



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

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Article History: Received 19th September 2013, Revised 17th January 2014, Accepted 24th January 2014.

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 21th 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 endangers, original Ayurvedic Siddha Unani ASU. Indian medicinal plants (Actual confirmation of Plant Occurrence, Harvesting, 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. Adulteration and Substitution in medicinal plants by various reported authorities (Kokate et al., 2007; Dubey, 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 endangers, 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 Ist. 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).

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 Vriddhi, 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 southern 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 abortifaciant 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 bitter taste; laghu (light), ruksha (unctuous) guna (quality) and has Kapha-vatahara property. While kantakari (*Solanum xanthocarpam*) has katu vipaka (punjent digestion) and ushna virya (hot potency). It has glycosides named verbascoside and solasoninie, 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, hyocyamin, lyoscine. The alkaloids are proved as bronchodialatory and inhibitor of secretion of mucous membrane. The alcoholic extract of *D. metal* shows anthelmintic 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* (Zygophyllaceae) and *Pedalium murex* (Pedaliaceae) of which, *T. terrestris* has the chemical constituents like chlorogenin, diosgenin, rutin, rhamnase 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

Embelica 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-

maceutical 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. Deptt., 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 typhii*, *Staphylococcus aureus*, *Pseudomonas Hygrobacterium*, Coliform bacterial concentration in cfu/gm.(Bacterial or microbial 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,Aflatoxine concentration grows reproductively by Aspergillues 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 investi-

gate 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 cheek, 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)

S.No. Used of Original Raw Drugs	Substitute Used
1. Chitrak , ^[A, B] <i>Plumbago zeylanica</i> (L.))	a- Danti , [<i>Baliospermum montanum</i> (Willd.) Muell.-Arg.]
	
	b- Apamarga , [<i>Achyranthus aspera</i> L.]
	

2. **Murva or Maruabel**, ^[A, B],
[*Marsdenia tenacissima* (Roxb.) Moon]



a- **Jhingan or Jinghini**, [*Lannea coromandelica* (Houtt.) Merrill]



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**, [*Saussurea lappa* C.B.CL.]



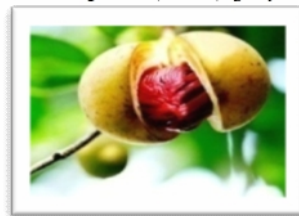
5. **Jaiphal or Jatipatra(Aril)**, ^[A, B],
[*Myristica fragrans* Houtt.]



a- **Loung or Lavanga**, [*Syzizium 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), [*Saussurea 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
rborea* (L.)]



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



- a- **Kati or Kantakari**, [*Solanum xanthocarpum* Schrad &
Wendal]



10. Dhanavayasaor Damahan ^[A, B],
[*Fagonia cretica* (L.)]



a- Duralabha, [*Alhagi pseudalhagi* (Bieb.) Desv.]



11. Ahimsa or Hainsa ^[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.)]



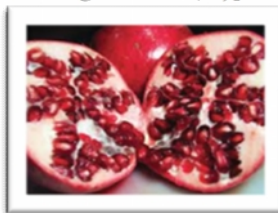
14. Bhallataka or Bhilavan, ^[A, B],
[*Semecarpus anacardium* (L.F.)]



a- Nadi Bhallataka, [*Semecarpus travancorica* Bedd]



15. **Dadim or Anar**, ^[A, B],
[*Punica granatum* (L.)]



16. **Karpua or Kapoor**, ^[A, B],
[*Cinnamomum camphora*]



17. **Nagapuspa or Nagakesar**, ^[A, B],
[*Mesua ferrea* (L.)]



18. **Kusha or Kunja, Dab** ^[A, B], [*Desmostachya*
bipinnata Stapf]



19. **Kutherika or Van tulasi**, ^[A, B],
[*Ocimum basilicum* (L.)]



20. **Amlavetas**, ^[A, B],
[*Garcinia pedunculata* (L.)]



- a- **Vrikshamla or Bilatti Amli, Indian Garcinia, Vishambil**,
[*Garcinia indica* (Dup.Choisy)]



- a- **Granthi parna or Bara Guma**, [*Leonotis nepetaefolia* R.Br.]



- a- **Padma Kesar Kamal**, [*Nelumbo nucifera* Gaertn]



- a- **Kasha or Kasa**, [*Saccharum spontaneum* (L.)]



- a- **Gramya tulasi**, [*Ocimum sanctum* (L.)]



- a- **Chukra**, [*Garcinia indica* (L.)]



21. Tulasi, ^[A, B], [*Ocimum sanctum* (L.)] a- Nirgundi, [*Vitex negundo* (L.)]**22. Brahmi, ^[A, B], [*Bacopa monneri* (L.)]****a- Manduka Parni or Brahmi buti, [*Centelle asiatica* (L.)Urban]****23. Guggul(Exudate), ^[A, B], [*Commiphora wightii* (A.) Bhandari]****a- Babul, Kikar (Exudate), [*Acacia nilotica* (L) Willd. ex Del.]**

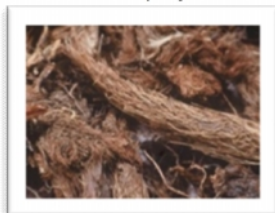
^APoornima (2010), ^BRoy et al. (2013)

Table 2: Adulterated and substitute parts used in endangered and rare original herbal drugs.

S.No. Used of Original Endanger and Rare Raw Substitute Used
Drugs

1. Ativisha or Atis (root), ^[A, B] [*Aconitum heterophyllum* Wall. ex. Royal]**a- Mustaka(root), [*Cyperus rotundus* (L.)]**

2. **Jatamansi** (root), ^[A, B, C],
[*Nardostachys jatamansi* D.C.]



- a- **Bhootkeshi or Bhutberi** (root),
[*Selinum vaginatum* C.B.Clarke]



3. **Kuth or Kustha** (root) ^[A, B, C],
[*Saussurea lappa* C.B.Cl.]



- a- **Kuth or Kout** (root),
[*Saussurea castus* (Falc.) Lipsch.]



4. **Riddhi Vriddhi** (Tuber) ^[A, B],
[*Habenaria intermedia* D.Don]



- a- **Varahikanda**(root), [*Dioscorea bulbifera* (L.)]



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- **Kusubh, Kusum** (Aerial of flower),
Aerial part of flower) ^[A, B, C], [*Crocus sativus* [*Carthamus tinctorius* (L.)]
Linn.]



^APoornima (2010), ^BRoy et al. (2013), ^CChouhan (1999)

Table 3: Adulteration and Exhaustion in Volatile oil based original herbal drugs.

Volatile Oil contained based medicines with botanical name	bo-Medicinal plant parts Used	Volatile Oil contained, %,v/w, (Standard Limit)
Ajmoda or Ajamoda , ^[1] <i>Apium leptophyllum</i> (Pers.),F.V.M. ex	Whole seeds	N.L.T.-2.0%
Dhaniya , ^[2,3] <i>Coriandrum sativum</i> Linn.	Whole seeds	NLT.-0.3%
Guggul (Exudate), ^[4,5] <i>Commiphora wightii</i> (Arn.) Bhand	Whole resins	NLT.-1.0%
Rumi Mastagee or Mastagi (Exudate), ^[6] <i>Pistacia lentiscus</i> Linn.	Whole resins	NLT.-1.5 to 2.0%
Haldi or Haridra , ^[7,8] (Dried and cured Rhizomes), <i>Curcuma longa</i> Linn.	Whole roots	NLT.-4.0%
Jatamansi, Balchara, or Sumbul-ut-teeb , ^[9,10] <i>Nardostachys jatamansi</i> DC.	Whole rhizome	NLT.-0.1%
Jaiphal or Jatiphala ^[11] <i>Myristica fragrans</i> Houtt	Whole arils	NLT.-5.0%
Krsn-Jiraka, Kala Jira, Zira Siyah , ^[12,13] <i>Carum carvi</i> Linn.	Whole seeds	NLT.-3.5%
Loung or Lavanga or Qarnful , ^[14,15] <i>Syzygium aromaticum</i> (Linn.)	Whole flower bud	NLT.-15%
Saunf or Misreya , ^[16] <i>Foeniculum vulgare</i> Mill	Whole seeds	NLT.-1.4%
Choti Ilayachi or Heel Khurd , ^[17] (Suksmalia), <i>Elettaria cardamomum</i> (Linn.) Maton	Whole seeds	NLT.-4.0%
Dalchini or Darchini , (Tvak) ^[18] <i>Cinnamomum zeylanicum</i> Blume	Whole steam barks	NLT.-1.0%
Tejpatra or Tezpat, Tvakpatra , ^[19,20] <i>Cinnamomum tamala</i> (Buch.Ham.)	Whole leaves	NLT.-1.0%
Ajwain or Yavani , ^[21] <i>Trachyspermum ammi</i> (Linn.)	Whole seeds	NLT.-2.5%
Soya or Shibt (Satahva,Fruit) , ^[22] <i>Anethum sowa</i> Roxb.	Whole fruits	NLT.-3.0%
Bari Elachi or Heel Kalan , ^[23] <i>Anomum subulatum</i> Roxb.	Whole seeds	NLT.-1.0%
Bach, Vaca or Waja-e-Turki , ^[24] (Rhizome), <i>Acorus calamus</i> Linn.	Whole rhizomes	NLT.-2.0%
Nagarmotha, Motha, Musta or Sad Kufi , (Rhizome) ^[25,26] , <i>Cyperus rotundus</i> Linn.	Whole rhizomes	NLT.-1.0%
Lahasun or Lahsan , (Bulb) ^[27,28] <i>Allium sativum</i> Linn.	Whole pulps	NLT.-0.1%
Safed Chandan or Sandal Safed , ^[29] <i>Santalum Album</i> Linn.	Whole steams	NLT.-1.5%
Khasa or Khas , ^[30] <i>Vetiveria zizanioides</i> (Linn.)	Whole fibrous roots	NLT.-1.0%
Kacura (Rhizome), ^[31] <i>Curcuma zedoaria</i> Rosc.	Whole rhizomes	NLT.-2.0%
Gandhabiroja or Cheed-ka-Gond , ^[32,33] <i>Pinus roxburghii</i> Sargent	Whole resins	NLT.-18.0%
Bach or Wajae Turki , (Rhizome) ^[34] <i>Acorus calamus</i> Linn.	Whole dried rhizomes	NLT.-2.0%

¹Anonymous (1986a), ²Anonymous (1989a), ³Anonymous (2007a), ⁴Anonymous (1989b), ⁵Anonymous (2007b), ⁶Anonymous (2008a), ⁷Anonymous (1986b), ⁸Anonymous (2007c), ⁹Anonymous (1986c), ¹⁰Anonymous (2007d), ¹¹Anonymous (1989c), ¹²Anonymous (1986d), ¹³Anonymous (2007e), ¹⁴Anonymous (1989d), ¹⁵Anonymous (2007f), ¹⁶Anonymous (1989e), ¹⁷Anonymous (1989f), ¹⁸Anonymous (1989g), ¹⁹Anonymous (1989h), ²⁰Anonymous (2007g), ²¹Anonymous (1989i), ²²Anonymous (1989j), ²³Anonymous (1989k), ²⁴Anonymous (1989l), ²⁵Anonymous (2001a), ²⁶Anonymous (2008b), ²⁷Anonymous (2001b), ²⁸Anonymous (2008c), ²⁹Anonymous (2001c), ³⁰Anonymous (2001d), ³¹Anonymous (2004), ³²Anonymous (2006a), ³³Anonymous (2008d), ³⁴Anonymous (2008e)

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

Essential or Volatile Oil contained based medicines with botanical name	Medicinal plant part Used	Essential or Fixed Oil contained, %, v/w, (NLT. - Standard Limit)	Volatile Oil contained, %, v/w, (NLT. - Standard Limit)
Kalonji , ^[35] <i>Nigella sativa</i> Linn	Seeds	31-36%	0.4-0.7%
Babchi , ^[36] <i>Psoralea carylifolia</i> Linn.	Seeds	10-12%	0.05%
Neem , ^[37] <i>Azadirachta indica</i> A. Juss)	Seeds	18-45%	N/D
Tulasi , ^[38] (<i>Ocimum sanctum</i>)	Seeds	18-22%	N/D
Karanja , ^[39,40,41] <i>Pongamia pinnata</i> Linn.	Seeds	31-41%	N/D
Alsi or Katan ^[42] <i>Linum usitatissimum</i> Linn.	Seeds	NLT.-25%	N/D
Kaunch or Konch ^[43] <i>Mucuna prurita</i> Hook.	Seeds	NLT.-3%	N/D
Arand or Erand ^[44] <i>Ricinus communis</i> Linn.	Seeds	NLT.-37%	N/D
Nariyal or Narjil ^[45] <i>Cocos nucifera</i> Linn.	Seeds	NLT.-59%	N/D
Saraso or Sarson ^[46,47] <i>Brassica campestris</i> Linn.	Seeds	NLT.-35%	N/D
Aamaa-haldi or Amiyaa haldi ^[48,49] <i>Curcuma amada</i> (Roxb.)	Whole root or rhizome	NLT.-1.0%	N/D
Apheem , ^[50] <i>Papaver somniferum</i> (Linn.)	Seeds	NLT.-19%	N/D
Khaaksee or Khubakalan ^[51] <i>Sisymbrium irio</i> (Linn.)	Seeds	NLT.-20%	N/D
Palash or Dhak, Tesoo ^[52] <i>Butea monosperma</i> (Lam.)	Seeds	NLT.-6%	N/D
Pudeenaa or Pudina ^[53,54] <i>Mentha viridis</i> (Linn.)	Leaves Aerial	NLT.- 0.2 to 0.8%	NLT.- 0.2%
Yukeliptas ^[55] <i>Eucalyptus globulus</i> Labill.	matured leaves	NLT.-2.0%	N/D
Khaaksee or Khaksi ^[56] <i>Sisymbrium irio</i> (Linn.)	Seeds	NLT.-20%	N/D

³⁵Anonymous (2007h), ³⁶Anonymous (2007i), ³⁷Anonymous (2007j), ³⁸Anonymous (2008f), ³⁹Angers et al. (1996), ⁴⁰Rehman et al. (2011), ⁴¹Anonymous (1989m), ⁴²Anonymous (1989n), ⁴³Anonymous (2001e), ⁴⁴Anonymous (2001f), ⁴⁵Anonymous (2001g), ⁴⁶Anonymous (2001h), ⁴⁷Anonymous (2008g), ⁴⁸Anonymous (2006b), ⁴⁹Anonymous (2008h), ⁵⁰Anonymous (2006c), ⁵¹Anonymous (2006d), ⁵²Anonymous (2006e), ⁵³Anonymous (2006f), ⁵⁴Anonymous (2008i), ⁵⁵Anonymous (2006g), ⁵⁶Anonymous (2008j)

Acknowledgement: I grateful thanks to Prof. Dr. S.S. Jamil, Director General, Research Council (CCRUM., AYUSH., New Delhi, Govt. of India) and Dr. M.A. Waheed, Dy. Director In-Charge, CRIUM., Council research institute (CCRUM., AYUSH., M.H. & F.W., Govt. of India) ,Erragadda,Hyderabad-50038, A.P. State and also thankful to Mr. V.K. Sexena, Managing Director, Indian Medicines Pharmaceutical Corp. Ltd., Mohan, Almora U.K. State,(AYUSH., M.H.&F.W., Govt. of India) for providing all voluble support and necessary research and extensive, authenticated literature survey, data collection facility for research and documentation work as well as I thanks to former Dean Prof. Dr. Ram Kumar Paliwal, Dept. of Chemistry and Pharmacy, Gurukul Kangri

University, Haridwar, Uttarakhand. State, India and my research collie Dr. M.K. Hussain, SMPU., Medicinal plant survey and Botany Deptt., Research Officer (Botany),SMPU In-charge,CRIUM.,Hyderabd-38.,A.P. state India for provide voluble suggestion and innovative research guidance time to time.

References

- Afaq SH. 1999. A comparative introduction of the Unani and Tibetan medical traditions, Ayur Vijnana; 6. Accessed on 25 January 2013.(http://www.ittm.org/publications/AyurVijnana/Vol_06/AV_V06_5.htm)
- Angers P. et al. 1996. *J. Janick* ; Edn. ASHS press, Basil seed oil : 598-601

- Anonymous, 1986a. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-I; I. Edn.: p-4
- Anonymous, 1986b. The Ayurvedic Pharmacopoeia of India. 1989. Part.-I; Volume-Ist; Ist Edn.: p-61
- Anonymous, 1986c. The Ayurvedic Pharmacopoeia of India. . Part.-Ist ;Volume-Ist; Ist Edn.: p-68
- Anonymous, 1986d. The Ayurvedic Pharmacopoeia of India. . Part-I; Volume-Ist ;Ist Edn.: p-102
- Anonymous, 1989a. The Ayurvedic Pharmacopoeia of India. . Part-I; Volume-Ist;Ist Edn.: p-42
- Anonymous, 1989b. The Ayurvedic Pharmacopoeia of India. Part.-I; Volume-Ist; Ist Edn.: p-57
- Anonymous, 1989c. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-Ist;Ist Edn.: p-70
- Anonymous, 1989d. The Ayurvedic Pharmacopoeia of India. Part-I; Volume- IInd;Ist Edn.: p-111
- Anonymous, 1989e. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd ;Ist Edn.: p-117
- Anonymous, 1989f. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd ;Ist Edn.: p-137
- Anonymous, 1989g. The Ayurvedic Pharmacopoeia of India. .Part-I; Volume-IInd ;Ist Edn.: p-152
- Anonymous, 1989h. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd ;Ist Edn.: p-154
- Anonymous, 1989i. The Ayurvedic Pharmacopoeia of India..Part-I; Volume-IInd ;Ist Edn.: p-171
- Anonymous, 1989j. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd;Ist Edn.: p-162
- Anonymous, 1989k. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd;Ist Edn.: p-167
- Anonymous, 1989l. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd;Ist Edn.: p-178
- Anonymous, 1989m. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IInd;Ist Edn.: p-83-84
- Anonymous, 1989n. The Ayurvedic Pharmacopoeia of India. Part.-I; Volume-Ist; Ist Edn.: p-23-24
- Anonymous, 2001a. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd; Ist Edn.: p-131
- Anonymous, 2001b. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-109
- Anonymous, 2001c. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd ;Ist Edn.: p-209
- Anonymous, 2001d. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-221
- Anonymous, 2001e. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-23-24
- Anonymous, 2001f. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-51-52
- Anonymous, 2001g. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-135-136
- Anonymous, 2001h. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IIIrd;Ist Edn.: p-194-195
- Anonymous, 2003. The Drugs and Cosmetics Act and Rule, (The Drugs and Cosmetics Act 1940, The Drugs and Cosmetics Rule 1945), Government of India, Ministry of Health and Family Welfare, chapter 2,: 5.
- Anonymous, 2004. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-IVth;Ist Edn.: p-44
- Anonymous, 2006a. The Ayurvedic Pharmacopoeia of India. Part-I; Volume-Vth;Ist Edn.: p-192

- Anonymous, 2006b. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-1-2
- Anonymous, 2006c. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-91-92
- Anonymous, 2006d. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-99-100
- Anonymous, 2006e. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-146-147
- Anonymous, 2006f. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-169 to 170
- Anonymous, 2006g. The Ayurvedic Pharmacopeia of India. Part-I; Volume-Vth; Ist. Edn.: p-199-200
- Anonymous, 2007a. The Unani Pharmacopeia of India. Part-I; Volume-Ist/Ist. Edn.: p-57
- Anonymous, 2007b. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-64
- Anonymous, 2007c. The Unani Pharmacopeia of India. 2007. Part-Ist; Volume-Ist; Ist. Edn.: p-91
- Anonymous, 2007d. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-85
- Anonymous, 2007e. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-93
- Anonymous, 2007f. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-71
- Anonymous, 2007g. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-79
- Anonymous, 2007h. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-72; W.E.P. 2013 Online; Wealth of India
- Anonymous, 2007i. The Unani Pharmacopeia of India. Part-Ist; Volume-Ist; Ist. Edn.: p-43; W.E.P. 2013 Online; Wealth of India
- Anonymous, 2007j. The Unani Pharmacopeia of India. Part-Ist; Volume-IIIrd; Ist. Edn.: p-105; W.E.P. 2013 Online; Wealth of India
- Anonymous, 2008a. The Unani Pharmacopeia of India. Part-Ist; Volume-V; Ist. Edn.: p-50
- Anonymous, 2008b. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-77
- Anonymous, 2008c. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-87
- Anonymous, 2008d. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-17
- Anonymous, 2008e. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-107-108
- Anonymous, 2008f. The Ayurvedic Pharmacopeia of India. Part-I; Volume-VIth; Ist. Edn.: p-146
- Anonymous, 2008g. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-84
- Anonymous, 2008h. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-6
- Anonymous, 2008i. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-54 to 55
- Anonymous, 2008j. The Unani Pharmacopeia of India. Part-Ist; Volume-Vth; Ist. Edn.: p-44
- Bisset W.G. 1984. Herbal drugs & phytopharmaceuticals, CRC Press, London
- Chouhan N. S. 1999. Medicinal and Aromatic plants of H.P.: 373-374
- Chunekar K.C. 2004. Bhavaprakasa Nighantu of Bhavamisra. Chaukhamba Bharati Academy, Varanasi.
- De Smet Pagm, Keller K, Hansel R and Chandler RF. 1992. Adverse effects of herbal drugs. Vol.1. Springer-Verlag, Heidelberg.
- Dubey N.K., Kumar R. and Tripathi P. 2004: Global promotion of herbal medicine: India's opportunity, Current Science; **86(1)**: 37-41.
- Gupta AK. 2003. Quality standards of Indian medicinal plants Vol. I. ICMR, New Delhi.
- Kokate CK, Purohit AP and Gokhele SB: Pharmacognosy. 2007. Chapter-6, Nirali Prakashan; 39th Ed: 97-98.

- Mishra B, Shankar and Vaishya.R (editor). 2002. "Bhava Mishra's Bhavaprakasha Choukamba Sanskrit sansthan, Varanasi, UP, 10th ed:
- Mitra S K and Kannan.R. 2007. A Note on Un-intentional Adulterations in Ayurvedic Herbs. *Ethno botanical Leaflets*; **11**: 11-15.
- Mukherjee P.K. 2002. Quality Control of Herbal drugs, Business Horizons, New Delhi; 1st ed: 113-117.
- Pandeya G. 1997. Caraka Samhita of Agnivesa with Cakrapanidatta Tika. Chaukhambha
- Poornima B. 2010. Adulteration and substitution in herbal drugs a critical analysis, *International Journal Research of Ayurvedic Pharmacy* ; **1(1)**: 8-12. (www.ijrap.net/first-issue/poornima%208-12.pdf)
- Rehman M. S. *et al.* 2011. *J. Scientific Research.*, v-3(3) : p-669
- Roy Anirban Mallick Arindam Kaour Amrinder. 2013. Adulteration and substitution in Indian medicinal plants.; ISSN: 2277-8713; *International Journal of Pharmaceutical Research & Bio-Science* **2(1)**: 208-218. (<http://www.ijprbs.com/issuedocs/2013/2/IJPRBS%20255.pdf>) Sanskrit Sansthan, Varanasi.
- Saraswathy A.2001. Adulterants and substitutes in Ayurveda. *Sachitra Ayurved*; **54(1)**: 63-66.
- Sarin YK. 1996. Illustrated Manual of Herbal Drugs used in Ayurveda, CSIR & ICMR, NewDelhi.
- Sarin YK. 1996. Illustrated Manual of Herbal drugs used in Ayurveda, Joint Publication of C.S.I.R and I.C.M.R, New Delhi.
- Shah Biren N. and Seth A.K. 2010: Test book of pharmacognosy & phytochemistry ; Drug Adulteration Chapter 10;: 107-109
- Shastri Ambikadatta. 2005. "Baishajya Ratnavali" Chaukambha Sanskrit Sansthan, Varanasi, U.P.18th Ed:
- Sunita G. 1992. Substitute and adulterant plants, Periodical Experts Book Agency, NewDelhi.
- Tewari N.N. 1991: Some crude drugs: source, substitute and adulterant with special reference to KTM crude drug market. *Sachitra Ayurved*; **44(4)**: 284-290.
- Uniyal M.R. and Joshi G.C. 1993. Historical view of the basic principles of the identification of controversial drugs, problems and suggestions. *Sachitra Ayurved*; **45(7)**: 531-536.
- Vasudevan Nair K, Yoganarasimhan KR, Kehava Murthy and Shantha TR. 1983. Studies on some south Indian market samples of Ayurvedic drugs II. *Ancient Science of Life*; **3(2)**: 60-66.