



## Notes on Ayurvedic Alternates Following Plant Taxonomy

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**Received: 12.01.2023; Revised: 24.05.2023; Accepted: 26.05.2023**

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**Abstract:** Ayurveda is an Indian system of traditional medicines as an alternative to allopathic medicine. Due to known side effects of synthetic drugs, there is an increasing demand in herbal Ayurvedic medicines. India is blessed with one of the richest flora of the world and still there are thousands of plant species that have high medicinal value. Plant resources are disappearing now at an alarming rate and enough attention is not being done to search for alternate sources. Many endemic MAPs are vanishing from the wild or getting threatened with near to extinction in the natural habitats at district and state levels. Intensive work is being carried out all over the world to find alternatives of non-available raw drugs. Acharya Vagbhata explained Abhava Pratinidhi Dravyas as; when there is unavailability of any particular drug during preparation of a compound, one should try to get another drug having similar properties. Etymology, identification, nomenclature either vernacular or scientific and classification of the respective raw drugs has been presented here with Ayurvedic alternatives and discussed with Taxonomical point of view like Rasa, Guna, Veerya, Vipaka and Prabhava vs Order, Family, Genus and Species. In the present communications few MAPs have also been suggested for the alternative use of the plants and plant parts. Selection of alternatives should be regional or disease wise in particular but in general the whole plant alternates has to need detailed study on botanical aspects and prospects, phytoconstituents, active marker compounds and pharmacological activity too.

**Keywords:** Ayurveda • Substitution • Alternative source • Raw drugs • Taxonomy • Etymology

### Introduction

The World Health Organization recognized the potential of the traditional (codified and non-codified) and alternative systems of medicine to provide a boost for health security of developing countries such as India. 72000 plants are being used for medicinal purpose globally (Schippmann et al., 2006). India has 15 Agro-climatic zones, 17,000 to 18,000 types of flowering plants in which 6000–7000 are evaluated to have therapeutic values (Dubey et al., 2004; Mao and Das, 2020). Out of the 3000 traded medicinal plants, only 900 are under cultivation and majority of the biomass is still harvested from wild sources (Anonymous). There are around 960 varieties of medicinal plants in trade, with 242 species having yearly consumption levels of more than 100 metric tonnes (Goraya and Ved, 2017).

The use of medicinal plants is found in numerous Indian societies and is archived in Indian systems of medication i.e., Ayurveda,

Siddha, Unani, Sowa-rigpa, and Homeopathy (Kumar, 2014; Sharma, 2014). Success of therapeutic plan and quality of the drug is always determined by the right from selection and collection of the raw drugs. Commercial cultivation for the raw material is emerging as an environmental and economically viable option to conserve the global wealth of medicinal plants and their biodiversity (Rana et al., 2022). Loss of potential habitats, over and unsustainable harvesting, and regional climate change are severely affecting local medicinal plant populations. Due to recent global climate warming, deforestation and human interference the population of many wild or cultivated MAPs has declined (Rana and Kimothi, 2016). Continuous deforestation and extinction of some natural habitats of MAPs and existing of incorrect identification in trade has resulted in an adulteration and substitution of the raw drugs. Non-availability of raw material provoke the



intentional adulteration and sometime textual substitutions are also provoking unintentional adulteration to fulfil the growing demand (Garg, 1992; Saraswathy, 2001; Mitra and Kannan, 2007; Poornima, 2010; Prakash et al., 2013; Poonam, 2016; Keshari and Pradeep, 2017; Sreelekshmi et al., 2017; Shinde et al., 2018).

In the olden days, as evident from the concept of alternative drugs (Pratinidhi Dravya) was available in Yogratnakara, Bhavaprakasha, Bhaishajya Ratnavali and Vaidya Chintamani. Therefore, Charka and later Acharyas have also dealt with authentication and standardization of herbal drugs and formulations in detail by using five Pramanas (Rasa, Guna, Veerya, Vipaka and Prabhava). The commonest problem involving in the medicinal plants sector is intentional or unintentional substitution owing to multiple reasons like unavailability of the raw materials, higher cost of cultivation, unfair trade and sometimes illegal collection (Prakash et al., 2013; Kumar, 2014; Keshari and Pradeep, 2017; Shinde et al., 2018). An alternative species/raw drug may represent few of them or respective species represents the characteristics of all fives (Rasa/taste, Guna/nature, Veerya/potency, Vipaka/results & Prabhava/action) with comparison between taxonomic order, family, genus and species.

Etymology is the study of the history of the form of words and, by extension, the origin and evolution of their semantic meaning across time. It is a subfield of historical linguistics, and draws upon comparative semantics, morphology, semiotics and phonetics. Identification, nomenclature (vernacular/scientific/botanical) and classification and description of the plant species may be an example for the selection of ethno-medicinal plants (Rana, 2007). With the current objectives of the study and as per review of the literature (Garg, 1992; Saraswathy, 2001; Shetty, 2005; Mitra and Kannan, 2007; Poornima, 2010; Joshi et al.,

2012; Prakash et al., 2013; Vaghela et al., 2013; Kumar, 2014; Poonam, 2016; Keshari and Pradeep, 2017; Prachi et al., 2017; Sreelekshmi et al., 2017; Shinde et al., 2018; Manisha et al., 2021; Rathore and Bhagat, 2022) as well as for the possible future mitigation plan, the present study has been carried out to revamp the gap for best selection of the alternate drugs in comparison to original as mentioned in the text, those are now not abundantly available due to scarcity of natural population/wild habitats, and most probably due to dwindling cultivation practices or it may be due to lacking of commercial cultivation of agronomic protocol of the MAPs.

### Results and Discussion

The future development and analysis of MAPs has largely depended upon reliable methodology for correct botanical identification, standardization and quality assurance. An alternative or the alternate provides a great scope for physician to utilize drugs that are easily not available in native places with better safety profile or the better safety for the purpose to utilize which are cost effective and more appropriate for the management and pre-clinical condition of disease as and when required (Saraswathy, 2001). Ancient Acharyas were innovative about taking alternate drugs in place of non-available original drugs on the basis of physical appearance (Guna) and Biological action (Karma) that was only possible due to their proper knowledge of raw drug identification. Shinde et al., (2018) has also stated that the most essential criteria for alternates are Pharmacological activity/Bioequivalence of that drugs other than morphology and resemblance of the Phytochemicals. The alternate plant species may represent all five characteristics (Rasa, Guna, Veerya, Vipaka and Prabhava) or the order, family, genus and species as per taxonomical criteria (**Fig. 1 A-X**).



### **Ayurvedic Alternates, Etymology and Botanical Validation:**

When the original drug mentioned in a formulation is not available then a drug with similar Ayurvedic bioequivalent (Rasa, Guna, Veerya, Vipaka and Prabhava) are to be selected and used in place of the genuine herbal drugs (Saraswathy, 2001; Shetty, 2005; Mitra and Kannan, 2007; Poornima, 2010; Joshi et al., 2012; Prakash et al., 2013; Vaghela et al., 2013; Kumar, 2014; Poonam, 2016; Keshari and Pradeep, 2017; Prachi et al., 2017; Sreelekshmi et al., 2017; Shinde et al., 2018; Manisha et al., 2021; Rathore and Bhagat, 2022). The ancient *Acharyas* and herbal experts were able to identify the following broad category of the alternates which are context specific and in such conditions they have also considered the other features along with *Guna* and *Karma*.

**Similarity in Rasa-Panchaka:** Bala (*Sida cordifolia* L.) and Atibala (*Abutilon indicum* L.) both are alternates for each other. Botanical point of view Rasa Panchaka/Dravya may be similar because both plant species belong to similar order (Malvales) and family (Malvaceae) too. Differences are found only in genus and most probably the morphological similarities may represent more than 50% characteristics (**Fig. A-B**).

**Cost of the Drugs:** It may be the most recent cause to require the alternatives. For example, Kumkuma/Keshar (*Crocus sativus* L.) is being costly so substituted or adulterated with Kusumbha (*Carthamus tinctorius* L.). The possible similarity is only based on the colour of the raw drugs. For the botanical point of view, both plant species belong to dissimilar order, family, genus and species. Infact, the usable plant parts are also different. Stigma and style parts of Keshar and ray and disc flowers of Kusum as source of the raw drugs (**Fig. C-D**).

**Geographical Distribution:** Specific drug action of the available source may be a

possibility of the introduction of regional alternative like Rasana. For taxonomical point of view, *Pluchea lanceolata* (DC.) C.B. Clarke belongs to the family Asteraceae and commonly distributed in Punjab and Gujarat, while Kulanjan (*Alpinia galanga* (L.) Willd. Zingiberaceae distributed in South India, meanwhile orchid Rasana (*Vanda roxburghii* R. Br.) is distributed in north-east parts like Bengal and Orissa (Mao and Das, 2020). Although all the species are distributed in tropical and sub-tropical regions and all plants are dissimilar in order, family, genus and species too. The possible selection of the alternates may be region to region and person to person and disease and ailments (Saraswathy, 2001; Shetty, 2005; Mitra and Kannan, 2007; Poornima, 2010; Prakash et al., 2013; Vaghela et al., 2013; Kumar, 2014; Poonam, 2016; Keshari and Pradeep, 2017; Prachi et al., 2017; Sreelekshmi et al., 2017; Shinde et al., 2018; Manisha et al., 2021; Rathore and Bhagat, 2022).

**Adverse reaction of the Drugs:** Vasa (*Justicia adhatoda* L.) is a well-known Raktapitta Hara (cures bleeding disorder) drug, but due to its abortifacient activity its utility in pregnant women is limited, instead drugs such as Laksha (*Laccifer lacca* Kerr.) and Ashoka (*Saraca asoca* Roxb.) are an alternative for the particular disease and ailments. It may be a possible cause to entail the alternative. Selection of alternates may be based on Rasa, Guna, Veerya, Vipaka and Prabhava. Notably, there are no morphological similarities between the original and alternative drugs. Some medicines work on particular patients and some medicines are generally not adequate to each other, so alternate approval has been done completely adopting dissimilar order, family, genus and species.

**Non-availability of Drugs:** For example, sometimes leaf of the *Taxus wallichiana* Zucc. -Taxaceae is used in place of Talisa Patra i.e., *Abies webbiana* Lindl. - Pinaceae.



*Abies* have six species (*A. pindrow* and *A. spectabilis*) in the Indian continent while *Taxus* is a monotypic genus (Singh et al., 2013). In this case, only order Pinales is the same for alternatives of both species (**Fig. E-F**). Botanically, *Abies* and *Taxus* are the gymnosperm distributed from an elevation of 25-3700 m. asl (Rana et al., 2010; Rana et al., 2013).

**Seasonal Availability:** Certain parts of drugs are available seasonally in these cases, other drugs may be introduced, which is having the same action. Rakta Punarnava (*Boerhavia diffusa* L. - Nyctaginaceae) can be substituted for Shweta Punarnava (*Trianthema portulacastrum* L. - Aizoaceae). Again Raktapunarva have eight species and meanwhile *Trianthema* have also five species in India (Mao and Das, 2020). The selection criteria of both plants for the alternative may be established based on the order Caryophyllales.

**Phytogeography of raw Drugs:**

Pashanbheda, (*Bergenia ligulata* Wall.) is used in North India while in south and central India, *Aerva lanata* and *Bryophyllum pinnatum* (Lam.) Kurz syn. *Kalanchoe pinnatum* (Lam.) Kurz are considered as the alternative source of the raw materials/drugs. Taxonomically, there are two more species of Pahadi Pashanbheda (*Bergenia stracheyi* Hk. f. and *B. ciliata* Haw. Sternb). The selection criteria of substitution between *Bergenia* and *Bryophyllum* may be based on the order Saxifragales (**Fig. G-H**). For the specific uses as Pashanbheda used to break or get rid of the stone in the kidney or gallbladder. Etymology of Pashanbheda means Pashan (stone) Bheda (breaker). So in the ancient literature the Acharya and faith herbal healers were aware and they have replaced plant species on the basis of action/uses of the plants following phytogeography or ethno-medicinal property (Rana, 2007; Rana et al., 2010; Rana et al., 2013).

**Figure 1:** Comparative images of the substitute's plants following Taxonomy or Etymology



**A:** Habit of *Sida cordifolia* Linn.



**B:** Habit of *Abutilon indicum* (L.) Sweet





C: Flower, Stigma and Style of *Crocus sativus* L.



D: Flowers of *Carthamus tinctorius* L.



E: Leaves of *Abies spectabilis* (D. Don) Mirb.



F: Leaves of *Abies pindrow* Royle



G: Habit of *Bergenia ciliata* (How.) Sternb.



H: Habit of *Bryophyllum pinnatum* (Lam.) Kurz.

**Regional Alternates:** Identification of Shankpushpi is based on shank (shell) and pushpi (flowers) as such appearance having pale white flowers which looks like the sea shell of shank (Fig. I-J). *Clitoria ternatea* L. a slender climbing herb belongs to the family Fabaceae which is distributed to all parts of India. Meanwhile, *Evolvulus alsinoides* L. a prostrate, semi-erect herb belongs to the family

Convolvulaceae. *Convolvulus pluricaulis* Choisy, a prostrate, some erect herb, belongs to Convolvulaceae distributed in North-West India (Mao and Das, 2020). 50% similarity may be observed following five characteristics of Ayurveda (Rasa, Guna, Veerya, Vipaka and Prabhava) and taxonomy (order, family genus and species). Etymology, Shankpushpi might be identified as *C. ternatea* based on shape



while chemical composition and pharmacology will depend where plants get fitting as per ancient literature/grantha.

**Morphological Similarity:** Nagkesar is an important drug in Ayurveda, the authentic source of drug is stamens of *Mesua ferrea* L. However, market/trade samples are substituted with flowers of *Calophyllum inophyllum* L. In this case, 50% similarity may be observed with taxonomy. Botanically both are belong to the order Malpighiales and family Calophyllaceae, and appearances of flowers (buds) including stamens are the same (**Fig. K-L**). Konch (*Mucuna pruriens* L. DC.) is also substituted with a similar family Fabaceae having similarity in morphology adopting botanical aspects and prospects. Etymology, Konch (snail-like shell) identified as *Mucuna pruriens* instead of *M. utilis* (white seed variety) and *M. deeringiana* are popular substitutes (**Fig. M-N**). In this case, 75% similarity has been found with the order Fabales, family Fabaceae and genus *Mucuna* vs Rasa, Guna, Veerya and Vipaka.

**Alternate with different drugs:** *Bharangi* (*Rotheca serrata* L.) has Tikta Rasa and Laghu, Ruksha Guna and has Kapha and Vatahara property too. Kantakari (*Solanum*

*surattense* Burm.f.) has Katuvipaka and Ushna Veerya property (Kumar and Nishteshwar, 2013). Chemically, it has Glycosides-Verbascoside and solasonine, solamargin, and solasurine. *R. serrata* and *S. surattense* are commonly used for the respiratory system. While as, both are belong to different order, family and genera and has been substituted for the particular disease and ailments. Stem parts of *Bharangi* (*R. serrata*) may be an alternative for the sustainability and quality compliances.

**Alternate of Genus:** Fruit/seeds and root parts of *Tribulus terrestris* L. (Zygophyllaceae) and *Pedaliium murex* L. (Pedaliaceae) are used in Ayurvedic formulation. Botanically, they are different in terms of order, family, genus and species. Gokhru/Gaukshuru (Gau meaning cow and Akshuru mean hoof) may be selected only on the basis of etymology/taxonomy of the root and fruit parts (**Fig. O-P**). *T. terrestris* has phytoconstituents like chlorogenin, diosgenin, rutin, rhamnase and alkaloid. While, *P. murex* has sitosterol, ursolic acid, vanillin, flavonoids and alkaloids (Kumbhar and Naikare, 2018).



**I:** Flowers of *Convolvulus pluricaulis* Choisy



**J:** Flower of *Clitoria ternatea* L. (CT)





**K:** Flower of *Mesua ferrea* L.



**L:** Flowers of *Calophyllum inophyllum* L.



**M:** Seeds of *Mucuna pruriens* (L.) DC.



**N:** Seeds of *Mucuna pruriens* var *utilis*



**O:** Fruits of *Tribulus terrestris* L.



**P:** Fruits of *Pedalium murex* L.

**Similar therapeutic Effects:** As per text, Ativisha (*Aconitum heterophyllum* Wall. ex-Royle) is an alternate of the Musta (*Cyperus scariosus* R. Br./*Cyperus rotundus* L.). Taxonomically, Atis (*A. heterophyllum* Wall. ex-Royle) have three varieties (*A. heterophyllum* var *barcteatum*, *A. heterophyllum* var *roylei* and *A. heterophyllum* var *heterophyllum*) for the selection of the best

alternative drugs. Remarkably, many of high-altitude MAPs are categorised as red listed as per IUCN red list. Nowadays, they are surviving in few of the districts and states due to cultivation interest of public and private sectors (Rana et al., 2022).

**Alternate of the Species:** For example, *Datura metel* L. and *D. stramonium* L. possesses the chemical constituents; alkaloids,



scopolamine, atropine, hyoscyamine and hyoscine. The Alkaloids have proved as bronchodilator and inhibitor of secretion of mucous membrane. The alcoholic extract of *Datura metel* shows anthelmintic activity (Kumbhar and Naikare, 2018). Botanically, they differ with few external morphology or taxonomic characteristics. Five features of Ayurveda (Rasa, Guna, Veerya, Vipaka and Prabhava) and order (Solanales), family (Solanaceae) and genus (*Datura*) possess 75% similarity.

One of the best examples of alternative may be the selection of Pushkara (*Inula racemosa* Hook. f.) with Kustha (*Saussurea costus* Falc. Lipsch) instead of Kutu (*Arctium lappa* L.). Pushkarmool (*I. racemosa*) and Kustha (*S. costus*) are taxonomically recognised as order Asterales and family Asteraceae. Here order and family has been taken in consideration except genus infact plant parts used are also the same. The usable plant parts or source of the drugs are substituted with roots (Fig. Q-T). Second example of botanical validation might be for the Somlata (*Ephedra gerardiana* Wall. ex Stapf) which is not a climber as per etymology. If we consider the external

morphology, then only Sombali (*Sarcostemma acidum* Roxb.) a climber should be recognised as Somlata (Fig. U-V). The major active principle of Ephedra is ephedrine in concentration of 40–80% of total alkaloid fraction, accompanied by pseudoephedrine, which is used in chronic bronchial asthma (Rana et al., 2010). Chemical constituents of Sombali (*S. acidum* Roxb.) are malic acid, succinic acid, reducing sugar-sucrose, traces of tannin, alkaloids, phytosterols, alpha & beta amyryns, lupeol & lupeol acetate, beta sitosterol (Dutta and Bordoloi, 2021). Alternate of plant parts may be the best option, adopting the example of Ashwagandha (*Withania somnifera* L.) where root is a usable plant part as per API. While active marker compounds (Withanolide) are also present in the stem parts, hence the stem part use may be an alternative option. As per API, Daruharidra (*Berberis aristata* DC.) has been used in different traditional Ayurvedic formulations (Rana et al., 2013). Bioactive compounds ‘Berberine’ are found higher side in roots and some lower side in stem parts for possible alternative of the plant part use (Fig. W-X).



**Q:** Habit of *Saussurea lappa* Clarke



**R:** Habit of *Arctium lappa* L.





S: Roots of *Inula racemosa* Hook. f.



T: Roots of *Saussurea costus* (Falc.) Lipsch.



U: Habit of *Ephedra gerardiana* Wall. ex Stapf



V: Habit of *Sarcostemma acidum* (Roxb.) Voigt.



W: Root parts of *Berberis aristata* DC.



X: Stem parts of *Berberis aristata* DC.

### Conclusion

Alternates are replacement of the equivalent drugs in place of the original drug on the basis of the similar chemical components, active markers, pharmacological actions and therapeutic uses. In Ayurveda, substitution has been described by the name of Abhava Pratinidhi Dravya. Notably, Acharya Vagbhata have also mentioned that the Dravya having similar Rasa (Taste), Guna (Property),

Veerya (Potency), Vipaka (Biotransformation) and Prabhava (action) should be used in absence of each other. Alternative plants or plant parts used should be selected as per Rasa, Guna, Veerya, Vipaka and Prabhava or otherwise it must be intent to order, family, genus and species. Today's herbal industries pursue high quality standards using modern techniques and instruments (HPLC/HPTLC/GC-MS/ IRMS/ LC-



IRMS/HRMS and NMR) to maintain their quality. Mitigation plan should be an alternative source of the plants and parts used as well as possible commercial cultivation of high demandable/traded and IUCN red listed plants. NMPB, SMPB, SBB, DBT, MoEFCC, horticulture and Forest departments can play the major role in this regard and infact they are also doing well as per their mandate.

Taxonomy and especially etymology, which deals with history of the form of words and, by extension, the origin and evolution of their semantic meaning, might play an important role in the identification and selection of the alternative source of plants and parts used. Entire plant species never can be substituted because they have no single use, they have multiple uses. There is no substitutes or alternative of the traditionally recommended genuine/original plant species but considering the Ayurvedic and botanical facts when Rasa/Order, Guna/Family, Veerya/Genus, Vipaka/Species and Prabhava/action are same, we can differentiate, define and execute them for possible alternates and sustainability for the conservation and future industrial demand and development or whenever original drugs as per Ayurvedic Pharmacopoeia of India (API) and grantha based are not available in the trade due to any of the above mentioned reasons.

On the basis of available data and literature, if barks are being used that may be also suggested to alternate with stem and branch bark instead of tree trunk bark. Root barks of the Brihatpanchmoola (*Aegle marmelos*, *Oroxylum indicum*, *Stereospermum colais*, *Gmelina arborea*, *Premna integrifolia/Clerodendrum phlomidis*) and Lagupanchmoola (*Desmodium gangeticum*, *Uraria picta*, *Solanum indicum*, *Solanum surattense*, *Tribulus terrestris*) plants may be recommended for possible alternate with young roots or aerial plant parts. Alternatives of roots with young roots and some of the aerial plant parts (may be stem/branches and

may be leaves/fruits) would be useful for sustainability and possible conservation of the particular plant species belonging to the red list category of the IUCN.

### Acknowledgments

We appreciate Govt. officials of CNH, Howrah (Herbarium division), BSI, Dehradun and Garhwal University Herbarium (GUH), Srinagar Garhwal for identification of the Herbarium specimens. CSR is always thankful to Prof. (Retd.) R. D. Gaur for guidance in plant taxonomy. We are grateful to our colleagues at Dabur Research and Development Centre (DRDC), Dabur India Limited, Sahibabad Unit for their kind support. Copyright of a few of images goes to <https://www.google.com>.

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