

SUBSTITUTION CAN BE A SOLUTION FOR SCARCITY OF HERBAL DRUGS: A REVIEW

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ABSTRACT

Use of medicinal plants is as old as human civilization. With the development of the civilization and industrialization the demand of medicinal herbs is increasing day by day. People every year turn towards complementary medicines for safe and effective health care. This resulted in overharvesting of medicinal plants and because of this many medicinal species are at risk of extinction. Ancient *Ayurvedic* scholars have already given solution to overcome shortage of medicinal plants in form of *Pratinidhi Dravya* (~substitution). Substitution is a replacement of equivalent drugs in place of original drugs based on similar pharmacological actions and therapeutic uses. Present paper is an attempt to analyze the significance and concept of *Pratinidhi Dravya* (~substitution) in present prospective to overcome the scarcity of medicinal plants.

Keywords: *Pratinidhi Dravya*, Substitution, Ideal substitute, Bio-equivalency

INTRODUCTION

Use of medicinal plants is as old as human civilization. Human being depends upon plants either directly or indirectly for all their basic needs e. g. food, vegetables, fruits, cosmetics etc. Over the time, as the urbanization and industrialization increase human beings have been shifted to allopathic medicines. Side effects or adverse effects are seen in almost all allopathic medicines containing synthetic, semi-synthetic chemical compounds. About 8% of hospital admission in the United States of America is due to adverse side effects of synthetic drugs.¹ Therefore, people every year turn towards complementary medicines for safe and effective health care. In recent past the medicinal

plants have received a great attention, so there is increasing pressure on the wild plant population from which most of the medicinal plants are harvested. Overharvesting has placed many medicinal species at risk of extinction. Commercial exploitation sometimes causes unavailability of traditional medicine to indigenous people.² Another important factor is climate change, which is causing marked effect on life cycles and biodiversity of the high-altitude plants. This climate change is due to global warming.³

Deforestation is also one of the important factors which are the result of increasing industrialization. All these factors like industrialization, climate changes,

overexploitation of medicinal plant species etc. are the main causes of scarcity of medicinal plants. In *Ayurvedic* pharmaceutical, medicinal plants are the basic component of almost all preparations. On other hand some medicinal plant species are extensively used in *Ayurvedic* preparations and they also have huge market potential. Due to this, they are overexploited. Scarcity of medicinal plants is the consequence of all these above said factors and ultimately adulteration and substitution come into practice. Adulteration 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 drugs or entirely different drug similar to that of original drug substituted with an intention of enhancement of profits.⁴ Substitution is a replacement of equivalent drugs in place of original drugs on the basis of similar pharmacological actions and therapeutic uses.⁵

Ancient *Ayurvedic* scholars have already given solution to overcome shortage of medicinal plants in form of *Pratinidhi Dravya* (~substitution). One can find the description of various *Pratinidhi dravya* (~Substitute) in classical texts like *Bhava Prakash*, *Yogratankara*, *Bhaishjya Ratnavali* under *Mishra Prakaran*. *Yogaratnakara* & *Bhaishjya Ratnavali* has also compiled valuable information regarding *Pratinidhi Dravya*. Present paper is an attempt to analyze the significance and concept of *Pratinidhi Dravya* (~substitution) in present prospective to overcome the scarcity of medicinal plants.

Concept of substitution in *Ayurveda*⁶

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

Criteria of substitution⁷

Yojmektarabhava param vaidyen janta Rasaviryavipakadayi samam dravyam vichintay ch...

...Anuktamapi yuktam ydyojyetrasadvit. (Bhav Prakash nighantu Purv khand – Mishra prakran)

According to above said verse following criteria should be followed for selection of a substitute: -

- When the drug mentioned in a formulation is not available, then the drug with similar *Rasa*, *Guna*,

Vipaka, *Veerya* (bio-equivalency) is to be selected and used

- In case of unavailability of the major ingredient of formulation, it should never be substituted with another bioequivalent drug.
- Any *dravya* which if not suitable for the disease but enlisted with the other drugs for that diseases, it should be excluded
- Any *dravya* which is not stated for the disease but if it is suitable or beneficial for that disease, it should be included.

Need of substitution^{4,8}

1. **Non or less availability of drugs-** Substitution for *Ashtavarga* group of drugs i.e. *Jeevaka* (*Malaxis acuminata* D. Don) & *Rishbhaka* (*Malaxis muscifera* (Lindl) Kuntze, *Meda* (*Polygonatum verticillatum* (L.) Allioni & *Mahameda* (*Polygonatum cirrhifolium* (Wall.) Royle, *Kakoli* (*Roscoea purpurea* Smith) & *Kshirkakoli* (*Lilium polypphyllum* D. Don), *Riddhi* (*Habenaria intermedia* D Don.) & *Vridddhi* (*Habenaria edgeworthii* Hook. f. ex Collett) these are rare drugs. These are only found in high altitude area of Himalayan region.
2. **Cost of the drug-***Kumkum* (*Crocus sativus* Linn.) being costly herb is substituted by *Kusumbha*, corolla of *Tagetes erecta* Linn.
3. **Geographical distribution of the drug –** *Pashanbheda* (*Berginea ligulata* Wall) is used in Northern India while in Southern India *Aerva lanata* Juss is considered as the source.
4. **Adverse reaction of the drug-** *Vasa* (*Adhotoda vasica* Nees) is well known *Rakta-Pittahara* drug but due to its abortifacient activity its utility in pregnant women is limited, instead drugs such as *Laksha* (*Laccifer lacca* (kerr)), *Ashoka* (*Saraca asoca* (Roxb.) De Wilde) etc. are substituted
5. **Shelf life of the drug-**Some drugs like *Ativisha* (*Aconitum heterophyllum* Wall.), which get easily destroyed by insects and difficult to store for long period of time, thus may be substituted by drug like *Musta* (*Cyperus rotundus* Linn).
6. **Preparation form of the drug -**Substitution can also be done in the form of preparation in case of

unavailable prepared material and which can be used in emergency conditions. Eg: In case of unavailability of *Guduchi Sattva* (*Tinospora cordifolia* (Willd.) Miers ex Hook. f. & Jhoms extract), *Guduchi Swarasa* (juice) can be used.

Characteristics of an ideal substitute ⁶

1. **Similarity in Rasa-panchakas:-** *Bala* (*Sida cordifolia* Linn.) and *Atibala* (*Abutilon indicum* (Linn.) Sw.) both have *Madhura Rasa*, *Laghu*, *Snigdha*, *Picchila Gunas*, *SitaVirya*, *Madhura Vipaka* so can be used as substitute.
2. **Exhibit similar therapeutic effects:** - *Ativisha* (*Aconitum heterophyllum* Wall. Cat.) and *Musta* (*Cyperus rotundus* L.) both are *Jawarhara*, *Sotha hara*, *Kasa hara*, *Vishahara*
3. **Using totally different drug:-** We can consider *Bharangi* (*Clerodendrum serratum* spreng.) and *Kantkari* (*Solanum surattense* Burm. F.) *Bharangi* has *Tikta Rasa*, *Ruksha Guna*, and has *Kapha* and *Vatahara* property. While *Kantkari* has *KatuVipaka* and *Usnha Veerya*. It has glycosides- verbascoside and solasonine, solamargine respectively. Both *C. serratum* and *S. surattense* have shown anti-histaminic activity. Both *C. serratum* and *S. surattense* are commonly used in the diseases related to the respiratory system, which are commonly associated with release of Histamines and other Autocoids.

4.Substitution of the species belonging to same family -The *Datura metal* L. and *Datura stramonium* L. can be considered for substitution of the species belonging to same family. Chemical constituents are alkaloids, atropine, scopolamine, lyoscine, hyocyanin. The alkaloids are proved as bronchodilatory and inhibitor of secretion of mucous membrane. The alcoholic extract of *D. metal* L. shows anthelmintic activity. The alkaloid present in both the species are well proven bronchodilators and, 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* L. and *D. stramonium* L. are beneficial, while as *D. metal* Linn. would be a better choice as it is a proven anthelmintic.

Berberis aristata DC. and its species *Berberis asiatica* Roxb.ex. DC., *Berberis lycium* Royle can be considered. Chemical constituents are berberine, berbamine, hydrastine, oxycanthine. Its species can be used as substitute.

5. Using different species- There are two types of Gokshura. *Tribulus terrestris* L. (Zygophyllaceae) and *Pedaliium murex* L. (Pedaliaceae). *Tribulus terrestris* L. has the chemical constituents like chlorogenin, diosgenin, rutin, rhamnose and alkaloids. While *P.murex* has sitosterol, ursolic acid, vanillin, flavonoids and alkaloids. Both the species are proved for nephroprotective, lithotriptic, diuretic and hepatoprotective activities. It has been found that both *T.terrestris* L. and *P.murex* L. are effective in *Mutrakrcra* (renal disorder), *Ashmari* (urinary calculi), *Prameha* (diabetes) etc.

6.Using different parts of plant -The root of *Sida cordifolia* L. and the whole plant of *Sida cordifolia* L. can be considered. Chemical constituents in root are sitoindoside, acylsteryglycoside, while the whole plant has alkaloid, fatty acids, hydrocarbons, and ephedrine. Various extracts of the whole plant showed antibacterial, hypoglycemic, antioxidant, hepatoprotective and cardio tonic activities. But the root of *Sida cordifolia* L. is the authentic part that should be used for therapeutic purpose and it is *Balya* (promotes strength), *Shotahara* (reduce inflammation) etc. Modern researches prove that even the aerial parts are also equally effective.

Dioscorea bulbifera L. and *Tacca aspera* Roxb. these are two sources for the drug *Varahikanda*. Most of the scholars consider *Dioscorea bulbifera* L. as *Varahikanda*. In Kerala *Trichopus zeylanicus* is used as *Varahikanda* and it is broadly used as *Rasayana dravya*.

7. Context specific substitution/Due to Same in action

Amalaki (*Embllica officinalis* Gaertn.) and *Bhallataka* (*Semecarpus anacardium* L. f.) can be considered. *Amalaki* possess *Pancharasa*, *Lavana varjita*, *Laghuguna*, *Madhurvipaka*, *Sheetvirya* and *Tridosahara* property. Chemical constituents in *Amalaki* are Vit. C, ellagic acid, phyllembin, lonolic acid, etc. While *Bhallataka* has *Laghu*, *Tikshna*, *Snigdha*guna,

Katu, Tikta, Kashaya Rasa, Madhur vipaka, Ushna virya and *Kaphavatahara* properties. Anacardic acid, nicotinic acid, riboflavin, thiamine

Research profile of *Emblca officinalis* Gaertn. shows anti-oxidant⁹, hepato-protective¹⁰, antimicrobial, hypoglycemic¹¹, hypolipidemic action. The research profile of *Semecarpus anacardium* L. f. shows anti-tumour¹², anti-cytotoxic and anticancerous properties etc.

Both *Amalaki* (*Emblca officinalis* Gaertn.) and *Bhallataka* (*Semecarpus anacardium* L. f.) are *Rasayana* drugs. *Amalaki* can be used as *Rasayana* in chronic debilitating diseases like Bronchial Asthma, Diabetes etc. While *Bhallataka* would be better choice in malignant conditions, both in solid tumours and in leukemia.

Table 1: Substitutes mentioned in BhavaPrakasha⁵

| S.N. | Dravya | Substitute |
|------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 1. | <i>Chitrak</i> (<i>Plumbago zeylanica</i> L.) | <i>Danti</i> (<i>Baliospermum montanum</i> Muell.-Arg.)/ <i>Apamarga</i> (<i>Achyranthes aspera</i> L.) |
| 2. | <i>Tagara</i> (<i>Valeriana wallichii</i> DC) | <i>Kutha</i> (<i>Saussurea lappa</i> C. B. Clarke) |
| 3. | <i>Murva</i> (<i>Marsdenia tenacissima</i> W. & A.) | <i>Manjeeth</i> (<i>Rubia cordifolia</i> L.) |
| 4. | <i>Jatipushpa</i> (<i>Jasminum grandiflorum</i> L.) | <i>Lavanga</i> (<i>Syzygium aromaticum</i> (L.) Merr. & L. M.Perry) |
| 5. | <i>Bakuchi</i> (<i>Psoralea corylifolia</i> L.) | <i>Chakvad Phala</i> (<i>Cassia tora</i> L.) |
| 6. | <i>Draksha</i> (<i>Vitis vinifera</i> L.) | <i>Kashmri Phala</i> (<i>Gmelina arborea</i> L.) |
| 7. | <i>Nakha</i> (<i>Helix aspera</i>) | <i>Lavanga kusum</i> (<i>Syzygium aromaticum</i> (L.) Merr. & L. M.Perry) |
| 8. | <i>Kasturi</i> (<i>Moschus moschiferus</i>) | <i>Kankol</i> (<i>Piper cubeba</i> L.f.) |
| 9. | <i>Kumkum</i> (<i>Crocus sativus</i> L.) | <i>Kusumbha kusum</i> (<i>Carthamus tinctorius</i> L.) |
| 10. | <i>Shweta chandana</i> (<i>Santalum album</i> L.) | <i>Karpura</i> (<i>Cinnamomum camphora</i> Nees & Eberm.) |
| 11. | <i>Shweta chandana</i> (<i>Santalum album</i> L.) & <i>Karpura</i> (<i>Cinnamomum camphora</i> Nees & Eberm.) | <i>Rakta chandana</i> (<i>Pterocarpus santalinus</i> L.f.) |
| 12. | <i>Rakta chandana</i> (<i>Pterocarpus santalinus</i> L. f.) | <i>Nava Ushira</i> (<i>Vetiveria zizanioides</i> (L.) Nash) |
| 13. | <i>Ativisha</i> (<i>Aconitum heterophyllum</i> Wall.) | <i>Motha</i> (<i>Cyperus rotundus</i> L.) |
| 14. | <i>Meda</i> (<i>Polygonatum verticillatum</i> (L.) Allioni & <i>Mahameda</i> (<i>Polygonatum cirrhifolium</i> (Wall.)Royle) | <i>Shatavari</i> (<i>Asparagus racemosus</i> Willd.) |
| 15. | <i>Jeevaka</i> (<i>Malaxis acuminata</i> D. Don) & <i>Rishbhaka</i> (<i>Malaxis muscifera</i> (Lindl) Kuntze) | <i>Vidarikanda</i> (<i>Pueraria tuberosa</i> DC.) |
| 16. | <i>Kakoli</i> (<i>Roscoea purpurea</i> Smith) & <i>Kshirkakoli</i> (<i>Lilium polyphyllum</i> D. Don) | <i>Ashwagandha</i> (<i>Withania somnifera</i> Dunal) |
| 17. | <i>Riddhi</i> (<i>Habenaria intermedia</i> D Don.) & <i>Vridhhi</i> (<i>Habenaria edgeworthii</i> Hook. f. ex Collett) | <i>Varahikanda</i> (<i>Dioscorea bulbifera</i> L.) |
| 18. | <i>Varahikanda</i> (<i>Dioscorea bulbifera</i> L.) | <i>Charmkaaralu</i> |
| 19. | <i>Bhallataka</i> (<i>Semecarpus anacardium</i> L. f.) | <i>Chita</i> (<i>Plumbago zeylanica</i> L.) |

Table 2: Substitute mentioned in Yogaratnakara¹³

| S.N. | Dravya | Substitute |
|------|----------------------------------------------------------------------------------------|------------------------------------------------------|
| 1. | <i>Guduchi satva</i> (<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook. F. & Jhoms) | <i>Guduchi Rasa</i> |
| 2. | <i>Lakshmana</i> | <i>Mayurshikha</i> (<i>Elephantopus scaber</i> L.) |
| 3. | <i>Bakul</i> (<i>Mimusops elengi</i> L.) | <i>Shweta/Raktakamla</i> (<i>Nelumbo nucifera</i>) |
| 4. | <i>Bakulatwaka</i> (<i>Mimusops elengi</i> L.) | <i>Babbulatwaka</i> (<i>Acacia arabica</i> Willd.) |

| | | |
|-----|-----------------------------------------------------------------------------|------------------------------------------------|
| 5. | <i>Chavya/Gajapippali (Scindapsus officinalis Schott)</i> | <i>Pippalimool(Piper longum L.)</i> |
| 6. | <i>Daruharidra (Berberis aristata DC.)</i> | <i>Haridra (Curcuma longa L.)</i> |
| 7. | <i>All Lavana</i> | <i>Saindhav lavana</i> |
| 8. | <i>Yashtimadhu (Glycyrrhiza glabra L.)</i> | <i>Dhataki (Woodfordia floribunda Salisb.)</i> |
| 9. | <i>Amlavetasa (Rheum emodi Wall.)</i> | <i>Chukra (Rumex vesicarius L.)</i> |
| 10. | <i>Chukra (Rumex vesicarius L.)</i> | <i>Jambiri Nimbu swarasa</i> |
| 11. | <i>Musta (Cyperus rotundus L.)/ Ativisha (Aconitum heterophyllum Wall.)</i> | <i>Haritaki (Terminalia chebula Retz.)</i> |
| 12. | <i>Madhu (Honey)</i> | <i>Puran guda</i> |
| 13. | <i>Nirgundi (Vitex negundo L.)</i> | <i>Tulsi (Ocimum sanctum L.)</i> |
| 14. | <i>Tulasi (Ocimum sanctum L.)</i> | <i>Nirgundi (Vitex negundo L.)</i> |
| 15. | <i>Rasna (Pluchea lanceolata Oliver & Hiern.)</i> | <i>Kulijan (Alpinia galangal Willd.)</i> |
| 16. | <i>Ksheera</i> | <i>Munga/Masura Rasa</i> |

Table 3: Substitute mentioned in *Bhaishjya Ratnavali*¹⁴

| S.N. | Dravya | Substitute |
|------|---------------------------------------------------------------------------------|---------------------------------------------------|
| 1. | <i>Sugar</i> | <i>Mishri</i> |
| 2. | <i>Dadima (Punica granatum L.)</i> | <i>Vrikshamla (Garcinia indica Chois)</i> |
| 3. | <i>Kumkum (Crocus sativus L.)</i> | <i>Nisha (Curcuma longa L.)</i> |
| 4. | <i>Dhaniya (Coriandrum sativum L.)</i> | <i>Saunf (Foeniculum vulgare Mill.)</i> |
| 5. | <i>Jeeraka (Cuminum cyminum L.)</i> | <i>Dhaniya (Coriandrum sativum L.)</i> |
| 6. | <i>Bhilava (Semecarpus anacardium L. f.)</i> | <i>Rakta Chitraka (Plumbago rosea L.)</i> |
| 7. | <i>Ahinshra (Capparis sepiaria L.)</i> | <i>Maankanda (Alocasia indica (Roxb.) Schott.</i> |
| 8. | <i>Langali (Gloriosa superba L.)</i> | <i>Kutha (Saussurea lappa C.B. Clarke)</i> |
| 9. | <i>Harad (Terminalia chebula Retz.)</i> | <i>Amalaki (Embllica officinalis Gaertn.)</i> |
| 10. | <i>Talamkhana (Hygrophila spinosa T. And. Syn. Asteracantha longifolia Nees</i> | <i>Gokshur beej (Tribulus terrestris L.)</i> |
| 11. | <i>Kutherika (Ocimum basilicum L.)</i> | <i>Tulasi (Ocimum sanctum L.)</i> |
| 12. | <i>Neelkamala (Nymphaea stelleta Willd.)</i> | <i>Kumuda (Nymphaea alba L.)</i> |

DISCUSSION

The most substantive criteria for substitution are the Pharmacological activities/Bio-equivalency rather than morphology or phyto-constituents of a drug. It bestowed a greater scope for the physician to utilize herbs that are easily attainable, profitable and most appropriate for clinical condition. One of the properties of an ideal drug mentioned by *Acharya Charaka* is “*Bahuta*”¹⁵ it means that the drug should be abundant in quantity. If drug is available in adequate amount it can be easily utilized by people. Nowadays people are facing depletion of natural resources. Mainly plant resources particularly medicinal plants are disappearing at a worrying rate and not enough attention is being given to find alternate sources or substitutes for many of these plants

It is the need of hour to develop the authentic substitute for the herbal drugs which are endangered or enlisted in red data book¹⁶. *Ayurveda* scholars can play a major role and contribute by analyzing different species of the genus for discovering substitute. e.g. species of *Berberis* like *asiatica*, *lycium*. After analysis and proper authentication, the other species of the *Berberis* can be consider as substitute for *Berberis aristata* DC.

Another property of an ideal drug mentioned by *Acharya Charaka* is “*Yogyatavam*” (ability to treat the disease). Instead of using adulteration, if we use authentic substitute of similar pharmacological actions then the drug will surely give the desired results.

CONCLUSION

Present review suggests that Substitution will play a significant role to overcome the scarcity of herbal drugs. This in turn will boost the growing herbal industry by filling the demand and supply gap. Ideal substitute will prevent and replace the unethical practice of adulteration. It will also provide quality evidence-based medicine to the patients. It will also help future researchers to discover the hidden therapeutic potential of the substitute drugs. A lot of work and researches are required to be done on this concept of substitution. If after researches we can find an ideal substitute, it can be used substitute for most endangered & rare drugs. Then this concept of substitution can itself be a solution.

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