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The real concept of substitution in Ayurveda literature and adulteration the misleading concept of modern era

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ABSTRACT

A quality drug is central to the success of any therapeutic plan. The quality of drug is determined right from the collection to delivery to the patients. The commonest problem involving the medicinal plant stating materials is intentional or unintentional substitution and adulteration owing to multiple reasons like unavailability, higher costs, unfair trade etc. This trend was also present in the olden days, as evident from the concept of substitute drugs *(Pratinidhi Dravya*) as available in *Yogratanakara, Bhavaprakasha* and *Bhaishajyaratnawali.* Therefore, *Charka* and later *Acharyas* also have dealt with authentication and standardization of herbal drugs and formulations in detail by using four *Pramanas* (tools of knowledge) *Ch.Vi.8/87.* Nowadays the concept of substitution is entirely converted into intentional and unintentional malpractices of adulteration. The established authenticity parameters for plant material identification and standardization like organoleptic, physical, chemical and genetic parameters are relatively inaccessible for routine use. Not withstanding the accuracy and usefulness of these lab parameters and delay in the development of easy to perform parameters for reasonable drug authentication. These adulteration malpractices spoils the market of herbal industries. In this article we discuss about concept of substitution in ancient Ayurveda and at present intentional and unintentional adulteration practices.

Key words: *Adulteration, Substitution.*

INTRODUCTION

Now a days the adulteration of herbal raw materials is the major crisis which hazardous to the herbal drug industry and to the research on commercial natural products. The term adulteration of an article covers a number of conditions which may be intentional or unintentional. The crude drugs are substituted with the inferior commercial varieties and are use as adulterant which may or may not have any therapeutic potential as that of original drug.

This trend was also present in the old days, as evident from the concept of substitute drugs (*Pratinidhi Dravya*) as available in *Yogratanakara, Bhavaprakasha* and *Bhaishajyaratnawali.* But at present, for the purpose of benefits many inferior quality raw materials are mixed instead of original drug. So there is a need to evaluate this concept with the present trend of adulteration and substitution so that we can implement the appropriate concept. This article clears the concepts of substitution given by our *Acharyas* and analyzes these with the present day existing trend of substitution and adulteration.

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CONCEPT OF SUBSTITUTE

Substitute is a drug having similar *Rasa, Guna, Vipak, Veerya* and is used on the absence or unavailability of original genuine drug.

The substitute drug has following characteristics.

When the drug mentioned in a formulation is not available, and then a drug with similar bio-equivalency is to be selected and used in place of original genuine drug.

In ancient era as in *Nighantu* period, the scarcity of genuine drug had been seen, for which the practice of substitution of genuine drug was promoted.

Our ancient *Acharyas* were able to identify the substitutes which are context specific and in such condition rather than giving importance to *Guna, Karma* was taken into consideration.[1],[2]

Need for Substitution[3-6]

- Unavailability of the drug. Eg: Substitution for *Jeevaniya* drugs.
- Uncertain identity of the drug. Eg: for the herb *Kakjangha* different species such as *Leea, Hirta,* etc. are considered
- Cost of the drug. Eg: *Kumkuma* being costly herb is substituted by *Kusumbha,* corolla of *tagetus indica.*
- Geographical distribution of the drug. Eg: As *Pashanbheda, Berginea ligulata* is used in Northern India while in southeren parts *Aerva lanata* is considered as the source.
- The adverse reaction of the drug. Eg: *Vasa* is a well known *Rakta-Pittahara* drug, but due to its Abortificiant activity its utility in pregnant women is limited, instead drugs such as *Laksha, Ashoka* etc. are substituted.[7]

Criteria for Substitution

When the drug mentioned in a formulation is not available, then a drug with similar bioequivalent *(Guna, Rasa,Vipak, Veerya)* is to be selected and used but in case the major ingredient of formulation should never substituted with other similar bioequivalent drug.[1],[5]

Eg: while preparing *Kutajghana Vati* should not substitute *Kutaj* with any other drug.

A drug to be considered as a substitute should fulfill the following criteria.[7]

1) Similarity in *Rasa-panchakas.*

Eg:-*Bala and Atibala,*

2) Exhibit similar therapeutic effects.

Eg:-*Ativisha* and *Musta.*

3) Substitution with totally different drug

Here we can consider *Bharangi* (*Clerodendron indicum*) and *Kantakari. Bharangi* has *Tikta Rasa* and *Laghu, Ruksha Guna* and has *Kapha* and *Vatahara* property. While *Kantakari* (*Solanum surattens linn.*) has *Katuvipaka* and *Ushnavirya*. It has Glycosides - Verbascoside and solasoninie, solamargin, solasurine respectively.

Both *C. indicum* and *S. xanthocarpam* have shown Anti-histaminic activity. Both *C. indicum* and *S. surattens* are commonly employed in the diseases related to the respiratory system, which are commonly associated with release of Histamines and other Autacoids.

4) Substitution of different Species

Here we can consider two types of *Gokshura*. *Tribulus terrestris* (zygophyllaceae) and *Pedalium murex (Pedaliaceae) T. terrestris* has the chemical constituents like chlorogenin, diosgenin, rutin, rhamnose and alkaloid. While *P.murex* has sitosterol, ursolic acid, vanilin, flavonoids and alkaloids.

Both the species are proved for nephroprotective, lothotriptic, diuretic and hepatoprotective activities. If we analyse the clinical conditions where *Gokshura* is indicated i.e. *Mutrakruchcha*, *Mutraghata, Ashmari, Prameha* etc. both *Tribulus terrestris* and *P. murex* appear to be appropriate.

5) Substitution of the species belonging to same family

The *Datura metal* and *Datura stramonium* can be considered here.

Chemical Constituents are alkaloids, scopalamine, atropine, hyocyamin and lyoscine. The Alkaloids are

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proved as bronchodilator and inhibitor of secretion of mucous membrane. The alcoholic extract of *Dhatura metal* show 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 *Krimihara, D.metal* would be a better choice as it is a proven anthelmentic.

6) Context specific substitution

The *Amalaki (Embelica officinalis*) and *Bhallataka (Semicarpus anacardium)* can be considered. The *Amalaki* has *Laghuguna* and *Lavana Vargitha Pancharasa*, *Madhuravipaka, Sheetavirya* and *Tridoshahara* property. It has chemical constituents such as vitamin c, phyllembin, linolic acid, indole acetic acid, ellagicacid, salts etc. While *Bhallataka* has *Laghu, Teekshna, Snigdhaguna, Katu, Tikta, Kashaya Rasa, Mardhura Vipaka, Ushna Virya* and *Kaphavatahara* properties. Biflavonoids, anacardic acid, nicotinic acid, riboflavin, thiamine and essential oils.

Research profile of E. officinalis shows Anti-oxidant, Hepato Protective, Microbial, Hypoglycemic Hypolipidemic action. The research profile of Semecarpus shows Anti-tumour, Hypotensive, Anti - Cytotoxic and anticancerous properties etc.

Both *Amalaki* and *Bhallataka* are *Rasayana* drugs. *Amalaki* is commonly employed as *Kamya Rasayana* and *Bhallataka* as *Nimittika Rasyana.* 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 Asthama*, Diabetes etc.

While *Bhallataka* would be better choice in malignant conditions, both in solid tumors and in leukaemia.

7) Substitution of different parts of the plant

The root of *Sida cordifolia* linn. and the whole plant of *Sida cordifolia* linn. can be considered. Root has the chemical constituents such as sitoindoside, Acylstery glycoside. While the whole plant has alkaloid, hydrocarbons, fatty acids, ephedrine. Various extracts of the whole plant showed Anti-bacterial, Anti-oxidant, 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, Brumhana, Shotahara* etc. modern researches proves that even the aerial parts are also equally effective.

In *Bhavaprakash Nighantu, Acharya Bhavamishra* quoted as “the drugs of *Astavarga* are unavailable for the general people as well as for the king also. So, in this case, *Acharyas* could use the substitute drugs which are having similar properties with that of *Astavarga”.* [8]

Bhavaprakash Nighantu mentioned the substitute drug for *Astavarga* in place of genuine drug as-

Genuine drug substitute drug

During the medieval period with the identification of newer species many more drugs added to the list of substitutes, this provided to the physician a great scope of selection of drug, which is most appropriate and easily available.[9]

Acharya Yogaratnakara, govidadas, Bhavamishra etc even provided the substitutes for the various plant products which contributed tremendously for better clinical approach.

During the modern era in an attempt to conserve the flora, various plant parts especially the aerial parts like bark, stem were screened for different Pharmacological activities and emerged with encouraging result. This provided a newer dimention for substitution.

The most essential criteria for substitution are the Pharmacological (Bioequivalent) activity rather than Morphology or Phytoconstituents. Substitution of herbs achieved many goals though basic idea was to provide similar therapeutic effect as that of original drug. It provided a greater scope for the physician to utilize herbs that are easily available, cost,

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effectiveness and most appropriate for the clinical condition.

Limitation of Substitution

Mentioned, the limitation and restriction in uses of substitute, as substitute is not to be adopted,

1. *Bhaishajya Ratnavali* for principle drug in a formulation but it can be done in case of such drugs which are subsidiary.
2. The substitute drugs cannot fulfill the whole properties of original drug.[2]

Acharya Yogaratnakara in his text give some example of substitute drugs naming under *Abhavadravya* That means the absence/unavailability of required drug we use another drug of similar *Rasa, Veerya, Vipaka* (bioequivalent) as that of original drug.

Table 1: *Abhava Dravya* mentioned by *Acharya Yogaratnakara.*

SN	Original drug	*Abhava Dravya*	Ref.
1.	*Guduchisatva*	*Guduchi Rasa*	Y.R.A,1[10]
2.	*Chitraka*	*Dantikshara/Apamargkshara*	Y.R.A,1[10]
3.	*Dhanvayasa*	*Duralabha*	Y.R.A,2[11]
4.	*Tagara*	*Kushta*	Y.R.A,2[11]
5.	*Murva*	*Gingini* Bark	Y.R.A,3[12]
6.	*Lakshmana*	*Mayurshikha*	Y.R.A,4[13]
7.	*Bakul*	*Shweta/Raktakamal*	Y.R.A,4[13]
8.	*Nilotpala*	*Kumudini*	Y.R.A,5[14]
9.	*Kamal*	*Kamalbeej*	Y.R.A5, [14]
10.	*Bakulatwaka*	*Babbulatwaka*	Y.R.A,6[15]
11.	*Jatipatra*	*Lavang/Jayafala*	Y.R.A,6[15]
12.	*Leaf milk of Arka*	Leaf juice of *Arka*	Y.R.A,7[16]
13.	*Pushkarmool*	*Kushta*/Rootbark of airand	Y.R.A,7[16]
14.	*Sthauneyaka*	*Kushta*	Y.R.A,8[17]
15.	*Chavya/Gajappali*	*Pippalimool*	Y.R.A,8[17]
16.	*Daruharidra*	*Haridra*	Y.R.A,9[18]
17.	*Rasanjana*	*Daruharidra*	Y.R.A,10[19]
18.	*Saurashtramruttika*	*Sphatika*	Y.R.A,10[19]
19.	*Talishapatra*	*Swarnatali*	Y.R.A,11[20]
20.	*Bharangi*	*Talishpatra*	Y.R.A,11[20]
21.	*All Lavana*	*Sendhalavana*	Y.R.A,12[21]
22.	*Yashtimadhu*	*Dhataki*	Y.R.A,13[22]
23.	*Amlavatasa*	*Chukra*	Y.R.A,13[22]
24.	*Chukra*	*Jambiri Nimbu Swarasa*	Y.R.A,14[23]
25.	*Draksha*	*Kashmariphala*	Y.R.A,14[23]
26.	*Draksha/kashmariphala*	*Madhukapushpa*	Y.R.A,15[24]
27.	*Nakhi*	*Lavangpushpa*	Y.R.A,15[24]
28.	*Shatavari/Vidari*	*Musali*	Y.R.A,16[25]
29.	*Khasa*	*Sugandhavala*	Y.R.A,17[26]
30.	*Shalaparni*	*Prushniparni*	Y.R.A,17[26]
31.	*Brihati*	*Kantakari*	Y.R.A,17[26]
32.	*Mishreya*	*Shatapushpa*	Y.R.A,17[26]
33.	*Mudgaparni*	*Mashaparni*	Y.R.A,18[27]
34.	*BrihataAgnimanth*	*Laghuagnimantha*	Y.R.A,18[27]
35.	*Kasturi*	*Kankola*	Y.R.A,20[28]
36.	*Kankola*	*Javitri/Malatipushpa*	Y.R.A,20[28]
37	*Karpura*	*Sugandhi Mustaka*	Y.R.A,21[29]
38.	*Karpura*	*Granthiparna*	Y.R.A,22[30]

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39.	*Kesara*	*Nava Kusumbhapushpa*	Y.R.A,22[30]
40.	*Shrikhanda/Sh wetaChandana*	*Karpura/Raktacandana*	Y.R.A,23[31]
41.	*Raktacandana*	*Navaushira*	Y.R.A,24[32]
42.	*Musta/Ativisha*	*Haritaki*	Y.R.A,26[33]
43.	*Haritaki*	*Karkatashrungi*	Y.R.A,26[33]
44.	*Nagakashara*	*Padmakeshara*	Y.R.A,27[34]
45.	*Bhallataka*	*Naddibhallataka*	Y.R.A,27[34]
46.	*Meda-Mahameda*	*Shatavari*	Y.R.A,28[35]
47.	*Kakoli-kshirakakoli*	*Ashwagandha*	Y.R.A,28[35]
48.	*Jivaka-rishavaka*	*Vidarikanda*	Y.R.A,28[35]
49.	*Riddhi-Vriddhi*	*Varahikanda*	Y.R.A,28[35]
50.	*Varahikanda*	*Charmakaralu*	Y.R.A,29[36]
51.	*Bhallataka*	*Chitrakamula*	Y.R.A,32[37]
52.	*Ikshu*	*Nala*	Y.R.A,32[37]
53.	*Madhu*	*Puranaguda*	Y.R.A,35[38]
54.	*Matsyandika*	*Khanda*	Y.R.A,36[39]
55.	*Khanda*	*Shwetasharkara*	Y.R.A,36[39]
56.	*Nirgundi*	*Tulasi*	Y.R.A,37[40]
57.	*Tulasi*	*Nirgundi*	Y.R.A,37[40]
58.	*Kutherika*	*Gramyatulasi*	Y.R.A,38[41]
59.	*Shwetapunarn ava*	*Raktapunarnava*	Y.R.A,38[41]
60.	*Rasna*	*Kulinjana*	Y.R.A,39[42]
61.	*Suwarna*	*Swarnamakshika*	Y.R.A,39[42]
62.	*Swarnamakshi ka*	*Raupyamakshika*	Y.R.A,40[43]
63.	*Makshika*	*Swarnagairika*	Y.R.A,40[43]
64.	*Rasabhasma*	*Lohabhasma*	Y.R.A,41[44]
65.	*Kantaloha*	*Tikshnaloha*	Y.R.A,42[45]
66.	*Mukta*	*Muktashukti*	Y.R.A,42[45]
67.	*Vaidurya*	*Muktabhasma*	Y.R.A,43[46]
68.	*Paradabhasma*	*Rasasindura*	Y.R.A,44[47]
69.	*Rasasindura*	*Hingula*	Y.R.A,44[48]
70.	*Goksheera*	*Ajaksheera*	Y.R.A,45[49]
71.	*Gogruta*	*Ajagruta*	Y.R.A,46[50]
72.	*Ksheera*	*Munga/Masura Rasa*	Y.R.A,47[51]

Y.R.A. - Yoga Ratnakara Abhavavarga

CONCEPT OF ADULTERATION[52]

It is the substitution of the original crude drug partially or fully with other substances which is either free from or inferior in therapeutic and chemical properties /Adulteration is a practice of substituting genuine drug partially or wholly with other similar looking substances which is either free from or inferior in chemical and therapeutic properties due to scarcity and high price of a drug. In this condition drug dealers substituted the genuine drug with cheaper materials. In simple term adulteration is debasement of an article. An adulterated drug does not conform to the official requirements. Adulteration involves following condition such as;

- **Deterioration -** It is impairment in the quality of drug.
- **Admixture -** It is addition of one article to another due to ignorance or carelessness or by accident.
- **Sophistication -** It is intentional or deliberate type of adulteration.
- **Substitution -** It is condition in which some totally different substance is added in place of original drug.
- **Inferiority -** It refers to any substandard drug.

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- **Spoilage -** It is due to the attack of microorganisms.

Reason for Adulteration[53]

1. **Intentional adulteration :** For commercial one with the intention of enhancement of profits.
2. **Unintentional adulteration :** Scarcity of drugs and its high price prevails in the market. Unintentional adulteration may be due to following reasons.

- Confusion in vernacular names between indigenous systems of medicine and local Dialects.
- Lack of knowledge about the authentic plant
- Non-availability of the authentic plant
- Similarity in morphology or aroma
- Careless collection
- Other unknown reasons

Types of Adulteration[54]

Different types of adulteration found in the market are given as follows;

1. Substitution with substandard commercial varieties

This is resemble the original crude drug by morphological, chemical or therapeutic varieties, but is substandard in nature.

- Cheaper in cost.
- Most common practice.

Example - Gentian substituted by *Kutaki*, Medicinal ginger replaced by African, Japanese and Cochin ginger, Strychnous nuxvomica substituted by S. potatorum etc.

2. Substitution with superficially similar inferior drugs

These inferior drugs used may or may not be having any chemical therapeutic value.

Due to their morphological resemblance, they are marketed as adulterants.

Example - Saffron is admixed with dried flowers of *Kusumbha*, belladonna leaves are substituted with Ailanthus leaves etc.

3. Substitution with artificially manufactured substances

Artificially prepared drugs are used as substitutes.

This is used for much costlier drugs.

Example - Compressed chicory in place of coffee, paraffin in place of bee wax etc.

4. Substitution of exhausted drugs

The same drug is admixed but it is devoid of any medicinally active constituents as they are already extracted out.

It is more common in case of volatile oil containing drug like fennel, clove, coriander etc.

5. Presence of vegetable matter from the same plant

Sometimes, the other miniature plants growing along with medicinal plant are allowed to get mixed with drug due to their resembling colour, odour and in some cases constituents.

Example - Stem portion are adulterated along with root drugs like Bharangi, Sarpagandha etc.

6. Harmful adulterants

The wastes from market are collected and admixed with authentic drugs.

This is particularly for liquids or unorganized drugs.

Example - Rodent fecal matter in cardamom seed, white oil in coconut oil, limestone's in asafoetida etc.

7. Adulteration of powders

Beside the entire drugs, the powdered forms are many times found to be adulterated.

Example - Bark powder adulterated by brick powder.

Methods of detection of Adulteration[55]

Evaluation of a drug means confirmation of its identity and determination of quality and purity. Taking into consideration the variations in sources of crude drugs

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and their chemical nature, they are standardized by different techniques such as;

1] Morphological or organoleptic evaluation - It includes colour, odour, taste, size, shape, special features, like touch, texture of a drug.

2] Microscopic evaluation - it includes more detailed examination of a drug. It can be used to identify the organized drugs by their known histological characters.

3] Physical analysis - moisture content, Viscosity, melting point, solubility, optical rotation, Refractive index, Ash value, Extractive-water, alcohol, ether soluble volatile oil content.

4] Chemical analysis - It includes detection of alkaloids, carbohydrates, glycosides, fixed oil and fats, saponin, tannins, Thin layer chromatography, H.P.L.C., H.P.T.L.C etc.

DISCUSSION

After analysis of the available information about substitute drug in ayurvedic literature the *Acharyas* were very sure and confident for taking substitute drug in place of original genuine drug on the basis of *Guna, Karma* due to proper identification of genuine drugs, absence of repeated names of two drugs and less quantity of drugs. *Acharya Yogaratnakara*, *Bhavaprakash*, *Govindadas* etc. provided the substitutes for the various plant products which contributed tremendously for better clinical approach this possible due to identification of new species and many more drugs were added to the list of substitute drugs. But in present era of modern science the prevailing clean trend of substitution is fully converted into intentional and unintentional adulteration malpractices to enhance profit due to increased demand, cheaper costs, and no side effects of herbal medicines. We can stop the both adulteration by using the methods of detection of adulteration in intentional adulteration and by giving education of authentic sources of drugs to suppliers and traders from WHO guidelines on quality standards for medicinal plant materials and new researches has been develops the use of various plant parts especially the aerial parts of same plant in the unavailability or absence of original drugs due to its probable similarity in active constituents to conserve the flora.This opens a new gate in the field of substitution.

CONCLUSION

In present era the need of crude drug market is proper and qualified substitute drug in the absence/ unavailability of original drug rather than different drug which is inferior in quality and action of original drug because most of the important plant species becomes listed as endangered plants.The most essential criteria for substitution are the Pharmacological activity/ Bioequivalency of that drug than Morphology or Phytoconstituents**.** Substitution of herbs achieved many goals though basic idea given by ancient Ayurveda. It provided a greater scope for the physician to utilize herbs that are easily available, cost effective and most appropriate for the clinical condition. It enriched the Materia Medica with the survey of natural resources, and contributed for conservation of flora. On our analysis not all the adulteration practices are intentional but some practices are unintentional also owing to illiterate and unaware attitude of crude drug suppliers, majorly lack of knowledge about authentic plant, confusion in name of plants and non availability of some important plants and unawareness of scientific community and traditional physicians from this problem. Today's herbal drug industries pursue, high quality standards using modern techniques and instruments to maintain their quality. World Health Organization (WHO), recommend more than 5% plant parts of same plants (eg. stem in leaf drugs), also rejected any batch of raw material, even though they derived from the authentic plant in its publication on quality standards for medicinal plant materials,On the basis of these standards, adulteration whether, intentional or unintentional, should be discarded. Also, suppliers and traders should be educated about the authentic sources.

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