Adulteration and substitution in endangered ASU medicinal plants of India: A Review

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Abstract: Medicinal plants used in Indian System of Medicines (ISM) ASU (Ayurveda, Siddha and Unani) as Indian traditional source form of alternative medicine. In 20th and 21st century generations are becoming aware of side effects and adverse reactions of synthetic drugs, so there is an increasing interest in ASU. Adulteration and substitution of endangered ASU herbs is the burning problem in herbal pharmacy and pharmaceutical industry and it has caused a major treat in the research and development on commercial natural products. The deforestation and extinction of many species and incorrect identification intestinally or unintentionally of many rare, endangered and original herbal plants has resulted in adulteration and substitution of raw drugs. The future research and development of the Pharmacognostic and Phytochemical analysis of herbs is largely depended upon reliable methodologies for correct identification, standardization and quality assurance, quality control of ASU. herbal drugs.

Keywords: Adulteration; Substitution; ASU (Ayurveda, Siddha and Unani); ISM (Indian System of Medicines); Medicinal plants.

Introduction

Adulteration it is a practice of substituting the original crude drug partially or fully with other substances which is either free from or inferior in therapeutic and chemical properties or addition of low grade or spoiled or spurious drugs or entirely different drug similar to that of original drug substituted with an intention of enhancement of profits (Kokate et al., 2007). A adulteration may also be defined as mixing or substituting the original drug material with other spurious, inferior, defective, spoiled, useless other parts of same or different plant or harmful substances or drug which do not confirm with the authenticated official standards. A drug shall be deemed to be adulterated if it consists, in whole or in part, of any filthy, putrid or decomposed substance (Anonymous, 2003). A treatise published two centuries ago (in 1820) on adulterations in food and culinary materials is a proof for this practice as an age-old one. Due to adulteration, faith in herbal drugs has declined (Dubey et al., 2004). Adulteration in market samples is one of the greatest drawbacks in promotion of herbal products. Many researchers have contributed in checking adulterations and authenticating them (Tewari et al., 1991; Vasudevan et al., 1983; Bisset et al., 1983; Sunita, 1992; Uniyal et al., 1993; Sarin et al., 1996; Gupta, 2003). It is invariably found that the adverse event or side effects reports are not due to the intended herb, but rather due to the presence of an unintended herb (De Smet et al., 1992). Medicinal plant dealers have discovered the scientific methods in creating adulteration of such a high quality that without microscopic, phytochemical and physicochemical analysis, it is very difficult to trace these adulterations (Afaq, 1999). Medicinal plants constitute an effective source of traditional (e.g., Ayurvedic, Chinese, Homeopathy and Unani) and modern medicine. Herbal medicine has been shown to have genuine utility. Germany and France, together represent 45% of the $23 billion global retail market as per current expect 2013 year. In India, about 80% of the rural population depends on medicinal herbs and/or indigenous sys-

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tems of medicine. In fact today, approximately 70% of “synthetic” medicines are derived from plants. Popularity among the common people increased the usage of medicinal plants/herbal drugs. Herbal adulteration is one of the common malpractices in herbal raw material trade (Mitra et al., 2007; Shah et al., 2010).

Materials and methods

Complete Information about the plant of Adulteration and Substitution in endanger, original Ayurvedic Siddha Unani ASU. Indian medicinal plants (Actual confirmation of Plant Occurrence, Hearbesting, Cultivation, Authenticated plant species and family, photographs etc.)’ were collected Source from standard, authenticated online world encyclopaedia, High altitude medicinal plants Archie and flora online Google searching engine or authenticated text, Wealth of India 1948-1976 (CSIR.) and authenticated literature survey by the scientific help of botanical, taxonomists expertise researchers of Research council (ISM., AYUSH.) and an extensive, authenticated literature survey by the Adulteration and Substitution in medicinal plants by various reported authorities (Kokate et al., 2007; Dubcy, 2004; Tewari, 1991; Vasudevan, 1983; Sunita, 1992; Uniyal, 1993; Sarin, 1996; Saraswathy, 2001; Gupta, 2003; Afaq, 1999; Sarin, 1996; Mishra et al., 2002; Shastri, 2005; Mukhrjee, 2002; Pandeya, 1997; Chunekar, 2004; Poornima, 2010; Roy et al., 2013) for identification and conformity of endanger, original Herbs adulteration and substitution appearance found in various plant, species naturally growing in Himachal and Nothen Himalayan higher altitude from 1200 to 4500 m asl. hill valleys and dense forest areas of Himachal and Uttarakhand state, various region of India. Selective and reported plant species were confirmed and identified with the help of standard flora, standard Ayurvedic and Unani pharmacopoeia Govt. of India, various reported volume in part 1st. Single drugs, Standard connected text books authenticated references, noted were prepared on their morphological attributes (Shah and Seth, 2010; Chouhan, 1999; Tahir et al., 2007; Krishnamurthi et al., 1969; Rastogi et al., 1998; Angers et al., 1996; Rehman et al., 2011).

Types of Adulterants presence in ASU Herbal drugs

Drugs are generally adulterated or substituted with substandard, inferior or artificial drugs.

Using substandard commercial varieties

Adulterants resemble the original crude drug morphologically, chemically, therapeutically but are sub standard in nature and cheaper in cost. This is the most common type of adulteration (Kokate et al., 2007; Dubey et al., 2004).

Using superficially similar inferior drugs

Inferior drugs may or may not have any chemical or therapeutic value. They resemble only morphologically, so due to its resemblance they are used as adulterants (Kokate et al., 2007).

Using artificially manufactured substance

The drug is adulterated with the substance which has been prepared artificially. The artificially manufactured substance resembles the original drug. This method is followed for the costlier drugs (Kokate et al., 2007).

Using exhausted drug

The same drug is admixed but that drug is devoid of medicinally active substance as it has been extracted already. Mainly volatile oil containing drugs like clove, coriander, fennel, caraway are adulterated by this method. As it is devoid of colour and taste due to extraction, natural colour and taste is manipulated with additives, describe and mention in related Tables 3 & 4 respectively.

Using of synthetic chemicals to enhance natural character

Synthetic chemicals are used to enhance natural character of the exhausted drug. Examples: citral is added to citrus oils like lemon and orange oils describe and mention in related Tables 3 & 4 respectively.
Presence of vegetative matter of same plant

Some miniature plants growing along with the medicinal plants are added due to their colour, odour, and constituents (Kokate et al., 2007).

Harmful adulterants

Some harmful materials as the adulterant, are collected from market waste materials and admixed with the drug. It is done for the liquid drugs (Kokate et al., 2007).

Adulteration of powders

The drugs which are in the form of powders are frequently adulterated. Such as dextrin is added in ipecacuanha, exhausted ginger in ginger, red sandal and white sandal wood in red and white capsicum powder and powdered bark adulterated with brick powder etc (Kokate et al., 2007).

Reason of adulteration of ASU Herbal drugs

Confusion in vernacular names

In Ayurveda, Parpatta refers to Fumaria parviflora. In Siddha, ‘Parpadagam’ refers to Mollugo pentaphylla. Owing to the similarity in the names in traditional systems of medicine, these two herbs are often interchanged or adulterated or substituted. Because of the popularity of Siddha medicine in some parts of South India, traders in these regions supply Mollugo pentaphylla as Parpatta/Parpadaga and the North Indian suppliers supply F. parviflora. These two can be easily identified by the presence of pale yellow to mild brown colored, thin wiry stems and small simple leaves of Mollugo pentaphylla and black to dark brown colored, digitate leaves with narrow segments of F. parviflora. Casuarina equisetifolia for Tamarix indica and Aerva lanata for Berginia ciliata are some other example for adulterations due to confusion in names (Mitra et al., 2007).

Lack of knowledge about authentic source

Nagakesar is one of the important drugs in Ayurveda. The authentic source is Mesua ferrea. However, market samples are adulterated with flowers of Calophyllum inophyllum. Though the authentic plant is available in plenty throughout the Western Ghats and parts of Himachal or J&K State, Himalayas valleys, suppliers are unaware of it. There may also be some restrictions in forest collection. Due to these reasons, C. inophyllum (which founds in the lower altitude) is sold as Nagakesar. Authentic flowers can be easily identified by the presence of two-celled ovary whereas in case of spurious flowers they are single celled (Mitra et al., 2007).

Similarity in morphology

Mucuna pruriens is adulterated with other similar Papilionaceae seeds having similarity in morphology. M. utilis (sold as white variety) and M. deeringiana (sold as bigger variety) are popular adulterants. Apart from this M. cochinchinensis, Canavalia virosa and C. ensiformis are also sold in Indian markets. Authentic seeds are up to 1 cm in length with shining mosaic pattern of black and brown color on their surface. M. deeringiana and M. utilis are bigger (1.5-2 cm) in size. While M. deeringiana is dull black and M. utilis is white or buff colored (Mitra et al., 2007).

Lack of authentic plant

Hypericum perforatum is cultivated and sold in European markets. In India, availability of this species is very limited. However, the abundant Indo-Nepal species H. patulum, sold in the name of H. perforatum. Market sample is a whole plant with flowers and it is easy to identify them taxonomically. Anatomically, transverse section of H. perforatum stem has compressed thin phloem, hollow pith and absence of calcium oxalate crystals. Whereas H. patulum has broader phloem, partially hollow pith and presence of calcium oxalate crystals (Mitra et al., 2007).
Adulteration and substitution in endangered ASU medicinal plants

Similarity in color

It is well known that with course of time, drug materials get changed to or substituted with other plant species. ‘Ratanjot’ is a recent day example. According to the suppliers and non-timer forest product (NTFP) contractors, in the past, roots of Ventilago madraspatana were collected from Western Ghats, as the only source of ‘Ratanjot’. However, that has not been practiced now. It is clearly known that Arnebia euchroma var euchroma is the present source. Similarity is in yielding a red dye, A. Euchroma substitutes V. madraspatana. Recently V. madraspatana is not found in market. Whatever is available in the market, in the name of Ratanjot is originated from A. euchroma (Mitra et al., 2007).

Careless collections

Some of the herbal adulterations are due to the carelessness of herbal collectors and suppliers. Parmelia perlata is used in Ayurveda, Unani and Siddha. It is also used as grocery. Market samples showed it to be admixed with other species (P. perforata and P. cirrhata). Sometimes, Usnea sp. is also mixed with them. Authentic plants can be identified by their thallus nature (Mitra et al., 2007).

Unknown reasons

‘Vidari’ is another example of unknown authentic plant. It is an important Ayurvedic plant used extensively. Its authentic source is Pueraria tuberosa and its substitute is Ipomoea digitata. However, market samples are not derived from these two. It is interesting to know that an endangered gymnosperm Cycas circinalis is sold in plenty as Vidari. The adulterated materials originated from Kerala, India. Though both the authentic plant and its substitute are available in plenty throughout India, how C. circinalis became a major source for this drug is unknown. P. tuberosa can be easily identified by the presence of papery flake like tubers and I. digitata by the presence of its concentric rings of vascular bundles and their adulterant C. circinalis by its leaf scars and absence of vessel elements (Mitra et al., 2007).

Need for Substitution

Non-availability of the drug: Substitution for Ashtvarga part (group of 8 crude drugs - Riddhi or Vridhhi, Kakoli, Kshirakakoli, Jibhaka, Rsabhaka, Meda and Meha meda), these endangers and rare drugs are found in high altitude area from 2000 to above 4000 m asl in Himachal and Himalaya northan valleys. Uncertain identity of the drug, for the herb Lakshmana different species such as Arlia quinquefolia, Ipomea sepiaria etc are considered. Cost of the drug, Kumkuma or Keser, KumKum, Zafran (Crocus sativus) largely used in Unani compound formulation being costly herb is substituted by Kusumbha or Kusum (Carthamus tinctorius) and White, Red Sander wood adulterated by White and Red Capsicum powder, Geographical distribution of the drug, Rasna (Pluchea lanceolata) is used in Northern India while in southeren parts Alpinia galanga is considered as the source. The adverse reaction of the drug, Vasa is a well known Rakta-Pittahara (cures bleeding disorder) drug, but due to its abortificiant activity its utility in pregnant women is limited, instead drugs such as Laksha, Ashoka etc are substituted (Sarin et al., 2010; Mishra et al., 2002; Mukherjee et al., 2002; Roy et al., 2013).

Types of substitution presence in ASU Herbal drugs

Using totally different drug

In case of Bharangi (Clerodendron indicum) and Kantakari, bharangi has better taste; laghu (light), ruksha (unctuous) guna (quality) and has Kapha-vatahara property. While kantakari (Solanum xanthocarpum) has katu vipaka (punjent digestion) and ushna virya (hot potency). It has glycosides named verbascoside and solasonine, solamargin, solasurine respectively. Both C. indicum and S. xanthocarpam have shown anti-histaminic activity. Both C. indicum and S. xanthocarpam are commonly used in the diseases related to the respiratory system, which are usually associated with release of histamines and other autacoids (Poonima, 2010; Roy et al., 2013).
Substitution of the Species Belonging to Same Family

The *Datura metal* and *Datura stramonium* can be considered here. Chemical constituents are alkaloids, scopolamine, atropin, hyocyanin, lyosine. The alkaloids are proved as bronchodilatory and inhibitor of secretion of mucous membrane. The alcoholic extract of *D. metal* shows anthelmentic activity. The alkaloid present in both the species are well proven bronchodilators and also they inhibit the secretion of mucous membrane of the respiratory tract. Thus as far as the diseases of the respiratory tract are concerned both *D. metal* and *D. stramonium* are beneficial, while as *D. metal* would be a better choice as it is a proven anthelmintic (Poonima, 2010; Roy et al., 2013).

Using different species

Two types of Gokshura viz. *Tribulus terrestris* (Zygophylaceae) and *Pedaliun murex* (Pedaliaceae) of which, *T. terrestris* has the chemical constituents like chlorogenin, diosgenin, rutin, rhamnose and alkaloids, while *P. murex* has sitosterol, ursolic acid, vanilin, flavonoids and alkaloids. Both the species are proved for nephroprotective, lithotriptic, diuretic and hepatoprotective activities. The clinical conditions where Gokshura is indicated i.e., *Mutrakrcra* (renal disorder), *Ashmari* (urinary calculi), *Prameha* (diabetes) etc, both *T. terrestris* and *P. murex* appear to be appropriate.

Using different parts of the plant

The roots and whole plant of *Sida cordifolia* can be considered. Root has the chemical constituents such as sitoindoside, acylsteryglycoside. While the whole plant has alkaloid, hydrocarbons, fatty acids, ephedrine. Various extracts of the whole plant showed antibacterial, antioxidant, hypoglycemic, hepatoprotective and cardio tonic activities. Though it is the root which is mentioned as officinal part of *S. cordifolia* in the classics as *Balya* (promotes strength), *Shotahara* (reduce inflammation) etc. Modern researches prove that even the aerial parts are also equally effective.

Due to same in action

*Emblica officinalis* shows antioxidant, hepatoprotective, antimicrobial, hypoglycemic and hypolipidemic action. *Semecarpus* shows anti-tumour, hypotensive, anticytotoxic and anticancerous properties etc. Both Amalaki and Bhallataka are Rasayana (rejuvenator) drugs. In current practice the Rasayana formulations are being employed as an adjuvant therapy in Chronic as well as Malignant diseases. Amalaki can be employed as Rasayana in Chronic debilitating diseases like bronchial asthma, diabetes etc, while Bhallataka would be better choice in malignant conditions, both in solid tumors and in leukemia.

Over all said adulterated and substituted detail of ASU, herbal drugs are described and mentioned with pictures respectively in Table 1, (Adulterated and substitute parts used in original herbal drugs), Table 2, (Adulterated and substitute parts used in endangered and rare original herbal drugs), 3 (Adulteration in Volatile oil based original herbal drugs), and Table 4, (Adulteration in Essential and Volatile oil based original herbal drugs).

Discussion and Conclusion

It is not that all adulterations are intentional malpractice as stated in many literatures. With our expertise experience it is noted that the original, endangered herbal drugs are adulterated and substituted unintentionally also. Suppliers and national Vander’s are illiterate and not aware about their spurious and substituted supply. Major reasons are confusion in name, non-availability and lack of knowledge about authentic plant species. As well as their not proper scientifically microscopic & macroscopic identification, even scientific community and traditional physicians(Medicinal plants based ASU. products Manufacturer Hakeem’s & Vad’s) are unaware of it and they also used organoleptically (only applied physical appearance of raw drugs ) malpractice, intensely or unintentionally to consumed spurious, adulterated and substitute in manufacturing of various herbal formulation from production end for their motive only gain financial benefits or achieve annual target . Nowadays, today hopefully some genuine ASU herbal drug pharmacy and phar-
pharmaceutical industries follow high quality standards using modern techniques and instruments to maintain their quality & safety, efficacy as multidimensional innovative investigation, evolution with controlling or regular monitoring of microbial load Germs, bacterial contamination or Microbial contamination as per detect of Compile standard parameters limits and Secretary, AYUSH. Deprt., Ministry of Health & Family Welfare., Govt. of India clear cut guide line issued in related Govt. Order for Laboratory Testing and Quality Control of every lots or batch to batch Herbal Raw & Compound Formulated ASU Drugs. Regularly using Proper Pharmacognostic or botanical identification, Detect Yeast mould count & Total plate count in cfu/gm. limit concentration as well as detect bacterial growth concentration of Escherichia coli, Salmonella typhi, Staphylococcus aureus, Pseudomonas Hygrobacterium, Coliform bacterial concentration in cfu/gm.(Bacterial or microbrial load concentration should be always found Nil or Absent in any tasted lots or batches samples), Mycotoxin, Aflatoxien- B1,B2 & G1,G2 or Total Aflatoxien concentration in p.p.b. levels,Aflatoxin concentration grows reproductively by Aspergillus species and also detect Heavy Toxicants metals concentration of Pb.,As.,Hg.,Cd., in p.p.m. or p.p.b. as well as p.p.t. levels as a aspect of evolutes and investigate quality, safety of ASU herbal raw drugs (Should be always found within standard permissible limits) as Q.A. R&D. research possibilities in every lots or batches of incoming receive supply of herbal raw drugs in modern Herbal Industries. World Health Organization (WHO), in its publication on quality standards for medicinal plant materials, recommends rejecting any batch of raw material, which has more than 5% of any other plant part of the same plant (e.g. stem in leaf drugs), never the less if they are derived from the authentic plant. Based on these standards, adulteration whether, intentional or unintentional, should be rejected as per authenticated pharmacopeial and In-House Quality Standard basis. Also, suppliers and traders should be educated about the authentic sources. Today or future important demand to be that stop and completely van of organoleptically malpractice to consume of herbal drugs in large scale as well as need of cross check, review control and completely assured with proper pharmacovigilance monitoring of herbal drugs before it’s commercially consumed and finally provide to our nation, develop highly efficacious, pure, safe and standard quality medicinal herbal products with proper Quality assurance and hygiene control monitoring.

**Table 1:** Adulterated and Substitute parts used in original herbal drugs [Source collect from standard, authenticated online world encyclopaedia, authenticated high altitude medicinal plants Archie and flora online Google searching engine, wealth of India (CSIR.) and scientific extensive and authenticated literature survey by the help of botanical, taxonomists expertise researchers of Research council institution (ISM., AYUSH. and CSIR)]

<table>
<thead>
<tr>
<th>S.No. Used of Original Raw Drugs</th>
<th>Substitute Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chitrak, [<em>A.</em> &amp; <em>B.</em>]</td>
<td>a- Danti, [<em>Baliospermum montanum</em> (Willd.) Muell.-Arg. ]</td>
</tr>
<tr>
<td>[Plumbago zeylanica (L.)]</td>
<td>b- Apamarga, [<em>Achyranthus aspera</em> L.]</td>
</tr>
</tbody>
</table>
2. **Murva or Maruabel**, [A, B], [Marsdenia tenacissima (Roxb.) Moon]  
   a- **Jhingan or Jinghini**, [Lannea coromandelica (Houtt.) Merill]

3. **Bakul or Bakula**, [A, B], [Mimusops elengi L.]  
   a- **Kamal**, [Nelumbo nucifera Gaertn]

4. **Tagar**, [A, B], [Valeriana wallichii D.C.]  
   a- **Koostha or Kustha**, [Saussrea lappa C.B.C.L.]

5. **Jaiphal or Jatipatra** (Aril), [A, B], [Myristica fragrans Houtt.]  
   a- **Loung or Lavanga**, [Syzygium aromaticum (L.) Merrill and Perry.]  
   b- **Jatiphala**(fruits), [Myristica fragrans Houtt.]
6. Puskar mool (root), [A, B],
   [Inula racemosa Hook. F.]

   a- Koostha or Kustha (root), [Saussrea lappa (L.)]

   b- Arand (root), [Ricinus communis (L.)]

7. Chavya or Gajphal, [A, B],
   [Piper chaba Hunter]

   a- Pippali or Piplamul (root), [Piper longum (L.)]

8. Angoor or Draksha, [A, B],
   [Vitis vinifera (L.)]

   a- Kashmari phala or Gambhar, Baro-pipal (Fruits), [Gmelina rhorea (L.)]

9. Bharangi, [A, B],
   [Clerodendrum serratum (L.) Moon]

   a- Kati or Kantakari, [Solanum xanthocarpum Schrad & Wendal]
10. Dhanavyasaor Damahan [A, B],
    \[Fagonia cretica (L.)\]
    a- Duralabha, [Alhagi pseudalhagi (Bieb.) Desv.]

11. Ahimsa or Haina [A, B],
    \[Capparis sepiaria (L.)\]
    a- Manakanda, [Alocasia indica (Lour.) Spach]

12. Bakul(bark) [A, B], \[Mimusops elengi (L.)\]
    a- Babul (bark), [Acacia arabica (L.)]

13. Ikshu or Eekh, Ganna, [A, B],
    \[Saccharum officinarum (L.)\]
    a-Nala, [Arundo donax (L.)]

14. Bhallataka or Bhilavan [A, B],
    \[Semecarpus anacardium (L.F.)\]
    a- Nadi Bhallataka, [Semecarpus travancorica Bedd]
Adulteration and substitution in endangered ASU medicinal plants

15. Dadim or Anar, [A, B], [Punica granatum (L.)]
   a- Vrikshamla or Bilatti Amli, Indian Garcinia, Vishambil, [Garcinia indica (Dup. Choisy)]

16. Karpua or Kapoor, [A, B], [Cinnamomum camphora]
   a- Granthi parna or Bara Guma, [Leonotis nepetfolia R. Br.]

17. Nagapuspa or Nagakesar, [A, B], [Mesua ferrea (L.)]
   a- Padma Kesar Kamal, [Nelumbo nucifera Gaertn]

18. Kusha or Kunja, Dal [A, B], [Desmostachya bipinnata Stapf]
   a- Kasha or Kasa, [Saccharum spontaneum (L.)]

19. Kutherika or Van tulasi, [A, B], [Ocimum basilicum (L.)]
   a- Gramya tulasi, [Ocimum sanctum (L.)]

20. Amlavetas, [A, B], [Garcinia pedunculata (L.)]
   a- Chukra, [Garcinia indica (L.)]
### Table 2: Adulterated and substitute parts used in endangered and rare original herbal drugs.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Used of Original Endanger and Rare Raw Drugs</th>
<th>Substitute Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ativisha or Atis (root), ([A, B]) [Aconitum heterophyllum Wall. ex. Royal]</td>
<td>Mustaka(root), [Cyperus rotundus (L.)]</td>
</tr>
<tr>
<td>21.</td>
<td>Tulasi, ([A, B]), [Ocimum sanctum (L.)]</td>
<td>Nirgundi, [Vitex negundo (L.)]</td>
</tr>
<tr>
<td>22.</td>
<td>Brahmi, ([A, B]), [Bacopa monnieri (L.)]</td>
<td>Manduka Parni or Brahmi buti, [Centelle asiatica (L.) Urban]</td>
</tr>
<tr>
<td>23.</td>
<td>Guggul(Exudate), ([A, B]), [Commiphora wightii (A.) Bhandari]</td>
<td>Babul, Kikar (Exudate), [Acacia nilotica (L) Willd. ex Del.]</td>
</tr>
</tbody>
</table>

\(^A\)Poornima (2010), \(^B\)Roy et al. (2013)
Int. J. Med. Arom. Plants

Adulteration and substitution in endangered ASU medicinal plants

2. **Jatamansi** (root) \[^{a,b,c}\]  
   [Nardostachys jatamansi D.C.]

   ![Jatamansi](image1)

3. **Kuth or Kustha** (root) \[^{a,b,c}\]  
   [Saussurea lappa C.B.Cl.]

   ![Kuth or Kustha](image2)

4. **Riddhi Vriddhi** (Tuber) \[^{a,b}\]  
   [Habenaria intermedia D.Don]

   ![Riddhi Vriddhi](image3)

5. **Bhootkeshi or Bhutberi** (root)  
   [Selinum vaginatum C.B.Clarke]

   ![Bhootkeshi or Bhutberi](image4)

6. **Kuth or Kout** (root)  
   [Saussurea castus (Falc.) Lipsch.]

   ![Kuth or Kout](image5)

7. **Varahikanda** (root)  
   [Dioscorea bulbifera (L.)]

   ![Varahikanda](image6)
5. Kakoli (root), [A, B, C], [Lilium polyphyllum D.Don]
a- Ashwaagandha, Asrol, Asgandh Nagori (root), [Withania somnifera Dunal]

6. Kshirakakoli (Rhizomes and Buelbs) [A, B, C], [Fritillaria roylei Hook]
a- Ashwagandha, Asrol, Asgandh Nagori (root), [Withania somnifera Dunal]

7. Kesar, KumKum, Zafran (Style and Stigma of [A, B, C], [Crocus sativus [Carthamus tinctorius (L.)]]
Aral part of flower), Kusubh, Kusum (Arial of flower), Linn.
a- Kusubh, Kusum (Arial of flower), [Carthamus tinctorius (L.)]

Poornima (2010), Roy et al. (2013), Chouhan (1999)
### Table 3: Adulteration and Exhaustion in Volatile oil based original herbal drugs.

<table>
<thead>
<tr>
<th>Volatile Oil contained based medicines with botanical name</th>
<th>Medicinal plant parts Used</th>
<th>Volatile Oil contained, %,v/w, (Standard Limit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajmoda or Ajamoda[1] Apium leptophyllum (Pers.) F.V. M. ex</td>
<td>Whole seeds</td>
<td>N.L.T.-2.0%</td>
</tr>
<tr>
<td>Dhania, [2,3] Coriandrum sativum Linn.</td>
<td>Whole seeds</td>
<td>N.L.T.-0.3%</td>
</tr>
<tr>
<td>Guggul (Exudate), [4] Commiphora wightii (Am.) Bhand</td>
<td>Whole resins</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Rumi Mastagee or Mastagi (Exudate), [4,5] Pistacia lentiscus Linn.</td>
<td>Whole resins</td>
<td>N.L.T.-1.5 to 2.0%</td>
</tr>
<tr>
<td>Harali or Haridra[7,8] (Dried and cured Rhizomes), Curcuma longa Linn.</td>
<td>Whole roots</td>
<td>N.L.T.-4.0%</td>
</tr>
<tr>
<td>Jatamansi, Balcharu, or Sunbod ul-tech, [9,10]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nardostachys jatamansi DC</td>
<td>Whole rhizome</td>
<td>N.L.T.-0.1%</td>
</tr>
<tr>
<td>Ksro-Jirka, Kale Jira, Zira Styah, [12,13] Cerium curvatum Linn.</td>
<td>Whole seeds</td>
<td>N.L.T.-3.5%</td>
</tr>
<tr>
<td>Loung or Lavanga or Qarnful, [14,15] Syzygium aromaticum (Linn.)</td>
<td>Whole flower bud</td>
<td>N.L.T.-15%</td>
</tr>
<tr>
<td>Saunf or Misreya [16] Foeniculum vulgare Mill</td>
<td>Whole seeds</td>
<td>N.L.T.-1.4%</td>
</tr>
<tr>
<td>Choti Bayachi or Heel Khurd, [17] (Sukkumia), Elettaria cardamomum (Linn.) Maton</td>
<td>Whole seeds</td>
<td>N.L.T.-4.0%</td>
</tr>
<tr>
<td>Dulchinis or Durchini, (Tvak) [18] Cinnamomum zeylanicum Blume</td>
<td>Whole steam barks</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Tejpatra or Tezap, Tvakpatra, [19,20] Cinnamomum tamala (Buch.Ham.)</td>
<td>Whole leaves</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Ajwain or Yavani [21] Trachyspermum ammi (Linn.)</td>
<td>Whole seeds</td>
<td>N.L.T.-2.5%</td>
</tr>
<tr>
<td>Soya or Shilt (Satalva, Fruit) [22] Anethum seres Roeb.</td>
<td>Whole fruits</td>
<td>N.L.T.-3.0%</td>
</tr>
<tr>
<td>Bari Elachi or Heel Kalan, [23] Anoman nabilatam Roeb.</td>
<td>Whole seeds</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Bach, Vaati or Waja-e-Turki, [24] (Rhizomes), Acorus calamus Linn.</td>
<td>Whole rhizomes</td>
<td>N.L.T.-2.0%</td>
</tr>
<tr>
<td>Nagarshoth, Motha, Mista or Sud Kaf, (Rhizomes) [25,26] Cyperus rotundus Linn.</td>
<td>Whole rhizomes</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Lahsum or Lahsun (Bibb) [27,28] Allium sativum Linn.</td>
<td>Whole pulps</td>
<td>N.L.T.-0.1%</td>
</tr>
<tr>
<td>Safed Chandan or Sandal Safed, [29] Sanjalan Allume Linn.</td>
<td>Whole steams</td>
<td>N.L.T.-1.5%</td>
</tr>
<tr>
<td>Khau or Khas, [30] Vetiveria zizanioides (Linn.)</td>
<td>Whole fibrous roots</td>
<td>N.L.T.-1.0%</td>
</tr>
<tr>
<td>Kaure/ (Rhizome), [31] Curcuma longa Rosc.</td>
<td>Whole rhizomes</td>
<td>N.L.T.-2.0%</td>
</tr>
<tr>
<td>Gandhabiroja or Cheeda-Gond, [32,33] Pinus roxburghii Sargent</td>
<td>Whole resins</td>
<td>N.L.T.-18.0%</td>
</tr>
<tr>
<td>Bach or Wajac Turki, (Rhizome) [34] Acorus calamus Linn.</td>
<td>Whole dried rhizomes</td>
<td>N.L.T.-2.0%</td>
</tr>
</tbody>
</table>

## Table 4: Adulteration and Exhaustion in Essential and Volatile oil based original herbal drugs

<table>
<thead>
<tr>
<th>Essential or Volatile Oil contained based medicines with botanical name</th>
<th>Medicinal plant part Used</th>
<th>Essential or Fixed Oil contained, %, v/w, (NLT. - Standard Limit)</th>
<th>Volatile Oil contained, %, v/w, (NLT. - Standard Limit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalonji, [35]</td>
<td>Seeds</td>
<td>31-36%</td>
<td>0.4-0.7%</td>
</tr>
<tr>
<td>Nigella sativa Linn</td>
<td>Babchi, [36]</td>
<td>Seeds</td>
<td>10-12%</td>
</tr>
<tr>
<td>Psoralea caryfolia Linn.</td>
<td>Neem, [37]</td>
<td>Seeds</td>
<td>18-45%</td>
</tr>
<tr>
<td>Azadirachta indica A. Juss</td>
<td>Tulasi, [38] ( Ocimum sanctum)</td>
<td>Seeds</td>
<td>18-22%</td>
</tr>
<tr>
<td>Karanja, [39,40,41]</td>
<td>Seeds</td>
<td>31-41%</td>
<td>N/D</td>
</tr>
<tr>
<td>Pongamia pinnata Linn.</td>
<td>Alsi or Katan [42]</td>
<td>Seeds</td>
<td>NLT. -25%</td>
</tr>
<tr>
<td>Linum usitatissimum Linn.</td>
<td>Arandi or Erandi [44]</td>
<td>Seeds</td>
<td>NLT.-3%</td>
</tr>
<tr>
<td>Kaunch or Konch [43]</td>
<td>Ricitus communis Linn.</td>
<td>Seeds</td>
<td>NLT.-37%</td>
</tr>
<tr>
<td>Mucuna prurita Hook.</td>
<td>Nariyal or Narjil [45]</td>
<td>Seeds</td>
<td>NLT.-59%</td>
</tr>
<tr>
<td>Babchi, [36] Psoralea caryfolia Linn.</td>
<td>Saraso or Sarson [46,47]</td>
<td>Seeds</td>
<td>NLT.-35%</td>
</tr>
<tr>
<td>Neem, [37] Azadirachta indica A. Juss</td>
<td>Brassica campestris Linn.</td>
<td>Seeds</td>
<td>NLT.-1.0%</td>
</tr>
<tr>
<td>Karporny, [38] Ocimum sanctum</td>
<td>Aamnaa-haldi or Amiya haldi [48,49]</td>
<td>Whole root or rhi-zome</td>
<td>NLT.-1.9%</td>
</tr>
<tr>
<td>Curcuma amada (Roxb.)</td>
<td>Apheem, [50]</td>
<td>Seeds</td>
<td>NLT.-19%</td>
</tr>
<tr>
<td>Papaver somniferum (Linn.)</td>
<td>Khaaksee or Khubakalan [51]</td>
<td>Seeds</td>
<td>NLT.-20%</td>
</tr>
<tr>
<td>Khakcsee or Khubakalan [51]</td>
<td>Sisygium irio (Lam.)</td>
<td>Seeds</td>
<td>NLT.-6%</td>
</tr>
<tr>
<td>Sisygium irio (Lam.)</td>
<td>Palash or Dhak, Tesoo [52]</td>
<td>Seeds</td>
<td>NLT.-20%</td>
</tr>
<tr>
<td>Butea monosperma (Lam.)</td>
<td>Pudeenaa or Pudina [53,54]</td>
<td>Leaves Aerial</td>
<td>NLT.-0.2 to 0.8%</td>
</tr>
<tr>
<td>Mentha viridis (Linn.)</td>
<td>Yukeliptas [55]</td>
<td>matured leaves</td>
<td>NLT.-2.0%</td>
</tr>
<tr>
<td>Eucalyptus globulus Labill.</td>
<td>Khakcsee or Khuksi [56]</td>
<td>Seeds</td>
<td>NLT.-20%</td>
</tr>
<tr>
<td>Sisygium irio (Lam.)</td>
<td>Sisygium irio (Lam.)</td>
<td>Seeds</td>
<td>NLT.-20%</td>
</tr>
</tbody>
</table>

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References


Int. J. Med. Arom. Plants

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Anonymous, 1986c. The Ayurvedic Pharmacopeia of India. Part.-I; Volume-I\textsuperscript{st}; I\textsuperscript{st} Edn.: p-68

Anonymous, 1986d. The Ayurvedic Pharmacopeia of India. Part.-I; Volume-I\textsuperscript{st}; I\textsuperscript{st} Edn.: p-102

Anonymous, 1989a. The Ayurvedic Pharmacopeia of India. Part.-I; Volume-I\textsuperscript{st}; I\textsuperscript{st} Edn.: p-42

Anonymous, 1989b. The Ayurvedic Pharmacopeia of India. Part.-I; Volume-I\textsuperscript{st}; I\textsuperscript{st} Edn.: p-57

Anonymous, 1989c. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{st}; I\textsuperscript{st} Edn.: p-70

Anonymous, 1989d. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-111

Anonymous, 1989e. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-117

Anonymous, 1989f. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-137

Anonymous, 1989g. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-152

Anonymous, 1989h. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-154

Anonymous, 1989i. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-171

Anonymous, 1989j. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-162

Anonymous, 1989k. The Ayurvedic Pharmacopeia of India. Part-I; Volume-I\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-167

Anonymous, 1989l. The Ayurvedic Pharmacopeia of India. Part-I; Volume-II\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-178

Anonymous, 1989m. The Ayurvedic Pharmacopeia of India. Part-I; Volume-II\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-83-84

Anonymous, 1989n. The Ayurvedic Pharmacopeia of India. Part-I; Volume-II\textsuperscript{nd}; I\textsuperscript{st} Edn.: p-23-24

Anonymous, 2001a. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-131

Anonymous, 2001b. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-109

Anonymous, 2001c. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-209

Anonymous, 2001d. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-221

Anonymous, 2001e. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-23-24

Anonymous, 2001f. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-51-52

Anonymous, 2001g. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-135-136

Anonymous, 2001h. The Ayurvedic Pharmacopeia of India. Part-I; Volume-III\textsuperscript{rd}; I\textsuperscript{st} Edn.: p-194-195


Anonymous, 2004. The Ayurvedic Pharmacopeia of India. Part-I; Volume-IV\textsuperscript{th}; I\textsuperscript{st} Edn.: p-44

Anonymous, 2006a. The Ayurvedic Pharmacopeia of India. Part-I; Volume-V\textsuperscript{th}; I\textsuperscript{st} Edn.: p-192


Rehman M. S. et al. 2011. J. Scientific Research., v-3(3) : p-669


Shastri Ambikadatta. 2005.”Baishajya Ratnavali” Chaukambha Sanskrit Sansthan, Varanasi, U.P.18th Ed:


