortuous in shape. External surface is rough and wrinkled shows longitudinally fissured.	Cylindrical, stout in shape, Some of them are tortuous in shape. External surface is rough, less easily removable.	Thin, cylindrical, slightly tapering, some of them are tortuous in shape. On the outer surface longitudinal ridges or furrowed are seen .
3.	Colour	Yellowish brown in colour.	Dull-yellowish brown in colour. Bark of root.	Pale-yellowish in colour..
4.	Taste	Bitter	Bitter	Bitter
5.	Odour	Odourless	Odourless	Odourless
6.	Fracture	Short, irregular. Cutting portion is pale- yellow in colour; numerous faint lines	Short and irregular. The cutting end of the root shows a pale brown cork	Short.



II. Conclusion

Adulteration and substitution continue to pose serious challenges to the safety, efficacy, and credibility of Ayurvedic drugs. While substitution is a scientifically and textually validated concept in Ayurveda, its irrational application in commercial practice leads to adulteration. Integration of classical Ayurvedic principles with modern pharmacognostic, analytical, and regulatory measures is essential to ensure authenticity, sustainability, and global acceptance of herbal medicines.

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