Source Plant Identification for Ayurvedic Polyherbal Formulation: A Hypothetical Model-based Critical Review

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ABSTRACT

Background: Polyherbalism is one of the key traditional practices in Ayurveda to attain multi-therapeutic effectiveness. Vast numbers of polyherbal formulations (PHFs) are recorded in Ayurvedic lexicons but identification of many drugs in such formulations is in a state of controversy after numerous redactions and multiple commentaries resulting in many scribal errors and misinterpretations. At present, while manufacturing a PHF for commercial/research purpose, the standard guidelines are to be adopted from the Ayurvedic Pharmacopoeia of India (API) monograph. But the idea of using homonyms, a common practice in earlier times, gives a lead that drug identity in a formulation may have been fixed on the basis of desired therapeutic action considering other drugs in the combination. This paper aims at opening discussions on the need of ascertaining source plants specific to polyherbal formulations as against isolated identity fixation.

Materials and methods: A polyherbal formulation Virataradi Kashaya was selected as the hypothetical model and an in-depth literary review of intertextual references of same in various Ayurvedic textbooks was undertaken to find out the controversial drugs and their probable botanical sources. Taking leads from such references along with supportive claims from folklore practices and preclinical studies, probable botanical sources were ascertained for inclusion.

Observation and results: Through chronological screening of classical texts, all controversial drugs in Virataradi Kashaya were identified. Probable botanical sources suitable for inclusion in the formulation were determined to an extent based on the leads from literature, folklore claims, and preclinical studies. Virataradi Kashaya marketed by two major pharmaceutical companies were also screened, which showed considerable variation in the ingredients used and also with the botanical sources identified as a part of this review. The findings are extrapolated to discuss the lacunas existing in identification of controversial drugs and to highlight the need of ascertaining botanical identities from the perspective of a PHF.

Conclusion: Currently, nonuniformity of botanical ingredients in marketed formulations has become a major factor that questions the authenticity of Ayurvedic products. This is due to controversy of identity of drugs in PHF resulting in usage of unjustified adulterants. Much work has been done in solving individual drug controversies through various analytical, pharmacological, and clinical studies but these cannot be pragmatically applied to all PHFs. Controversial drugs in PHFs are to be identified through a systematic literature study with due consideration to empirical clinical practices. This paper through a hypothetical model Virataradi Kashaya proposes methods that may be positively adopted to identify the botanical sources of controversial drugs in a PHF, which needs to be further ascertained by various preclinical and clinical studies.

Keywords: Adulteration, Botanical source identification, Controversial medicinal plants, Polyherbal formulations, Virataradi Kashaya.

Introduction

Ayurvedic professionals are lately keen in developing quintessential models for evidence-based research in Ayurvedic sciences. It is a matter of fact that for Ayurvedic research, all attention in this regard is given to research methodologies with special mention to person-centered strategies. What is being left out all together is the concern of research drug-/formulation-related standardization and profiling, which is fundamental in translating research outcomes into clinical practice.

Complex polyherbal formulations that have been documented in Ayurvedic literature like Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya are proposed based on years of practical application. The context wherein herbominerals were classified into different ganas (group of drugs) gives significant evidence that, in those days too, pharmacological action of drugs on various physiological systems was critically analyzed before adopting them...
into clinical practice. Also, specific herbomineral formulations are documented in the context of specific disorders in major aforesaid literatures like Kalyanaka ghrutha in Unmada chapter (context of psychiatric ailments).¹

Major concern prevailing in Ayurvedic pharmaceutical industries and research, though it is less spoken about, is primarily “the source plant identification crisis.” Large-scale and small-scale pharmacies (GMP-certified or otherwise) have their own standardization techniques based on their available resources, which significantly differ from each other. This sector is also facing a major setback in the form of unavailability of many important and genuine plants/plant parts for which most firms in the pharmaceutical industry are compelled to either substitute or adulterate the concerned formulation. Further, there is no genuine phytochemical/pharmacological or clinical evidence-based guidelines formulated for substitution of a plant species with another variety. Thus, rather than evidence-based substitution, there is more often the practice of adulteration.

Also, the Ayurvedic Pharmacopoeia of India (API) has identified particular plant species to be considered with respect to classical herbs available in the literatures. But in many parts of the country, API-identified plant species seems to be unavailable. This greatly hinders drug standardization process in research, e.g., Sida cordifolia L. is the officially identified source plant of Bala but mixture of other Sida species like S. acuta, S. rhombifolia, and S. cordata are widely used.² There are instances, where a particular plant species which is not the one identified by API for a classic drug is massively used by pharmaceutical companies in the name of that classic drug, as it is commonly prescribed by Vaidyas in their routine clinical practice yielding them genuine results, e.g., Desmodium gangeticum L. is identified and used as Prishniparni in southern parts of country while Uvaria picta (Jacq.) DC. is the officially listed source.³

Charaka stated that localites who were experts in plant species identification like shepherds, hunters, local tribes, and other forest dwellers were to be appropriately utilized to identify source plants proposed to be used in different formulations.⁴ It was further discussed that mere botanical identity ascertainment would do no good for a physician. It had to be appropriately validated with applied research and clinical practice. Vaidya should also have considered minute details such as geographical and climatic conditions, diseased state of individuals, and other associated factors finally to select the herb for a particular formulation. This means that in those days too, botanical identity of plants were ascertained by tracing the local availability and documentation of local/folkslore practices with locally prevalent precautionary antidote measures, considering geographical and edaphic factors and finally after clinical application. The long history of safe usage of these medicines can be extrapolated only when the botanical identity of the plant going into those medicines is established and standardized.

Much work has been done in depth to understand and solve the controversial individual drugs.⁵ But less efforts are put forth to solve the same from the perspective of a polyherbal formulation (PHF) containing such controversial drugs. For instance, Dusparsha (one that is difficult to touch) synonym is attributed to drugs like Kapikacchu (Mucuna pruriens (L.) DC.), Kantakari (Solomon xanthocarpum Schrad. and H. Wendl.), and Yavasa (Alhagi camelorum Fisch.). Thus, when the name Dusparsha is mentioned in a PHF, the botanical source to be used should be fixed after analyzing desired therapeutic action of the formulation, pharmacological actions of others drugs in it, and regional pedagogy/folkslore uses related to combination. The paper through a hypothetical model puts forward an attempt to understand and solve the controversial drugs from the perspective of a PHF.

Major Concerns in Standardization of Polyherbal Formulations

Ayurvedic medicinal practice has undergone a lot of transformation in the recent past especially in the medicine manufacturing sector, where it has emerged as a competing alternative to the biopharmaceutical market. With the paradigm shift of medicine production from small-scale outlets to industrial marketing commodity, there emerged a prevalent practice of alteration/addition/omission of drugs from classical formulae based on convenience resulting in nonuniformity of ingredients in the same formulation manufactured by different pharmaceutical units.⁶

In an attempt to create a standardized platform, the Ayurvedic Formulary of India (AFI) and the Ayurvedic Pharmacopeia of India (API) were developed during twentieth century as an official document of Govt. of India consisting of monographs of single drugs and compound formulations.⁷ But most of the pharmaceutical companies including GMP-certified ones do not strictly adhere to these documents due to the unavailability of mentioned source plants.

In Kerala, where Ayurveda has a rich lineage, formulations based on major anthology works such as Sahasrayoga and Chikitsamanjari (compilations based on observations and clinical experience of traditional physicians) are widely marketed by pharmaceutical companies. The AFI has included many such formulations owing to its popularity among physicians throughout the country. But many of botanical sources enlisted in these when checked seems to evidently differ from the ones traditionally used by physicians and thus it may fail to replicate the desired results. Currently, the production and marketing of Ayurvedic pharmaceuticals comes under the jurisdiction of Drug and Cosmetics act of 1940; but none of the official bodies assures whether the final products contains the same ingredients as mentioned in the label.⁸ Failure of product validation with uniform ingredients due to afore-cited reasons still remains a major hurdle for Ayurvedic medicine to find a breakthrough in international markets.

Problem Statement

A major issue that pharmaceutical research organizations and commercial industry faces is difficulty in standardizing commonly prescribed PHFs. Only if a suitable PHF is selected as a hypothetical model to illicit such specific issues, then alone the concern pertaining to standardization of controversial source plants may be conveyed appropriately. Hence, Virataradi Kashaya is postulated as the hypothetical model. The results thus obtained are generally applicable to standardization of any PHF. Thus, the objective of this paper presented through a hypothetical model is to summarize effective ways of resolving controversial source plant identity in PHF and to project the need of ascertaining specific botanical sources specific to PHF.

Materials and Methods

Virataradi kashaya (a polyherbal decoction prepared with drugs of Virataradi gana) was selected as the hypothetical model. The intertextual references of Virataradi gana from Samhitas were compared and screened for similarities. For establishing identity of drugs from Ayurvedic perspective, commentaries on Samhitas,
namely Nibanda Sangraha, Bhanumati Vyakhya, Sarvangha sundari, Ayurveda Rasayana, Sashilekha, Nighantus, medicinal plant compendia, other grey literatures like ‘Glossary of Vegetable drugs in Brihattrayi’ along with Dravyaguna books written during twentieth century and official API were consulted. Folklore uses and preclinical validation studies of the identified controversial botanical sources were explored in peer-reviewed journals to draw valuable conclusions.

**Observation and Results**

**Virataradi Gana**

Virataradi gana is a group of drugs with its prime indication in Ashmari (Urolithiasis) as seen in Table 1.

**Collection of Textual Information**

Intertextual references and literary search based on etymology and synonyms were done, followed by screening of opinion among authors of Samhita Nighantus. Botanical correlations by ethnobotanists and experts in Ayurveda about these were compiled to shortlist the controversial drugs (Table 2).

**Virataru**

It is the first drug on which the whole group is named. Virataru is not described by Charaka but it is quoted by Sushruta and Vaghbata. Dalhana equates it with Shara (Saccharum munja Roxb.), but quoting others’ view he described the plant is known as Vellantara bearing white, red, pink, and blue flowers. It is mentioned as a tree that grows in waste/dry lands with leaves similar to Shami (Prosopis cineraria (L.) Druce) with thorns all over it and flowers like that of Adhari (Acacia pinnata (L.) Willd.). Arunadatta on the other hand equates Virataru with Ushira (Chrysopogon zizanioides (L.) Roberty Syn. Vetiveria zizanioides (L.) Nash.). But abovementioned morphological description closely matches with Dichrostachys cinerea (L.) Wight & Arn., which is a profusely branched thorny shrub or small tree with branches armed with spiny tips.

**Sahachara**

Sahachara and Saireyaka are used synonymously in Samhitas due to the gregarious nature and habitat of the plant. Charaka did not seem to mention it in group of 50 Mahakashaya but has mentioned drug Sahachara in many places. Sushruta mentions Saireyaka dwaya in Varunadi gana and Sahachara dwaya in Virataradi gana, but in

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**Table 1: Ingredients of Virataradi gana in different Ayurvedic texts**

| Sl. no. | Su Sa | AS | AH | S Sa | Botanical sources as per AFI/API |
|--------|-------|----|----|------|-------------------------------|
| 1      | Virataru | Virataru | Vellantara | Virataru | nm |
| 2      | Sairayaka | Sairayaka | Sairayaka | Sairayaka | Barleria prionitis L. |
| 3      | nm | Sairayaka (Variety) | Sairayaka (Variety) | nm | Barleria prionitis L. |
| 4      | Darbha | Darbha | Darbha | Darbha | Imperata cylindrica Beauv. |
| 5      | Kusha | Kusha | Kusha | Kusha | Desmostachya bipinnata Stapf. |
| 6      | Vrikshadani | Vrikshadani | Vrikshadani | Vrikshavanda | Dendrochloe falcata (L.f.) Ettingsh |
| 7      | Gundra | Gucha | Gundra | Gundra | Typha australis Schum. and Thonn. |
| 8      | nm | Gundra | nm | Gundra | nm |
| 9      | Nala | Nala | Nala | Nala | nm |
| 10     | Kash | Kash | Kash | Kash | Saccharum spontaneum L. |
| 11     | Ashmabheda | nm | Ashmabheda | Pashanabheda | Saxifraga ligulata Wall. |
| 12     | Agnimanthra | Aranika | Aranika | Aranika | Clerodendrum philomidis L. |
| 13     | Morata | Morata | Morata | Morata | Maresedina tenacissima Wight and Arn. |
| 14     | Vasuka | Vasuka | Buka | Bakapushpa | Spermacoce hispida L. |
| 15     | Vasira | Vasira | nm | nm | nm |
| 16     | Bhalooka | Tuntuka | Bhalooka | Shyonaka | Oroxylum indicum (L.) Kurz |
| 17     | Kurandika | Manjari | Kuranda | Celosia argentea L. |
| 18     | Indeexara | Nm | Nm | Nm | Monochoria vaginalis Presl. |
| 19     | nm | Karkasha | Kamba | Kamba | nm |
| 20     | nm | Itkata | Itkata | nm | Sesbania bispinosa W.F.Wight |
| 21     | nm | Vrisha | Vrisha | nm | Adhatoda vasica Nees. |
| 22     | Swadamstra | Swadamstra | Gokantaka | Gokshura | Tribulus terrestris L. |
| 23     | nm | Mustaka | nm | Cyperus rotundus L. |
| 24     | Kapotavanga | Partha | Partha | nm | |
| 25     | nm | Nm | Nm | Brahmi | Bacopa monnieri (L.) Pennell |
| 26     | nm | Nm | Nm | Kamala | Nelumbo nucifera Gaertn. |
| 27     | nm | Nm | Nm | Apamarga | Achyranthes aspera L. |
| 28     | Total 19 | 20 | 21 | 19 | |

Su Sa, Sushruta Samhita; AS, Ashtanga Sangraha; AH, Astanga Hridaya; S Sa, Sharangadhara Samhita; nm, not mentioned
Table 2: Controversial drugs and probable botanical sources

| Sl. no. | Sanskrit name | Botanical source |
|---------|---------------|------------------|
| 1       | Viratara      | Dichrostachys cinerea/Chrysopogon zizanioides |
| 2       | Sahachara     | Barleria strigosa/Barleria cristata/Nilgirianthus ciliatus |
| 3       | Pashanabheda  | Homonoia riparia/ Rotula aquatica/Saxifraga ligulata |
| 4       | Gunda         | Typha latifolia/ Fimbristylis annua |
| 5       | Nala          | Phragmites australis/ Arundo donax/ Lelobia nicotianifolia |
| 6       | Morata        | Marsdenia tenacissima/Saccharum officinarum/Alangium salviifolium/ Chomomorpha fragrans |
| 7       | Indeevara     | Monochoria vaginalis/Nymphea stellata/Celosia argentea Var. crisata |
| 8       | Kambhama      | Pergularia lanceolata/ |
| 9       | Partha        | D. lanceolata/ Terminalia arjuna |
| 10      | Buka          | Osmanthus fragrans/ Trianthis/ Portulastrum/Saccharum spicata |
| 11      | Vasisra       | Achyranthes aspera/Eleusine aegytiaca |
| 12      | Ikata         | Seshanobisina/Saccharum munja/ Hygrophiola salicifolia |

Aragwadhadhi gana,\(^{17}\) he mentions it as Kuranta (synonym due to presence of thorns) and Dasi kuranta (smaller variety similar to Kuranta). Vaghbata also similarly mentions the second variety as Bana (synonym due to presence of piercing seedlings which after detachment from parent plant like an arrow on land). Dalhana identifies Sahachara as Kantashel,\(^ {12}\) which he mentions later as Kurubaka in Kashaya skanda (group of bitter drugs), where it is told as a plant having smooth leaves and white flowers. Later, Nighantus have mentioned two/three/four varieties of Saireyaka based on their color flower. As per majority of authors, Kurantaka is one with yellow flower and Dasi kuranta/Bana as one with blue flower. Saireyaka varieties are identified to be different Barleria species of Acanthaceae family, in which two varieties mentioned here as sahachara dwaya may be Barleria priorititis L. and Barleria strigosa Willd., which have yellow and blue flowers, respectively. Bhavaprakasha Nighantu included a third variety with red flower identified as Barleria cristata.\(^ {18}\) Kerala physicians recognize Sahachara dwaya as black variety (Karimkuruni) and white variety (Venkuruni) instead of Barleria species and as per practitioners both possess similar therapeutic properties and thus black variety (Nilgirianthus ciliatus (Nees) Bremek.) that is abundantly available is used in double quantity wherever both are mentioned and is commonly used as Sahachara in different parts of Kerala.\(^ {19}\)

Kusha/Darbha

Two varieties of Kusha are mentioned in all the Samhitas as Kusha and Darbha. In some contexts, it is used synonymously and sometimes due to the similarity of properties it might have been used as substitute in place of each other, which further created doubt regarding two types of Kusha. Dalhana clearly differentiates Kusha as a grass variety with smaller, softer pointed leaves and Darbha as thicker, longer one. Later authors have confirmed the identity of Kusha as Desmostachya bipinnata (L.) Stapf and Darbha as Imperata cylindrica (L.) Rausch.\(^ {20}\)

Vrikshadani

Charaka described it as Vriksharsha under the Hikkamigrahana group.\(^ {21}\) Dalhana mentions it is also famous by names like bandaka, kavalekhu, and vrikshakalambu\(^ {15}\) whereas Hemadri mentions it as kamavrikshaka.\(^ {22}\) All of the mentioned synonyms point its identity to Dendropothoe falcata (L.f.) Etingh, which is a stem parasite seen on trees with leaves usually opposite, oblong, variable in shape, and orange-red or scarlet-colored flowers in axillary racemes.

**Gunda**

Gunda is mentioned in all the Samhitas. Charaka samhita included Gunda in Stanyajanana (Galactagogue),\(^ {23}\) Muttravirechaniya (Diuretics)\(^ {24}\) groups and also in Madhura skanda (group of drugs having sweet taste). In Sushruta samhita, it is seen in group of drugs alleviating Pitta and specifically in treatment of Pittaja ashmari.\(^ {25}\) Gucca mentioned by Vaghbata is also a synonym of Gunda. As per Dalhana, it is Pateraka bheda,\(^ {15}\) i.e., variety of Erika (Typha elephantina Roxb.). Typha australis Schum. is generally taken as source plant of Gunda.

**Nala**

It is seen mentioned in all the Samhitas usually along with Pitta alleviating grass varieties like Kusha, Kashha, etc., and Dalhana identifies it as a plant similar to Durva\(^ {15}\) (Gynodorch dactylon (L.) Pers.) and are hollow within. Raja Nighantu and Dhanwanthari Nighantu mention about two types as Nala and Mahanala among which former is considered to be of cold potency and later as tikshna and ushna (Sharp and hot potency).\(^ {28}\) Arunadatta identifies it as Mrituyupushpaka\(^ {29}\) but Astanga Nighantu clarifies it may be Mridu pushpaka\(^ {29}\) and hints its habitat to be on riverbanks, which closely matches with Phragmites australis (Cav.) Trin. ex Steud. of the Poaceae family. Arundo donax L. that may be easily confused with \( P. \) australis is also considered as Nala. Some authors considered wild tobacco, Lobelia nicotianifolia Roth ex Schult. of Companulateae family as the botanical source. But \( L. \) nicotianae foliales seeds and leaves are poisonous and is traditionally used as contraceptive agent, hence may not be suitable for internal administration.\(^ {30}\) Hence in the context of Virataradi gana its identity as \( P. \) australis may be considered more suitable.

**Pashanabheda**

It is one of most controversial drugs in Ayurveda when it comes to its botanical identity, but it has got supreme importance in this context as the etymology of the drug itself means that which breaks or destroy stones. Taking leads from classical text books, the botanical description of Pashanabheda is correlated as a plant which can break stones/ that which grow on rocks, which created non unanimity among Ayurvedic fraternity regarding the identity of this drug. Bapalal vaidya opines that Pashanabheda name is
attributed to ten drugs including *Plectranthus amboinicus* (Lour.) Spreng. Syn. *Coleus amboinicus* Lour., *Homomonia riparia* Lour., *Rotula aquatica* Lour., and *Saxifraga ligulata* Wall. In many parts of Kerala, *Ammoman baccifera* Linn. and *Aerva lanata* L. are also used as source plants. But *Homomonia riparia* Lour., *Rotula aquatica* Lour., and *Saxifraga ligulata* Wall. are three widely used source plants in the pharmaceutical industry. As per API/AFI, *Saxifraga ligulata* Wall. is the botanical source of *Pashanabheda*.

**Agnimantha**

Samhita mentions two types of *Agnimantha* as Tarkari and Agnimantha and almost all Nighantus accept the same except *Bhavapraksha nighantu* who mentions only one variety. In *Nighantu ratnakara*, two varieties of *Agnimantha* are described as smaller and bigger, which is considered as *Agnimantha* and Tarkari, respectively. *Clerodendrum phlomidis* L.f. and *Premna integrifolia* L. are identified as source plants of *Agnimantha* and Tarkari, respectively.

**Morata**

The source plant of *Morata* is in controversy right from the *Samhita* period as the commentators also seem to mention different drugs at different places. Charaka uses the term *Morata* in *Madura skanda* and in ingredients of *Agyavadi taila*. Chakrapani identifies it as *Piluparni* (indicating similarity of its leaf with that of *Pili* [Salvadora persica L.]; he quotes as per it is *Murva* which may not be true as Charaka separately mentions *Murva* in *Tikta skanda*. As per Jejata, *Piluparni* is of two types: one with *Snigdhaapatra* (with unctuous leaves) and other *Doomara patra* (rough leaves), and he equates those with *Murva* and *Morata* respectively. Dalhana identifies it as *Ankola pushpa* (flower of *Alangium salviifolium* [Linn.f.] in *Virataradi gana* and as *Ikshu moola* (root of *Saccharum officinarum* L.) in treatment of *Pittaja ashmari*. *Arunadatta* identifies it as *ksheera morata* (with milky exudates) whereas Indu identifies it to be root of *Ikshu*. Later during the *Nighantu* period, most of the authors have equated it to *Murva* (*Marsdenia tenacissima* (Roxb.) Moon). Commentary on *Bhavapraksha nighantu* mentions *Morata* to be a variety of *Murva*, *Chonemorpha fragrans* (Moon) Alston, which also have got long, wiry, fibrous stem and milky exudates quoted in identifying features of *Murva*.

**Buka**

Charaka has included it in the *Mootra virechaniya* group and Vaghbata specifically mentions its usage in *Vatika ashmari*. Chakrapani identifies it as *Vasuhattah*, which according to some authors is *Premna barbata* Wall. ex Schauer. Buka/*bakapushpa/shivamalikika* name is used synonyms to *vasuka*, which is identified as *Osmanthus fragrans* Lour. that is a small tree found in Himalayas with strongly fragrant and small flower clusters in an assortment of white, pale yellow, yellow, or orange-yellow colors in late summer and autumn. Due to unavailability of the same, *Arka* (*Calotropis gigantea* L.) is also used as substitute. *Trianthema portulacastrum* L. of *Ficoidacea* is also used as *Vasuka* but Kerala physicians widely use *Spermacoce hispida* L. belonging to the *Rubiaceae* family, AFI also considers this as the botanical source of *Vasu*.

**Kurandika**

*Kurandika* is mentioned by Sushruta for treatment of *Pittaajashmari* also. Dalhana clarifies it is same as plant *Sirivalika* that has black small fruits, but in *ashmari* context he explains *Pattura* as *Sirivalika* and *Kurantika* as its type with red flowers. *Kurandika* name is not seen in Charaka samhita but use of *Sirivalika* seed is mentioned in treatment of dysuria and urolithiasis. *Astagha Hridaya* mentions *kuranda*, which Indu clarifies to be *Sirivalika*. As per Acharya PV Sharma from above, descriptions given in classics *kurandika* may be *Celosia argentea* L. of the *Amaranthaceae* family, which is an annual herbaceous plant with minute black seeds enclosed in bracts. *Manjari* mentioned in *Astagha Sangraha* might be *Kurantika* only, as *Mastaka manjari* is one of synonyms attributed to it in *Nighantu*.

**Karambha**

*Karambha* is included only by Vaghbata in *Virataradi gana* and both Indu and Arunadatta identify it as *Uttamarani*. Sushruta mentions *Uttamarani* among drugs used for topical application in hemorrhoids, where Dalhana comments it to be *yodhamali*. *Raja Nighantu* mentions about a drug *Indeevera* and *Uttamarani* is mentioned as its synonym, which creates the doubt whether *Karambha* of Vaghbata is same as that of *Indeevera* told in *Sushruta Samhita*. But as per other characteristics explained in *Nighantu*, many experts consider *Uttamarani* to be *Vrischikali* that is a dextrose climber having leaves slightly hairy and similar to that of *Patha* (*Cyclea peltata* (Lam.) Hook. f. & Thomson) in shape, spiny fruits looking like *meshashinga* (horns of sheep) possessing white cluster flower that is botanically identified as *Pergularia daemia* (Forsk.) Chiov. of the *Apocynaceae* family. In *Astagha Sangraha*, *Karkasha* is mentioned and *Astagha Nighantu* clarifies it as synonym of *Karambha*.

**Itkata**

*Itkata* is included by Charaka in group of *Stanya janana* (galactagogue) and *Mootra virechaniya* (diuretics). Although not mentioned under *Virataradi gana*, Sushruta quotes its use in *Pittaajashmari* but both Vaghbatas include it in *Virataradi gana*. Dalhana identifies it as *Khagali*, which is *Ishuvalkika* (Hygrophila sp.), and in another context he quotes it as *Mahati khagali*, which hints it may be variety of *Ishuvalkika*; as per Arunadatta also, it is a plant having smaller leaves and red-colored stem, which closely matches with *Hygrophila salicifolia* Nees. Syn. *Hygrophila ringens* var. *ringens*. There is also an opinion that *Itkata* is always seen mentioned along with grass variety like *Kusha*, *Kasha*, etc., hence it may be the stem parts of *Shara* (*Saccharum bengalense* Retz. Syn. *Saccharum munja* Roxb.) as in colloquial language reaped Shara is usually called as *Ikkad*.

**Kapotavanga**

Sushruta has included *Kapotavanga* in *Virataradi gana*; he also mentions it in treatment of urolithiasis. Dalhana himself had some confusion in identity of *Kapotavanga* and he identifies it as *Suvarchala*, plants having leaves similar to *Shirisha* (*Albizia lebbeck* (L.) Benth.) but in *Chikitsasthana* it is told to a plant having leaves like that of *Katabhi* (identified as *Albizia lucida* Benth.). As per Acharya PV Sharma from above, descriptions given in classics *Kapotavanga* is same as *Dolbergia* species, i.e., *D. lanceolaria* Linn. or *D. volubilis* Roxb.

*Purthusa* is included in *Virataradi gana* by both the Vaghbatas; as per Indu, it is *Sushruta* and Arunadatta considers it as *Adityabhakta*. As per Bopadeva also, it is same as *Kapotavanga* mentioned in *Sushruta Samhita*. *Brahmi* (*Bacopa monnieri* (L.) Wettst.) also has synonym *Kapotavanga* and the same is thus included by *Saccharum bengalense* Retz.

**Indeevera**

The drug *Indeevera* is mentioned only by Sushruta in *Virataradi gana*. He also mentions its use in treatment of *ashmari* and bleeding disorders. As per Dalhana, it is a variety of *Sirivalika* having long
leaves and plenty of flowers called as *Kamapooraka*; as per Jejjata and other commentators, *Indeevara* is *Nilotpala*. Due to same there are two views regarding identity of *Indeevera*, as per majority it is a *Celosia argentea* var. *cristata* Voss. and some suggest tubers of blue variety of *uptala*, i.e., *Nymphoea stellata* Wild may be considered. Kerala physicians use root stock of an aquatic plant *Monochoria vaginalis* (Burm.f.) C.Presl. of the Pontederiacea family as *Indeevara*.17

**Vasira**

Charaka includes it in group of diuretics, whereas Sushruta adds it in *Varunadi gana* and *Vata samshamana gana* in addition to *Virataradi gana*. Both Sushruta and Vagbhata mention its use in treatment of *Vatika ashmary*.25,26 As per Chakrapani, it is *Suryavarta* but Dalhana gives a detail identity that it is a grass variety known as *Markata trina*. Indu directly refers it to *Aparamarga* (*Achyranthes aspera* L.). Most of the authors consider that seeds of *Markata trina* may be used as *Vasira*, which is botanically identified as a grass variety *Eleusine coracana* (L.) Gaertn..

### Folklore Claims and Preclinical Validation on Controversial Botanical Sources

Available folklore claims and their pharmacological validations related to urolithiasis on controversial botanical sources were screened and compiled (Table 3).

#### Ingredients of Marketed Formulation “Virataradi Kashaya”

*Virataradi kashaya* (decoction) is widely marketed in Kerala for treatment of pain due to *ashmari* (urolithiasis), *sharkara* (small gravel of broken stones), *mutrakrichra* (dysuria), and *mutraghata* (urinary obstruction). The botanical ingredients on the label of *Virataradi Kashaya* procured from the local market are given in Table 4.

### Discussion

#### Need of Intertextual Referencing

Chronological screening of specific formulations in different Ayurvedic literatures (with commentaries) can help in ascertaining plants to a significant extent. For instance, the number of drugs in *Virataradi gana* seems to evidently vary among *Samhitas* (Table 1). Thus, the scribing errors and misinterpretations that happened with time may be positively resolved considering the pharmacological actions and clinical application too. For e.g., *Partha* is a common synonym of *Arjuna* (*Terminalia Arjuna* Roxb. ex DC.) Wight & Arn., but a thorough literature review hints its identity to an entirely different plant *Kapitavanga in Virataradi gana*. (Table 4).

#### Efficacy and Effectiveness of Folklore Claims

Several factors like clinical settings, cultural beliefs, knowledge, practical abilities of the healer, prejudices of the patient, and differences in access to other treatments confound the efficacy of a folklore claim.28 Hence with sole claim of being used in the folklore practice, any plant may not be correlated to classically enlisted drug. Evidence-based reliable data should be generated on these claims using explanatory and pragmatic studies.

#### Evidence-based Substitution

Due to unavailability and many other reasons, the practice of using regionally available plants as substitutes is a common practice. Usages of many such substitutes are passed on as a pedagogy based

### Table 3: Folklore claims in urolithiasis and pharmacological validations

| Sl. no. | Botanical sources | Part used in folklore | Reported use | Reported preclinical study on the claim |
|---------|-------------------|-----------------------|--------------|----------------------------------------|
| 1       | Dichrostachys cinerea | Root*67 Kidney stones | AL*49 DI*50 |
| 2       | Vetiveria zizanioides | Root*51 Diuretic | DI*52 |
| 3       | Typha latifolia | Leaf*61 Kidney stones | NDF |
| 4       | Phragmites australis | Root*53 Kidney stones | DI, LT*53 |
| 5       | Arundo donax | Rhizome*54 Diuretic | DI*55 |
| 6       | Labelia nicotianifolia | NDF | NDF |
| 7       | Saxifraga ligulata | Rhizome*51 Kidney stones | AL*56 |
| 8       | Rotula aquatica | Root/stem*51 Kidney stones | AL*57 |
| 9       | Homonoia riparia | Root*58 Kidney stones | DI*59 AL*60 |
| 10      | Saccharum officinarum | Root*51 Kidney stones | NDF |
| 11      | Alangium salvifolium | NDF | Root (DI)*61 |
| 12      | Osmanthus fragrans | Flower*54 Diuretic | NDF |
| 13      | Spermacoce hispida | NDF | – AL*62 |
| 14      | Trianthemia portulacastrum | Leaf*51 Kidney stones | DI*63 AL*64 |
| 15      | Eleusine aegyptiaca | Seed, upper parts*65 Pain in kidney region | NDF |
| 16      | Achyranthes aspera | Root*51 Kidney stones | DI*66 |
| 17      | Celosia argentea | *Seed*67 Kidney stones | *AL*68 |
| 18      | Celosia argentea | Seed*54 Painful micturition | NDF |
| 19      | Nymphoea stellata | Root*69 Diuretic, Urinary tract infection | NDF |
| 20      | Pergularia extensa | NDF | Wholeplant (AL,DI)*70,71 |
| 21      | Saccharum munja Roxb. | Root*54 Urinary complaints | NDF |
| 22      | Hydrophiia salicifolia NEES | Whole plant *DI, **AL*72 |
| 23      | Dalbergia lanceolaria Linn. | *Leaf*73 Aerial parts*74 Diuretic | NDF |
| 24      | Terminalia arjuna | Bark*51 Kidney stones | **AL*75 |

**in vitro study; AL, antilithiatic; DI, diuretic; NDF, no data found**
on years of practical experience. *Merremia tridentata* (L.) Hallier f. is mostly used as *Prasarani* in South India whereas *Paederia foetida* L. is considered in North India. A comparative analytical study done on these source plants of *Prasarani* reported much similarities in phytoconstituents with slight variations in its concentration. Further, clinical comparison revealed the effectiveness of both plant species in rheumatoid arthritis; but the offensive smell of *P. foetida* reported⁷⁹ might have been one of the reasons why physicians preferred the use of *M. tridentata*. Justified inclusions of such substitutes in API can help in avoiding adulteration.

**Expertise in Sanskrit Language**

Expertise in decoding Sanskrit words written in the form of verses is fundamental for assuring the correct identity of plants. The drug *Karambha* seems to be misread as *Rambha*, which resulted in extensive usage of source plants like *Musa paradisiaca* and *Pandanus latifolia* by pharmaceutical companies (Table 4).

**PHF-specific Variations in Source Plants**

Common name attributed to same plant species is one of the major reasons for controversial identity. In such cases, the distinction ought to be done on the basis of intended pharmacological action of the prescribed formulation. Grass varieties like *Darbha, Kasa, etc.*, are the main ingredients of *Trina panchamoola* (root of five medicinal grasses) and *Mootrivirechaniya* drugs, indicated in urinary system disorders. Hence, grass varieties should always outweigh other controversial source drugs in the context of urolithiasis. For instance, root of *Ikshu* in *Virataradi varga* seems to be *Morata* rather than *Moorna; S. munja* as more suitable source of *Ikshata* than *S. sesban* in context of *Virataradi gana* (Table 2).

### Comparative Studies of Polyherbal Formulations

The available comparative analytical studies of controversial drugs seem to be limited to single drug pharmacology. Comparative preclinical studies suggested leaves of *Coleus aromaticus* as *Pashanabheda* owing to its better diuretic effects.⁸⁹ Further, surprisingly in disparity to diuretic activity of a traditional herb *Darbha* (*Imperata cylinndrica*), some studies also reported its antiuicter effectiveness. ⁸⁸ Thus, it is inferred that the botanical source plant identification for a PHF should not be ascertained only through its pharmacological activity as pharmacological activities of active constituents are only significant when potentiated by other ingredients. Researchers should also generate evidences on plant species identity with respect to specific PHF.

### Limitations

This paper has not collected empirical data regarding the ingredients of *Virataradi Kashaya* prepared and practiced by the traditional *vaidyas*. Data on identified botanical sources, authentic substitutes along with their availability were not analyzed; if not obtainable, it may not resolve the problem of adulteration.

### Conclusion

At present, nonuniformity of botanical ingredients in marketed formulations has become a major factor that questions the authenticity of Ayurvedic products. This is due to controversial identity of drugs in PHF resulting in usage of unjustified adulterants. Hence, this paper suggests that primarily a market survey must be conducted to identify PHF with maximum turnover, following which an opinion survey about the ingredients of such PHF may be conducted among experienced *Vaidyas*. Based on these findings along with critical review of concerned literature and preclinical and clinical studies, reverse ascertainment of controversial plant species may be done.

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**Table 4: Ingredients on label of marketed Virataradi Kashaya**

| Sl. no. | Sanskrit name (as per AH) | Marketed formulation I | Marketed formulation II |
|--------|--------------------------|------------------------|------------------------|
| 1      | Vellantara               | Vetiveria zizanoides   | Dichrostachys cinerea  |
| 2      | Aranika                  | Premna corymbosa       | Clerodendrum phlomidis |
| 3      | Buka                     | Spermacoce hispida     | Spermacoce hispida     |
| 4      | Vrisha                   | Justicia beddomei      | Adhatoda vasica        |
| 5      | Asmabheda                | Rotula aquatica        | Bergenia ligulata      |
| 6      | Gokantaka                | Tribulus terrestris    | Tribulus terrestris    |
| 7      | Itkata                   | Commiphora caudata     | Alangium salvifolium   |
| 8      | Sahachara                | Barleria strigosa      | Nilgirianthus ciliatus  |
| 9      | Bana                     | Teprosia purpurea      | Barleria prionitis     |
| 10     | Kasa                     | Saccharum spontaneum   | Saccharum spontaneum   |
| 11     | Vrikshadani              | Dendrophthoe falcata   | Dendrophthoe falcata   |
| 12     | Nala                     | Saccharum of-ficinum   | Saccharum arundinaceum |
| 13     | Kusa                     | Desmostachya bipinnata | Desmostachya bipinnata |
| 14     | Gucha                    | Typha angustata        | Cyperus rotundus       |
| 15     | Gunda                    | Typha elephantina      | Typha angustata        |
| 16     | Bhalluka                 | Oroxylum indicum       | Oroxylum indicum       |
| 17     | Morata                   | Chonemorpha fragrans   | Chonemorpha fragrans   |
| 18     | Kuruntaka                | Pergularia daemia      | Marselia quadrifolia   |
| 19     | Karambha                 | Musa paradisiaca       | Callicarpa macrophylla |
| 20     | Partha                   | Terminalia arjuna      | Terminalia arjuna      |
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हिंदी सारांश

आयुर्वैदिक पौरीन्तिक कार्यक्रम के लिए जोत पादप का परिचय: एक हाइपॉथेटिकल मॉडल-बेस्ड आलोचनात्मक समीक्षा

पूर्वभूमि: बहु-चिकित्सीय प्रभावपूर्णता प्राप्त करने के लिए पौरीन्तिक औषधि में प्रमुख पारंपरिक चिकित्सकों में से एक है।
पौरीन्तिक फॉर्मुलेशन (पीएचएफ) की विश्लेषण संख्या आयुर्वैदिक शास्त्रीय क्षेत्रों में उल्लिखित है, लेकिन ऐसे फॉर्मुलेशनों में कई औषधियों की पहचान कई संपादकों एवं कई टिप्पणियों के बाद संदिग्धता की स्थिति में होती है, जिसके परिणामस्वरूप कई त्रिकोण गर्भ और गर्भ व्यवस्था होती है। वर्तमान में, वाणिज्यिक/अनुसंधान उद्देश्य के लिए एक पीएचएफ का निर्माण करते समय, मानक दिशानिर्देशों को भारत के आयुर्वैदिक फार्माकोपिया (एपीआई) मोनोग्राफ से अपनाया जाता है। लेकिन प्रारम्भिक समय में एक सामान्य चिकित्सा, होमीयोपैथी, उपयोग करने का विचार एक नेतृत्व दर्शन करता है कि संयोजन में अन्य औषधियों पर विचार करते हुए वाणिज्यिक तकनीक करने के आधार पर एक फॉर्मुलेशन में औषधि की पहचान तय की जा सकती है। इस पद का उद्देश्य पूर्वक पहचान विवरण के सार्वजनिक पौरीन्तिक फॉर्मुलेशनों के लिए विशिष्ट स्रोत पादपों की आवश्यकता पर विचार-विमर्श करना है।

सामग्री एवं विधियाँ: संदर्भ केंद्र औषधियों एवं उनकी संभावित वनस्पति स्रोतों का पता लगाने के लिए एक पौरीन्तिक फॉर्मुलेशन वीरतरादि क्रान्ति के रूप में उपलब्ध और विशिष्ट आयुर्वैदिक ग्रन्थों में समान संदर्भों की गहन सहायता संगीत की गई। लोक विविधताओं और पूर्व-अध्ययन संबंधी सहायक दांतों के साथ ऐसे संदर्भों के में आवश्यक है। संदर्भों का उपयोग करने पर विवरण करने और एक पीएचएफ के परिप्रेक्ष्य से वनस्पतिक पहचान की आवश्यकता करने के लिए विशिष्ट किया गया है।

अवलोकन एवं परिणाम: शास्त्रीय क्षेत्रों की विश्लेषण संख्या के माध्यम से, वीरतरादि क्रान्ति के रूप में संभावित औषधियों की पहचान की गई। फॉर्मुलेशन में समावेश हेतु उपयुक्त संभावित वनस्पति स्रोत साहित्य, लोक विविधता और पूर्व नैतिक अध्ययनों के में से आधार पर एक सीमा तक निर्धारित किया गया। दो प्रमुख कार्यक्रम के में से व्यवस्था की गई वीरतरादि क्रान्ति की जो इस संरचना के एक रूप में पहचान जाने वाले वनस्पति स्रोतों के साथ उपयोग की गई संगीत्रों में काफी भिन्नता दर्शी है। निकृष्ठों की संदर्भों औषधियों की पहचान में विवाद उठाए गए और एक पीएचएफ के परिप्रेक्ष्य से वनस्पतिक पहचान की आवश्यकता करने के लिए विशिष्ट किया गया है।

निकाय: वर्तमान में, विवरण फॉर्मुलेशनों में वनस्पति संगीत्रों की गेता-संरचना एक प्रमुख कारक बन गई है जो आयुर्वैदिक उद्योगों की प्राप्ति उत्तमात्मा के प्रभावित प्राप्ति है। यह पीएचएफ में औषधियों की संदर्भ के पहचान के लिए जिसके परिणामस्वरूप अनुशंसित अभिव्यक्ति करने गर्भ का संदर्भ किया जाता है। विविध विश्लेषणक, कार्यक्रम-कोषिकाएं और नैतिक अध्ययनों के माध्यम से व्यवस्था औषधि विविधताओं को हर करने में बहुत कार्य किया गया है, लेकिन इसके विभिन्न रूप से सभी पीएचएफ पर लागू नहीं किया जा सकता है। पीएचएफ में संदर्भ केंद्र औषधियों की पहचान एक व्यवस्थापित साहित्य अध्ययन के माध्यम से की जानी चाहिए, जिसमें प्रोफेसर नैतिक विविधताओं पर विचार किया जा रहा है। एक हाइपॉथेटिकल मॉडल वीरतरादि क्रान्ति के माध्यम से इस पद पर ऐसे विविधता की समीक्षा है जो एक पीएचएफ में संदर्भ केंद्र औषधियों के वनस्पतिक स्रोतों की पहचान करने के लिए सकारात्मक रूप से अपना जा सकते हैं, जिन्हें विभिन्न पूर्वानुमानिक और नैतिक अध्ययनों का उपयोग करने और पता लगाने की आवश्यकता है।

मुख्य शाखा: अभिव्यक्ति, वनस्पतिक स्रोत की पहचान, संदर्भ केंद्र औषधि पादप, पौरीन्तिक फॉर्मुलेशन, वीरतरादि क्रान्ति।