



## ADULTERANTS AND SUBSTITUTES FOR HERBAL PLANTS IN SIDDHA SYSTEM OF MEDICINE

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Article Received on  
27 October 2017,

Revised on 17 Nov. 2017,  
Accepted on 07 Dec. 2017

DOI: 10.20959/wjpps20181-10623

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### ABSTRACT

The world is endowed with the richest wealth of medicinally active plants. The Human body is much better suited for the treatment with medicinally active plants (Herbal remedies) than with isolated chemical constituents. The Physiology and digestive system of Human Beings have evolved side by side utility of medicinally active plants for more than ten thousand years. In India, about 80% of the rural population depends on Medicinally Active Plants for primary health care. Fraud and adulteration in use of medicinally active plants is considered as an intentional or careless addition of foreign substance and plant products to increase the weight of the product or to decrease

its cost. In this present article, an attempt has been made to document the list of adulterants of medicinally active plants that are available in the market.

**KEYWORDS:** Medicinally active plants, intentional or careless adulterants, Substitution, Siddha.

### INTRODUCTION

The medicinal god or goddess has gifted medicinally active plants as our richest local heritage of global importance. Ancient Indian Medical system provides a strong base for the utilization of a large number of medicinally active plants in terms, of safety and effectivity for the management and treatment of different disease conditions.

### Proportion of medicinally active plants

As per WHO, 74% of 119 modern medicinally active plants derived pharmaceutical products are used in the ways that co-related directly with the Indian system of medicine. The proportions of medicinally active plants used in the different system of medicine are as follows:

- Ayurveda - 2000
- Siddha - 1300
- Unani - 1000
- Homeopathy - 800
- Tibetan - 500
- Modern - 200
- Folk - 4500

The Fraud and adulteration in use of medicinally active plants is the major problem causing threat to public health and research activities.<sup>[1]</sup>

### Causes for the Fraud and adulteration in use of the medicinally active plants

- Enhancement of profit
- Lack of knowledge about authentic source
- Careless collection
- Similarity in morphology of plants (uncertain identity of plants)
- Confusion in vernacular names

### Demerits of fraud and adulteration in the use of medicinally active plants:

Human beings have well generated digestive and utilizing capacity of medicinally active plant edible materials containing alkaloid, glycoside, phenol and flavanoid but fraud and adulteration in the use of medicinally active plants causes serious health complications such as multiple organ failure, stroke, liver damage and kidney damage etc<sup>[2]</sup>

### Adverse consequences of adulteration in use of medicinally active plants

De Smet *et al*; reported that tea containing the adulterant *Adenostyles alliariae* causes severe liver diseases if consume for a prolonged period.<sup>[3]</sup> Tea has also been reported to be adulterated with *Illicium anisatum*<sup>[4]</sup>, *aconitum*<sup>[5]</sup> and *Datura metal*<sup>[6]</sup>, all of which can cause neurotoxicity in the body. *Echinacea* is one of the leading herbal product sold in US markets for the common cold and as an inflammatory and immune modulator. Wallace *et al.* reported

that Echinacea products often contained Walnut, which can lead to severe health issues such as nut allergies.<sup>[7]</sup> Newmaster et al. showed that adulteration in Echinacea products could have possibly arisen as, the Echinacea herbs are often bordered with Walnut trees.<sup>[8]</sup> Walnut leaves, bark and fruits contain Juglone, a tumorigenic agent that promotes skin tumors and causes Oxidative Stress in human.<sup>[9]</sup>

One of the most notable examples of the consequences of medicinally active plants adulteration known to date is the case where more than 100 women suffered kidney failure due to adulteration of the roots of *Stephania tetrandra*, an anti-inflammatory agent, with the roots of the toxic herb *Aristolochia fangchi*. Their identity was confused during collection<sup>[10,11]</sup>

### **Types of adulteration and the way of fraud**

#### **Adulteration in powdered drug**

The drugs which are in the form of powder are frequently adulterated.

#### **Examples**

- Olive stone powder is added in Gentian root powder, *Glycyrrhiza glabra* root powder, *Piper nigrum* seed powder.<sup>[12]</sup>
- Guaiacum wood powder is added in *Strychnos nux-vomica* seed powder.<sup>[12]</sup>
- Red and white sandal wood powder is added in red and white Capsicum powder.<sup>[13]</sup>
- Powdered bark is adulterated with brick powder.<sup>[13]</sup>

#### **Adulteration by synthetic principles**

Synthetic chemicals are used to enhance natural character of the exhausted materials.

**Example:** Adding citral oil to the oil of lime<sup>[14]</sup>

#### **Adulteration by artificially manufactured substances<sup>[15]</sup>**

The medicinally active plants are adulterated with the substance which has been prepared artificially. The artificially manufactured substance resembles the original substance. This method is followed for costlier drugs.

#### **Examples**

- Adulteration of artificial invert sugar in honey-*Apis mellifica* (tean).
- Adulteration of artificial colored saffron in *Crocus sativus*-Iridaceae.

- Adulteration of artificial bitter substance in Aloe vera-Liliaceae.

### Adulteration by exhausted plant materials<sup>[16]</sup>

The plant material which has been extracted already and devoid of medicinal contents, are admixed with the same plant materials of medicinally active plants.

#### Examples

Volatile oil containing drugs like Clove, Fennel, Caraway are adulterated by this method, as it is devoid of color, taste due to extraction. The natural color and taste is manipulated with additives.

### Adulteration by addition of heavy metals<sup>[17]</sup>

It is an intentional or unintentional addition of heavy metals to increase the weight of the product and it possess serious health implications.




#### Examples











- Adulteration by adding pieces of limestone in Asafoetida.
- Adulteration by adding pieces of lead in Aceetum opii(opium vinegar)-Papaveraceae.

### Adulteration with inferior commercial varieties<sup>[18]</sup>









Inferior commercial varieties of plant products which may or may not have any chemical or therapeutic value are adulterated with superior commercial varieties of costlier drugs.

#### Examples

Medicinally active plants	Adulteration by inferior commercial varieties
<p data-bbox="277 1630 632 1659"><i>Piper nigrum – Piperaceae</i></p> 	<p data-bbox="895 1451 1270 1480"><i>Carica papaya – Caricaceae</i></p>  <p data-bbox="778 1715 1382 1744"><i>Lantana indicum – Verbenaceae (Unni vidhai)</i></p> 











<p><i>Atropa belladonna</i> – Solanaceae (Deadly night shade leaf)</p> 	<p><i>Alianthus leaf</i> (Perumaram leaf)</p> 
<p><i>Syzygium aromaticum</i> – Myrtaceae</p> 	<p><i>Cinnamomum wightii</i> – Lauraceae (Sirunagapoo)</p> 
<p><i>Mucuna pruriens</i> – Fabaceae (Poonaiikkali vithai)</p> 	<p><i>Mucuna atropurpurea</i> – Fabaceae (Wild Poonaiikkali vithai)</p> 
<p><i>Ferula asafetida</i> – Apiaceae</p> 	<p><i>Pterocarpus marsupium</i> – Fabaceae (Indian kino tree gum)</p> 
<p><i>Oleum olivae</i> – Oleaceae (Olive oil)</p> 	<p><i>Amygdalus persica</i> – Rosaceae (Peach seed oil)</p> 













<p><i>Catharanthus roseus</i> – Apocyanaceae (Root)</p> 	<p><i>Solanum melongena</i> – Solanaceae (Root)</p> 
<p><i>Glycyrrhiza glabra</i> – Fabaceae (Root)</p> 	<p><i>Abrus precatorius</i> – Fabaceae (Root)</p> 
<p><i>Rauvolfia serpentina</i> – Apocyanaceae</p> 	<p><i>Rauvolfia canescens</i> – Apocynaceae</p> 
<p><i>Echinacea</i> herbs</p> 	<p>Walnut leaves.</p> 

**Adulteration by uncertain identity of medicinally active plants.<sup>[19]</sup>**







The medicinally active plants resembles morphologically, so due to its resemblance they are used as adulterant.

Medicinally active plants	Uncertain identity of medicinally active plants
<p><i>Saraca asoka</i> – Fabaceae</p> 	<p><i>Uvaria longifolia</i> – Annonaceae <i>Polyalthia longifolia</i> (False asoka – Nettilingam tree)</p> 
<p><i>Millettia pinnata</i> <i>Pongamia glabra</i> – Fabaceae (Pungam)</p> 	<p><i>Millettia peguensis</i> <i>Millettia ovalifolia</i> (Moulmein rosewood) an ornamental pungam – Fabaceae</p> 
<p><i>Stephania tetrandra</i></p> 	<p><i>Aristolochia fangchi</i></p> 
<p><i>Triticum aestivum</i> – Poaceae (Common wheat)</p> 	<p><i>Lolium perenne</i> <i>Lolium temulentum</i> – Poaceae (Perennial rye grass)</p> 
<p><i>Malva sylvestris</i> – Malvaceae (Marsh mallow – thuthi)</p> 	<p><i>Malva moschata</i> - musk mallow <i>Malva arboreus</i> var <i>drummondii</i> – wax mallow – Malvaceae (Ornamental thuthi) a hybrid</p> 



<p><i>Hedyotis diffusa</i> – Rubiaceae (Inbural root)</p> 	<p><i>Hedyotis affinis</i> <i>Neanotis indica</i> – Rubiaceae (Chay root)</p> 
<p><i>Gossypium arboreum</i> – Malvaceae (Cotton)</p> 	<p><i>Gnaphalium affine</i> (Jersey cud weed) <i>Gnaphalium uliginosum</i> (Cotton weed, cotton dawes)</p> 
<p><i>Eclipta prostrata</i> – Asteraceae (Karisalalai)</p> 	<p><i>Eclipta latifolia</i> – Asteraceae (Para cress grass)</p> 
<p><i>Aloe vera</i> – Liliaceae (Katraalalai)</p> 	<p><i>Echinocactus lewinii</i> <i>Echinocactus williamsii</i> (Ornamental crab cactus) – Cactaceae</p> 
<p><i>Rauvolfia serpentina</i> – Apocyanaceae (Sarpagandha root)</p> 	<p><i>Chassalia curviflora</i> – Rubiaceae (Umari)</p> 



<p><i>Crocus sativus</i> – Iridaceae (Saffron Nagakeshra)</p> 	<p><i>Carthamus tinctorius</i> – Asteraceae (False saffron) <i>Carthamus flavescens</i> <i>Carthamus oxyacanthus</i> – Asteraceae (Wild saffron plant)</p> 
<p><i>Camellia sinensis</i> – Theaceae (Common tea leaf)</p> 	<p><i>Camellia sasanque</i> – Theaceae (Ornamental tea leaf)</p> 
<p>Harlequin comfits – Karuvaapattai (Common cinnamon bark)</p> 	<p><i>Cassia lignea</i> – Bastard cinnamon <i>Cinnamomum cassia</i> (False cinnamom bark)</p> 
<p><i>Anthocephalus cadamba</i> – Rubiaceae (Ven cadamba)</p> 	<p><i>Betula pendula</i> – Betulaceae (European white birch)</p> 
<p><i>Datura species</i> – Solanaceae</p> 	<p><i>Brugamansia insignis</i> <i>Brugamansia versicolor</i> – Solanaceae (Angel's trumpet – Ornamental plant)</p> 







*Asclepia volubilis* – Asclepiadaceae*Asclepias tuberosa* – Asclepiadaceae  
(Butterfly weed root)*Aristolochia indica* – Aristolochiaceae  
(Indian birthwort)*Aristolochia elegans* – Aristolochiaceae  
(Calico flower – Ornamental plant)*Araucaria bidwillii* – False monkey puzzle  
(Bunya nut) – Edible pine*Araucaria araucana* – Chilean pine  
(Monkey puzzle tree)*Acalypha india* – Euphorbiaceae  
(Kuppaimeni)*Acalypha lanceolata* – Euphorbiaceae  
(Indian common copper leaf)*Acalypha chamaedrifolia* – Euphorbiaceae  
(Cat tail – Ornamental plant)*Acalypha wilkesiana* – Euphorbiaceae  
(Jacob's coat copper leaf – crotons)





*Cinnamomum zeylanicum* – Lauraceae*Cinnamomum aromatica* – Lauraceae (False cinnamon bark)*Phyllanthus emblica* – Phyllanthaceae  
(Indian gooseberry)*Phyllanthus polyphyllus* – Euphorbiaceae  
(False gooseberry)*Strychnos nux-vomica* – Loganiaceae  
(Indian poison nut)*Strychnos glabra* – Loganiaceae  
(Arrow poison nut)*Rubia cordifolia* – Rubiaceae  
*Rubia tinctorum* – Rubiaceae  
(Manjistha)*Sherardia arvensis* – Field madder European weed.  
*Sherardia indica* – Indian madder (a weed of manjistha)



<p><i>Teucrium marum verum</i> – Aromatic plant (Cat thyme)</p> 	<p><i>Teucrium chamaedrys</i> – Shrub germander (Ornamental plant)</p> 
<p><i>Zingiber officinale</i> – Zingiberaceae (Common ginger)</p> 	<p><i>Zingiber cassumunar</i> – Zingiberaceae (Ornamental plant) <i>Zingiber zerumbet</i> – Zingiberaceae (Pinecone ginger – Ornamental plant)</p> 

**Addition of medicinally active plants substitutes for the enhancement of profit<sup>[19]</sup>**

In terms of Pharmacy, Substitutes are generally used when original medicinally active plants are not available or may be available in small quantity. The principles to select the substitutes of medicinally active plants is based on similarity in properties but most important factor is its therapeutic action.

Medicinally active plants	Substitutes and Fraud in Adulteration
<p><i>Cassia lanceolata</i> – Fabaceae (Tirunelveli senna)</p> 	<p><i>Cassia obovata</i> – Fabaceae (Italian senna) <i>Cassia auriculata</i> – Fabaceae Wild cassia senna (Arabian senna)</p> 



*Jamika ginger – Zingiberaceae*

*Siphonochilus aethiopicus* (Africa ginger)  
*Zingiber mioga* (Japan ginger)  
*Zingiber officinale* (Cochin ginger)



*Aconitum heterophyllum – Ranunculaceae*  
 (Indian atees) Root - tuber



*Aconitum pardaliances – Ranunculaceae*  
 (Nnaatu athividayam - Corm)



*Piper cubeba – Piperaceae*  
 (Vaal milagu)



*Piper clusi*  
*Piper lowong – Piperaceae*

*Panax ginseng –**Codonopsis pilosula (Poorman's ginseng)*



*Embelia ribes* – Myrsinaceae  
(Vaaividangam)



*Embelia basal*  
*Embelia robusta*  
*Malaba rembelia* – Myrsinaceae



*Aceetum opii* – Papaveraceae



*Lactuca virosa* (Salaathu keerai)  
*Opium lettuce* (Wild lettuce) – Papaveraceae



*Lobelia inflata* – Indian tobacco  
Campanulaceae



*Lobelia nicotianaefolia* – Wild tobacco  
(Valdunkola)













*Asparagus racemosus* – Liliaceae (Satavari)



*Trachydium lehmanni* – Wild parsnip root  
(Satali)





<p><i>Cinchona officinales</i> – Rubiaceae (Cinchona bark)</p> 	<p><i>Swietenia macrophylla</i> – Meliaceae (Common coaba tree bark)</p> 
<p><i>Hemidesmus indicus</i> – Asclepiadaceae (Nannari)</p> 	<p><i>Smilax zeylanica</i> <i>Smilax ovalifolia</i> – Liliaceae (Thorny Indian smilax)</p> 
<p><i>Rauvolfia serpentina</i> – Apocyanaceae (Sarpagandha)</p> 	<p><i>Rauvolfia tetraphylla</i> – Apocynaceae (Paambu kalaa)</p> 
<p><i>Marsdenia tenacissima</i> – Asclepiadaceae (Perunkurijan - Eagle vine bark)</p> 	<p><i>Sida cordifolia</i> – Malvaceae (Sittramutti bark)</p> 
<p><i>Crocus sativus</i> – Iridaceae</p> 	<p><i>Mesua nagassariumm</i> – Guttiferae (Nagakesarah)</p> 



*Calotropis indica* – Asclepiadaceae  
(Erukku)



*Calotropis procera* – Asclepiadaceae  
(Crown plant)



*Withania somnifera* – Solanaceae  
(Amukkara)



*Tetranthera roxburghii* – Lauraceae  
(Picin pattai)



*Plumbago zeylanica* – Plumbaginaceae  
(Kodi velli)



*Baliospermum monatanum* – Euphorbiaceae  
(Nepal castor plant - Deththa seed)



*Ipomea sepiaria* – Convolvulaceae  
(Lakshmana keera)



*Elephantopus scaber* – Asteraceae  
(Rough elephant foot – Aanachudadi)





*Iris germanica* – Iridaceae  
(Orris root)



*Saussurea lappa* – Asteraceae  
(Kostum)



*Hygrophila spinosa* – Acanthaceae  
(Neer mulli seed)



*Tribulus terrestris* – Zygophyllaceae  
(Puncture vine – Nerunjil seed)



*Cannabis sativa* – Cannabaceae  
(Indian hemp – Kancha)



*Zornia latifolia* – Fabaceae  
*Zornia gracilis* – Fabaceae  
(False marijuana).





Adulteration by geographical distribution of different species<sup>[19]</sup>

Medicinally active plants	Adulteration by geographical distribution of different species
<p data-bbox="320 658 663 725"><i>Taxus baccata</i> – Taxaceae Common yew</p> 	<p data-bbox="927 331 1374 365"><i>Taxus canadensis</i> – Canadian yew</p>  <p data-bbox="831 696 1469 730"><i>Taxus brevifolia</i> <i>Taxus floridana</i> – American yew</p>  <p data-bbox="951 992 1350 1025"><i>Taxus cuspidate</i> – English yew</p> 
<p data-bbox="264 1496 719 1570"><i>Magnifera indica</i> – Anacardiaceae (Common mango)</p> 	<p data-bbox="919 1346 1382 1379"><i>Magnifera sylvatica</i> – Nepal mango</p>  <p data-bbox="890 1648 1414 1682"><i>Magnifera zeylancia</i> – Srilankan mango</p> 

*Mohonia lomariifolia* – Berberidaceae  
(Chinese holly grape – a hybrid)



*Mahonia napaulensis* – Nepal barberry



*Mahonia aquifolium* – Creeping barberry



*Calophyllum inophyllum* – Calophyllaceae  
(Poon tree)



*Calophyllum tomentosum* – Srilankan poon



*Calophyllum trapezifolium* – Srilankan poon



*Caladium cochin Chinese* – Araceae  
(Common chamboo)



*Caladium esculentum* – Indian kales





*Caladium seguinum* – elephant ear kales



*Beta vulgaris* – Chenopodiaceae  
(Common beetroot)



*Beta maritima* – Amaranthaceae  
(European wild seashore beetroot)



*Berberis aristata* – Indian barberry



*Berberis vulgaris* – Berberidaceae  
(Jaundice curing herb – True barberry)



*Berberis lomariifolia* – China barberry



*Berberis nepalensis* – Japan barberry



*Artocarpus integrifolia* – Moraceae  
(Common trunk jackfruit)



*Artocarpus integer* – Malaysian jack



*Artocarpus chempeden* – Malaysian jack fruit



*Araucaria araucana* – Pinaceae  
(Pine tree)



*Araucaria cunninghamii* – Australian pine



*Aleurites javanicus* – Common walnut  
*Aleurites pentaphyllus*



*Aleurites moluccana* – Bengal walnut





*Aleurites triloba* – Bengal walnut



*Aleurites trisperma* – Philippine walnut



*Heliotropium indicum* – Boraginaceae  
(Common scorpion sting plant)



*Heliotropium europaeum* – European heliotrope



*Heliotropium ovalifolium* – Picchavaram  
heliotrope



*Heliotropium zeylanicum* – African heliotrope



*Glycyrrhiza glabra* – Fabaceae  
(True liquorice)



*Glycyrrhiza triphylla* – Chinese liquorice



*Glycyrrhiza radix* – Chinese liquorice



*Capsicum annum* – Solanaceae  
(Common red or green chilly)



*Capsicum annum var conoides* – Mexican chilli.



*Capsicum Chinese* – Bird's eye chilli



*Bhut jolokia* – Nagaland ghost chilli  
(a hybrid of *Capsicum Chinese*)





*Trinidad moruga scorpion – Mexican chilli**Capsicum minimum – African chilli*

## CONCLUSION

Medicinally active plants are important health care and economic component of the flora in developed as well as developing countries. Increasing world-wide interest in herbal remedies, expanding reliance of local health care of medicinally active plants remedies and a renewed interest in the development of pharmaceuticals from plant sources have greatly increased the trade around the world. Since most medicinally active plants have prolonged usage, it is important that the medicinally active plants being used should undergo strict authentication, safety assessment in similar quality and regulatory approvals as the modern pharmaceuticals drugs.

The development of comprehensive medicinally active plants product authentication system, incorporating elements ranging from unique identifiers to trade policy, must be the way to regulate the fraud and adulteration in use of medicinally active plants and its serious health implication on human beings and also to regain consumer confidence around the world market.

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