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COMMERCIAL CRUDE HERBAL DRUGS AND THEIR QUALITY

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ABSTRACT

Millions of people in the third world will always use herbal medicines because they believe in them. They regard them as their own traditional system of medicine. The use of herbal medicines in India, China, Thailand, Sri Lanka and Myanmar is reported to be significantly high because people prefer in many cases. About 80 per cent of the 4000 million inhabitants of the world rely on herbal medicines for their first kind of health care because they cannot afford allopathic medicines. Moreover, many of those persons now using herbal medicines, would continue to use even if the prices of allopathic medicines came down. Further, there is viable option for prevention, treatment and remedy of chronic diseases like cancer, diabetes, hypertension, leprosy, etc. In this situation, national government needs to think about developing infrastructure for research on medicinal plants. An integrated approach for promoting export of medicinal plants is also called for. Against this view point, present paper focuses on quality, safety and efficacy of herbal medicines, contaminations in herbal products and literature review pertaining to contamination in herbal drugs.

Introduction

Herbal medicines have become more popular in recent years, their importance and acceptability in commercial production as medicines, cosmetics and other products not only increased many folds in our country but world over. 45000 plant species found in India in which about 7500 are medicinal and 800 plants used by pharmaceutical/cosmaceutical industries. Currently more than10,000 licensed pharmaceuticals units manufacturing herbal medicines and supply to more than 55,000 pharmacies. The herbal industry requires constant supply of genuine crude drugs. The ever increasing demand of these herbal drugs led to unprecedented demand of the raw materials of herbal drugs, which are mostly collected from the wild. Herbal drugs should also meet the WHO guidelines ie properly identified and should be free from excessive metals and microbs. In addition they should not be contain any infestation of insects, free from extraneous matter

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and defective material. Herbal drugs normally carry a great number of bacteria and fungi. Current practices of harvesting, handling and production of herbal drugs/products may also cause microbial contamination in these drugs. Bacterial endospores and fungal spores are the two dominating groups of microbial contaminants associated with medicinal plants. Among these microorganisms pathogens may also occur and limits the utilization of herbal drugs. The toxins such as aflatoxin, ochratoxins, stigmat cystine and sporidesmins etc. in herbal drugs due to the microbial contamination, may cause cancer and gastro intestinal disorders. Another aspects of poor quality of herbal drugs is heavy metal and pesticide accumulation in these drugs. It has been found that soil pollution by heavy metals can not only restrict the growth of plants or produce but also accumulate in the plants at high level. The heavy metals like Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn and Hg could cause harmful effects on human life. Cd causes osteomalacia, pyelonephritis and Pb may cause renal tumors and other carcinomas. Although Cd and Mn are micronutrients, but these are toxic at higher concentration. There are certain WHO limits for the presence of these metals in herbal drugs/products.WHO has emphasized on the need to ensure the quality of medicinal plants/ products. Adulteration and substitution of genuine drugs is very common in the herbal drug trade. Such adulteration and substitution lead to the poor quality of herbal products. In India, the supplies are usually obtained through various trade channels and are generally lacking in uniform quality. This has created frightening problems with regards to the quality, safety and stability of the raw material and their desired therapeutic efficacy. The situation became more serious due to the confusion of botanical identity of a majority of drugs mentioned in the pharmacopoeias of various indigenous systems of medicine. There is, however, a number of crude drugs where botanical identity of plant source has not been finally established and these are subjected to adulterations and substitutions. The botanical source of 'Soma' and many components of 'Ashtaverga' are still unknown in other cases, more than one plant species are considered the source of a particular drug eg. *Aerva lanata* (Linn.) Juss., *Didymocarpus pedicellatus* R. Br. and certain species of *Coleus and Bergenia* are variously considered the source of 'Pashanbheda'; 'Sariva' where four plants *viz. Hemidesmus indicus* (Linn.) R. Br., *Cryptolepis buchanani* Roem. & Schult., *Decalepis hemiltonii* Wt. & Arn. And *Ichnocarpus frutescens* (Linn.) R. Br. constitute the source. 'Punarnava' is another example to which four plants, namely, *Boerhavia diffusa* Linn., *B. erecta* Linn., *B. repens* Linn. and *Trianthma portulacastrum,* are attributed.

The Ayurvedic and Unani nomenclature of drug is also an important factor. A number of plants belonging to same genera are considered to be the source of a particular drug eg. 'Bala' (different Sida species) In some cases different plant parts are being used and considered as substitute eg.

Dashmool where stem stem/stem barks are recognized as substitute of roots/root barks. In other cases we found that the botanical source of a particular drug is different in various regions of our country. For instance, in case of 'Rasana'-*Pluchea laneolata* (DC.) Clarke in north & northwest, *Vanda roxburghii* R. Br. in central and *Alpinia galanga* Willd. in southern part of India.

What is Adulteration?

Adulteration may broadly be defined as admixture or substitution of genuine article with spurious inferior, defective or otherwise useless or harmful substances.

Adulterant—Those herbs/materials having resemblance with that of genuine herbs/materials but have no biological or very non significant medicinal activity. For example-Ratanjot–*Arnebia nobilis* is genuine drug but *Jatropha curcus* is an adulterant.

Substitute—Those herb/material having more or less similar medicinal properties of that of genuine one. For example-Ratanjot-*Arnebia nobilis* is genuine drug but O*nosma hispidum* is a substitute.

Adulteration/substitution is mainly of following types:

1. **Unintentional Adulteration**
   - Ayurvedic and Unani nomenclature
   - Common vernacular names
   - Same plant with different vernacular names
   - Season of collection
   - Diurnal variation
   - Stage of plant
2. **Intentional Adulteration**
   - Different but similar looking material
   - Exhausted products
   - With similar looking other plants
   - Partial adulteration with similar looking substances.

1. **Undeliberate/Unintentional**—This type of adulteration/substitution is only due to the confusion of the proper plant identity.

   A. The Ayurvedic and Unani nomenclature—A number of crude drugs, where botanical identity of plant source has not been finally

established, are subjected to adulteration/substitution eg. The identity of 'Ashtavarga' and 'Soma' is still unknown.

- Ashtavarga–Jivak, Rishbhak, Meda, Mahameda, Kakoli, Ksheer kakoli, Ridhi, Vridhi
- Soma–13 families,16 genera, 24 species

B. Same vernacular with different plant species—The traditional and regional names of drug play an important role for deciding substitute viz.

Ayurvedic Names	**Plant Species**
Punarnava	*Boerhavia diffusa, Trianthma portulacastrum*
Brahmi	*Bacopa monnieri, Centella asiatica*
Shankhpushpi	*Evolvulus alsinoides, Convolvulus microphyllus*
Talishpatra	*Taxus wallichiana, Abies spectabilis Rhododendron spp.*

C. Same plants with different vernacular names—The various vernacular names of single plant species also create confusion and leads to the adulteration/substitution viz.

Aconitum balfourii	Aconite, Mithazehar, Visha, Ativisa.
Alpinia officinarum	Bach, Galaij, Kulanjan.
Callophyllum innophyllum	Punnaga, Sultan champa, Lal Nagkesar.
Coscinium fenestratum	Peat Chandan, Pesta Dares, Daru haldi.

D. Season of collection—The season at which drug is collected are usually a matter of consideration, since the amount and sometime nature of active constituents varies throughout the year. Example-Rhubarb (*Rheum emodi*) should be collected in summer because the active constituent (anthraquinones) are present in this seasons only but in winter no anthraquinones but anthranols (inactive) are presents.

E. Diurnal variation—The time of collection is also an important factor for the presence of active constituents eg. in *Digitalis purpurea* leaves contain glycoside at day time which is more active. These glycoside breakup into aglycone and sugar, a less active substance at night.

F. Stage of plant—Quality and quantity of chemical constituents varies according to stage of plant.

Plant Name	Chemical variation
Clove	Bud–14-21% Essential oil, Mother brown bud- < 8%
Coriandrum sativum	Maximum oil just before flowering
Artemisia maritima	Santonin–Maximum in unexpanded flower bunds, No Santonin in open flowers .
Digitalis lanata	Medicinal glycosides are maximum in second year plants.
Vanilla planifolia	Maximum content after 8 months of pollination.
Papaver somniferum	Morphine content highest in yellowish green Capsules.

2. **Deliberate/Intentional**—When the adulteration/substitution is made to gain more profit.

   A. Different but similar looking material—Various species of a particular genus or similar looking entirely different plant taxa are being sold under the same vernacular name. This type of substitution or adulteration is common in the commercial samples.

Drug	Genuine	Adulterate/Substitute
Ashoka	*Saraca indica*	*Polyalthea longifolia, Shorea robusta, Bauhinia variegata*
Bala	*Sida cordifolia*	Other *Sida* species
Kurchi	*Holarrhena antidysentrica*	*Wrightia* species
Banafsha	*Viola odorata*	Other *Viola* species
Ratanjot	*Arnebia nobilis*	*Arnebia benthamii, Arnebia euchroma,Onosma hispidium.*
Kesar	*Crocus sativus*	*petals of Carthamus tinctorius*

   B. Partial adulteration with other plant species—Partial adulteration is common in the commercial samples when the genuine plant material is in scarcity. The similar looking plant materials are being mixed with the genuine materials. Some of the examples are given below:

Digitalis purpurea (G)	**Mixed with**	*Digatalis thapsi*
Swertia chiriata (G)	**Mixed with**	*Swertia alata, Swertia angustifolia*
Rauwolfia serpentine (G)	**Mixed with**	*Rauwolfia canescens*
Viola odorata (G)	**Mixed with**	*Viola serpens*

C. **Substitution of exhausted products**—Substances like cloves, fennel, caraway, which are used to obtained volatile oils by steam distillation are mixed with genuine articles after removal of their volatile oils contents. In this way no change was observe in external physical characteristic of these articles. Similarly exhausted Ginger and Liquorice are often mixed with genuine drugs. A classical example of this type of adulteration is provided by used tea leaves which are collected, dried, sometimes dyed and mixed with fresh leaves.

D. **Adulteration with non-plant material**—It is a common practice of any trade to find out similar looking substances for mixing with the precious genuine article to gain more profit. Some examples of admixture of genuine plant material with non-plant material are given below:

Clove & caraway	=	imitation mode of clay
Catechu	=	clay with tannin.
Asafoetida	=	synthetic resin.

3. **Microbial contamination**—Herbal drugs normally carry a great number of bacteria and fungi. Current practices of harvesting, handling and production of herbal drugs may cause the microbial contamination in herbal drugs. Bacterial endospores and fungal spores are the two dominating groups of microbial contaminants associated with medicinal plants. Among these microorganisms pathogens may also occur and limits the utilization of herbal drugs. The toxins, such as aflatoxin, ochratoxins, stigmatocystine and sporidesmins etc. in herbal drugs due to the microbial contamination, may cause cancer and gastro-intestinal disorders.

4. **Heavy metals and pesticides accumulation**—Another aspect of poor quality of herbal drugs is heavy metal and pesticide accumulation in these drugs. It has been found that soil pollution by heavy metals can not only restrict the growth of plants or produce but also accumulate in medicinal plants at high level. The heavy metals like Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn and Hg could cause harmful effects on human life. Cd causes osteomalacia, pyelonephritis and Pb may cause renal tumors and other carcinomas. Although Cd and Mn are micronutrients, but these are toxic at higher concentration. There are certain WHO limits for the presence of these metals in herbal drugs/products.

WHO has emphasized on the need to ensure the quality of medicinal plants/products. In view of the growing importance of the herbal drugs, the Government is now quite alive to the need for introducing some minimum

regulatory measures to discourage possible unscrupulous operators. Hence, there is an urgent need that quality of herbal drugs should be defined in terms of Botanical, Chemical & Physico-chemical standards. We have studied 30 herbal drugs along with their substitutes/adulterants (Total 86) under a project sponsored by Dept. of AYUSH, Ministry of Health & Family Welfare, New Delhi and developed the markers for the authentication of herbal drugs. Ultimately, such standards can be used as diagnostic characters by the pharmaceutical industries for the identification of herbal raw materials.

Survey of herbal drug markets and authentication of commercial samples is given below:

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Chart 1: Authentication of Herbal Drugs

Sl. No.	*Drug*	*Official part*	*Genuine sample*	*Substitute/ adulterants*	*Samples procured from*	*Samples Authenticated*
1.	Akashbali	Aerial parts	*Cuscuta reflexa* Roxb.	*Cuscuta chinensis*	Delhi, Amritsar, Kanyakumari	Delhi – *Cuscuta reflexa* Amritsar mixture of *C. reflexa, C. chinensis,* Kanyakumari *C. chinensis.*
2.	Apamarg	Stem	*Achyranthus aspera* Linn.	*Achyranthus bidentata*	Amritsar, Ahmedabad, Bangalore, Delhi	Only in Bangalore market *A. bidentata* was found.
3.	Ashoka	Stem bark	*Saraca asoka* L.	*Polyalthia longifolia, Shorea robusta, Bauhinia varigata* and other species	Kolkatta, Bangalore, Lucknow, Ahmedabad, Delhi, Amritsar	In all the market *Polyalthea logifolia* was abundant and mixture of all the plant species used as Ashoka are being sold. Only in Ahmedabad market *S. asoka* was found in Kolkatta market in 1 kg sample 2-3 pieces of *S. asoka* were present.
4.	Bala	Dried roots	*Sida cordifolia*	*S. acuta, S. cordata, S. rhombifolia*	Amritsar, Bangalore, Delhi, DeharaDun, Trichur, Lucknow	In all the markets mixture of whole plants of all the species are being sold. The percentage of *S. cordifolia* was very less or absent.
5.	Banafsha	Flower	*Viola odorata*	*V. pilosa, V. serpens, V. betonicifolia*	Amritsar, DehraDun, Delhi, Pathankot	In all the markets mixture of all the *Viola* species are being sold as 'Banafsha' except in Pathankot market presence of *V. odorata* was determined but the percentage was very low.
6.	Bhavya	Flower and dried fruits	*Dillenia indica*	—	DehraDun, Kolkatta	Dried fruits of *D. inica* were being sold.
7.	Bhuamliki/ Bhuiamla	Aerial parts	*Phyllanthus amarus*	*P. fraternus, P. maderasptensis*	Lucknow, DehraDun, Coimbatore, Bangalore, Amritsar, Delhi	Lucknow market and DehraDun *P. amarus* was found but in other mixture of all the species were being sold.

Sl. No.	*Drug*	*Official part*	*Genuine sample*	*Substitute/ adulterants*	*Samples procured from*	*Samples Authenticated*
8.	Brahmi	Whole plant	*Bacopa monieri*	*Centella asiatica*	Lucknow, Delhi, DehraDun, Kolkatta, Coimbatore	In Lucknow, Delhi and Dehra Dun markets *Centella asitica,* In Kolkatta and Coimbatore *Bacopa moneiri.*
9.	Daruharidra	Root	*Berberis aristata*	*B. asiatica, B. lyceum, B. chitria, Coscinium fenestratum*	Amritsar, Bangalore, Hyderabad, Lucknow, DehraDun, Kolkatta and Jammu	In DehraDun market roots of *B. aristata,* In South Indian markets roots and stem of *Coscinium fenestratum;* Delhi and Lucknow samples were identified as *B. asiatica.* In Amritsar, Jammu mixture of stem and root of different *Berberis* species and Hyderabad sample mixture of three species of *B. ariststa, B. asiatica, B. tinctoria* are being sold as 'Daruharidra'
10.	Dronpushpi	Aerial parts	*Leucas cephalotes*	*Leucas aspera*	Amritsar, DehraDun, Lucknow, Ahmedabad, Delhi, Kolkatta	In all the market samples except Kolkatta all together different plant species *Convolvulus prostatus* were being sold as 'Dronpushpi'. In Kokatta *L. aspera* was found.
11.	Dugdhika	Whole plant	*Euphobia thymifolia*	*Euphorbia prostata, E. granulata, E. microphylla*	No market samples were available.	—
12.	Gandeer	Root	*Coleus forshohlii*	*Ranunculus sceleratus* Linn.	No market samples were available.	—
13.	Hansraj	Whole plant	*Adianthum capilla-venesis, A. venustum*		Amritsar, DehraDun, Bangalore, Delhi	Mixture of all the species.

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Sl. No.	*Drug*	*Official part*	*Genuine sample*	*Substitute/ adulterants*	*Samples procured from*	*Samples Authenticated*
14.	Kapikachhu	Seeds	*Mucuna pruriens*	*Mucuna utilis, M. nivea*	Amritsar, Bangalore, DehraDun, Delhi, Lucknow.	*Mucuna pruriens*
15.	Kantkari	Stem	*Solanum surratense*	*Solanum indicum*	Kolkatta, DehraDun, Lucknow, Delhi	Mixture of whole plant of both the species.
16.	Jatamansi/ Mansi	Root	*Nardostachys jatamansi*	*Salinium vaginatum*	Amritsar, Bangalore, DehraDun, Delhi	Dehradun in one place *Salinium vaginatum.* In other market *N. jatamansi* are being sold as Mansi
17.	Deodar	Heartwood	*Cedrus deodara*	*Pinus roxburghii*	DehraDun, Lucknow	DehraDun *Cedrus deodara* Lucknow *Pinus roxburghii*
18.	Jivanti	Root and stem	*Leptadenia reticulata*	*Dregea volubilis, Sarcostemma brevistigma, Ephemerantha macraei*	Amritsar, DehraDun, Kolkatta, Lucknow, Kerala, Ahmedabad.	In amritsar and Ahmedabad, *Leptadenia reticulata.* In Kerala *Holostemma adakodien.* In Lucknow, Kolkatta and in DehraDun whole plant of *Ephemerantha macraei*
19.	Mustak	Root and rhizome	*Cyperus rotundus*	*Cyperus rotundus*	Amritsar, Bangalore, Delhi	Mixture of both the species.
20.	Nagkesara	Stamen	*Mesua ferrea*	*Calophyllum inophyllum, Mammea suriga, Cinnamomum tamala*	Amritsar, DehraDun, Ahmedabad, Kolkatta, Delhi, Hyderabad, Lucknow Coimbatore.	In Kolkatta and Amritsar markets stamen and flower of *Mesua ferrea.* In Ahmedabad stamen of *Mesua ferrea.* In Coimbatore fruits of *Cinnamomum* species. In remaining market, floral buds of *Mammea suriga.*
21.	Pitpapra/ Parpat	Whole plant	*Fumaria indica*	*Oldenlandia corymbosa*	Amritsar, Bangalore, Delhi, Hyderabad, Trichur, Lucknow	Trichur – *Oldenlandia corymbosa.* In other market mixture of both the species.
22.	Ratanjot	Root and root stock	*Arnebia nobilis*	*Arnebia benthamii, A. euchroma,Onosma*	Amritsar, Kolkatta, Delhi, Hyderabad,	*Arnebia nobilis* in Amritsar, mixture of *Onosma hispidum,* and

Sl. No.	*Drug*	*Official part*	*Genuine sample*	*Substitute/ adulterants*	*Samples procured from*	*Samples Authenticated*
				hispidum, Maharanga emodi	Lucknow, Jammu	*Maharanga emodi* in Delhi; Kolkatta, Lucknow, Delhi and Jammu mixture of *Onosma hispidum* and *Arnebia nobilis* Hyderabad mixture of *Arnebia nobilis, Onosma hispidum* and other boraginous taxa.
23.	Renuka	Stem, leaf	*Vitex negundo*	*Vitex agnus-costus*	Ahmedabad, DehraDun, Lucknow	Mixture of both species.
24.	Satawar	Root	*Asparagus racemosus*	*Asparagus adscendens, A. sprengeri*	Amritsar, Bangalore, Ahmedabad, Delhi, Lucknow, Hyderabad	Ahmedabad, and Hyderabad *Asparagus adscendens*. In remaining *A. racemosus.*
25.	Resha Khatmi	Roots	*Althaea officinalis*	*Althaea rosea*	DehraDun, Delhi, Hyderabad, Jammu, Lucknow	Hyderabad, mixture of both the species DehraDun, Lucknow roots of *A. rosea;* Jammu and Delhi roots of *Althaea officinalis*.and *A. rosea.*
26.	Sappan	Heartwood	*Caesalpinia sappan*	*Pterocarpus santalinus, Pterocarpus marsupium, Pterocarpus dalbergioides, Gluta travencorea, Toona ciliata*	Mumbai, Kolkatta, Lucknow, Haridwar	Mumbai – mixture of *Pterocarpus* species; Kolkatta mixture of *Gluta* and *Toona ciliata* Haridwar *C. sappan* one sample of Lucknow and Mumabi was *P. marsupium.*
27.	Talishpatra	Leaves	*Abies spectabilis*	*Taxus wallichiana*	Amritsar, DehraDun, Bagalore, Trichur	Amritsar, DehraDun, *Abies spectabilis* Bangalore mixture of both the species.
28.	Tukm-e-khatmi	Seeds	*Althaea officinalis*	*Althaea roses*	Amritsar, Delhi, Lucknow, DehraDun	In all market seeds of *A. rosea* in Amritsar mixture of both the species.

Contd....

Sl. No.	*Drug*	*Official part*	*Genuine sample*	*Substitute/ adulterants*	*Samples procured from*	*Samples Authenticated*
29.	Tulsi	Leaves	*Ocimum sanctum*	*Ocimum basilicum, O. gratissimum, Ocimum canum*	Amritsar, DehraDun, Bagalore	Mixture of all the species.
30.	Vidarikand	Root tuber	*Pueraria tuberosa*	*Ipomoea digitata*	Amritsar, Bangalore, Hyderabad, Trichur, Delhi, DehraDun, Lucknow.	In DehraDun, Hyderabad *Pueraria tuberosa* in other markets *Ipomoea digitata*